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Revisiting Agricultural Extension Strategies for Enhancing Food and Nutritional Security, Sustainable Livelihoods and Resilience to Climate Change

- Towards Transforming Agriculture

22nd -24th, April 2017

Organisers

Sarvareddy Venkureddy Foundation for Development
Participatory Rural Development Initiatives Society

PRDIS

In collaboration with

Professor Jayashankar Telangana State Agriculture University

National Conference

on

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University Auditorium

Professor Jayasankar Telangana State Agriculture University (PJTSAU)

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PJTSAU

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Theme I Agricultural Extension and SDGs

Information Communication Technologies: Unique Innovation for Agricultural Development

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Abstract

Information has been playing an important role in all societies since the dawn of civilization. The world is undergoing an Information Communication Technology (ICT) revolution, a revolution that has enormous socio-economic implications for the developed and developing countries. ICT plays a vital role for the development of agriculture and allied segments in our country. In India, over 112 million households have Television sets. As early as 1995, television exposure in China was estimated at one billion people. ICTs range from technologies such as radio and television to the advanced modern technologies, such as GPS navigation, satellite communication, and wireless connectivity. The latest innovations of ICTs in fisheries sectors have brought about a tremendous change in the life styles of the fish-farmers. Different initiatives in ICTs have been taken up which would also help in expanding and developing the fisheries technologies for the benefit of fish-farmers. However, the rural people still have difficulties in accessing crucial information in forms they can understand in order to make timely decisions. New information and communication technologies are generating possibilities to solve problems of rural people and also to promote the agricultural production by providing scientific information to the farmers. But the rural communities still lack basic communication infrastructure. Government has initiated different programme and policies for the welfare of farming communities. Present paper aim to discuss about the programme and policies for the welfare of farming community.

Key words: farmers, programme, policies, ICTs

New ICTs are being used across the fisheries sector, from resource assessment, capture or culture, commercial fish farming to processing and marketing in and outside India. Some are specialist applications such as sonar for locating fish. Others are general purpose applications such as Global Positioning Systems (GPS) used for navigation and location finding, mobile phones for trading, information exchange and emergencies, radio programming with fishing communities and web-based information and networking resources. Introduction of mobile phones in India has brought about a tremendous change in fisheries sector. One result was a dramatic improvement in the efficiency and profitability of the fishing industry. As mobile phone service spread, it allowed fishermen to land their catches where there were wholesalers ready to purchase them. This reduced wastage from 5to8 per cent of total catch to close to zero and increased average profitability by around 8 per cent. At the same time, consumer prices fell by 4 per cent. Different communication technologies have been used by the fishermen, entrepreneurs, aquaculturists, extension workers, etc. Of all these, radio has been found to be the most widely used by farmers.

Information on various innovations of fisheries technologies are being disseminated among the farmers. The internet is emerging as a tool with potential to contribute to rural development. Internet enables rural communities to receive information and assistance from other development organizations: offer opportunities for two-way and horizontal communication and for opening up communication channels for rural communities and development organizations. **Jain et. al. (2012).** It can facilitate dialogue among communities and with governments, planners, development agencies, researchers, and technical experts: encourage community participation in decision-making; coordinating local, regional and national development efforts for increased effectiveness; and help agricultural researchers, technicians, farmers and others in sharing information. Internet can also give a vast global information resource. **Amtul et. al (2012).** In recent years, the Internet has proven valuable for the development of Fisheries in developing countries like India.

The ICTs in recent years have witnessed major changes and are emerging as a powerful tool for accelerating agricultural growth in a developing country like India. There has been a rapid growth in the ICT sector since the late 1980s and the use of ICT has dramatically expanded since the 1990s. Simultaneously the Indian agriculture is moving towards feminisation and the role of women in agricultural growth and development has been increasing considerably. Though women's contribution in food production, food processing leading to eventual export of agricultural production has been well documented but not fully recognised they face greater constraints than men farmers **(Chand et al.,2012).** Women farmers have been reported to be 20-30 per cent less productive than men **(FAO, 2011).** The less productivity of women is attributed to lack of access to resources including land, finance and technology, among other things. In addition, women's participation in benefits such as training, information and knowledge is not adequate. Despite women's significant and crucial role in agricultural development and allied fields, they have virtually no access to agricultural information, services or production assets and have very limited control over their earnings **(Huyer and Carr 2002).** Access to ICT means has potential to make significant contribution in the empowerment of farm women and support their endeavour for productivity enhancement in diverse farm activities. ICTs are a diverse set of technological tools and resources to create, store, generate value and manage information. It consists of segments as diverse as telecommunications, radio and television broadcasting, computer hardware, software and services and electronic media. For ICTs to benefit women in agricultural production and to challenge the existing gender imbalances in rural livelihoods, understanding of women's access to ICTs, usage of ICTs by them, barriers for access, and the impact of ICTs on agricultural productivity and ultimately the empowerment of farm women is crucial.

Innovations for developing agriculture [1] **Agricultural Technology Information Centers [ATIC]**: It is not enough to generate information alone but it is also necessary to ensure that the required information is delivered to the end users at the earliest and with the least dissemination loss. The establishment of ATIC can forge a better interaction between researchers and technology users. This acts as a single window system with an objective to help farmers and other stakeholders to provide solutions to their agriculture related problems. This also helps in providing technological information along with technology inputs and products. Such information is useful for farmers, entrepreneurs, extension workers, NGOs and private sector organizations. [2] **Kisan Call Centre [KCC]**: The Department of Agriculture & Cooperation (DAC), Ministry of Agriculture, Government of India launched KCCs across the country to deliver extension services to the farming community. A KCC consists of a complex of telecommunication infrastructure, computer support and human resources organized to respond the queries raised by farmers in their local languages. Subject Matter Specialists (SMS) using telephone and computers, interact with farmers directly to understand the problems and answer the queries at the KCCs. There are KCCs for every state that are expected to handle traffic from any part of the country. [3] **Helpline:** Leveraging on the IT revolution in India and the increasing penetration of telephones in villages, many State Agricultural Universities and ICAR institutes have started helpline services. The helplines address queries related at specific hours. The helpline number is advertised through mass media viz., radio and press. [4] **Aqua Service Centers [ASC]**: Promising unemployed educated youths have started operating ASCs on the line of agri-clinics. These ASCs offer services like soil and water testing, feed analysis, seed quality testing (PCR test), disease diagnosis and market intelligence. They also sell inputs such as feed, fertilizers, pesticides, other therapeutics etc. In Andhra Pradesh, several such centers can be found in Kolleru lake area of West Godavari district. Farmers need to pay for availing services of these centers. [5] **One Stop Aqua Shop [OAS]**: One of the major recommendations of DFID funded project "Investigating improved policy on aquaculture service provision to poor people" was to establish OAS. The OAS would provide better access to farmers regarding appropriate aquaculture technology as well as information on government schemes including rural banking and micro finance. It was also envisaged that OAS would sell fish seed and other inputs. The shop is a single outlet for all inputs that a farmer may require in the cultivation of fish. The inputs include fish seed, fertilizers, chemicals etc. The OAS is also helping farmers in providing information on fish farming through information brochures supplied by state departments and research institutes. **[6]Aqua choupalAC]**: Aqua choupal, the unique web based initiative of ITC Ltd. offers the farmers of the state of Andhra Pradesh all the information, products and services they need to enhance productivity, improve farm gate price realization and cut transaction cost. Farmers can access information on weather, scientific farming practices and market prices through a web portal. Aqua choupal also facilitate the supply of high quality farm inputs as well as purchase of shrimps at their doorstep. [7] **Rural Knowledge Center[RKC]**: Rural Knowledge Centre is a part of a nationwide plan and has been set in motion in July 2004 by the Centre in collaboration with the states, NASSCOM, UNDP and a host of NGOs. Its primary aim is to set up multipurpose resource centers at the villages of the country. Each Knowledge centre is run by local self help groups, and cater to knowledge based livelihoods and create income avenues for rural people, farming communities and disadvantaged people. [8] **Cyber extension**: The internet is emerging as a tool with potential to contribute to rural development. Internet enables rural communities to receive information and assistance from other development organizations: offer opportunities for two-way and horizontal communication and for opening up communication channels for rural communities and development organizations. It can facilitate dialogue among communities and with government planners, development agencies, researchers, and technical experts: encourage community participation in decision-making; coordinating local, regional and national development efforts for increased effectiveness; and help agricultural researchers, technicians, farmers and others in sharing information. Internet can also give a vast global information resource.

Farming Portals: [1] KisanSuvidha: KisanSuvidha is an omnibus mobile app developed to help farmers by providing relevant information to them quickly. With click of a button, they can get the information on weather of current day and next 5 days, dealers, market prices, agro advisories, plant protection, IPM Practices etc. Unique features like extreme weather alerts and market prices of commodity in nearest area and the maximum price in state as well as India have been added to empower farmers in the best possible manner.**[2] PusaKrishi:**ZTM&BPD Unit; ICAR-IARI, New Delhi is leading 14 ICAR institutes of North Zone-I. The unit strives to be a strong link between the research community and the outside world. It promotes Agribusiness Ventures through technology development and commercialization for everyone from a corporate to an individual farmer. We have a variety of technologies/products for commercialization. Some technologies may be market ready, however some may require validation and some may require up scaling. We license our technologies to both private and public sectors. [**3] MKisan Application**: This app has been designed and developed by inhouse IT team of DAC with the help of C-DAC Pune. It enables farmers and all other stakeholders to obtain advisories and information being sent by experts and government officials at different levels through mkisan portal without registering on the portal.**[4] ShetkariMasik Android App**: "ShetkariMasik" is one of the most popular monthly magazines in the Agriculture sector, under publication since 1965. It is published by Department of Agriculture, Maharashtra.The Android app for Shetkari magazine has a very simple interface and requires mobile internet or Wi-Fi connectivity to register and download the issues. Once downloaded, the magazine can be read without internet connectivity.**[5]Farm-o-pedia:** Developed by CDAC, Mumbai. The application is a multilingual Android application targeted for rural Gujarat. The app is useful for farmers or anyone related to agriculture. It is available in English and Gujarati languages. The main functionalities of the app are: **[1]** Get suitable crops as per soil and season **[2]** Get crop wise information **[3]** Check weather in your area **[4]** Manage your cattle.**[6]Bhuvan Hailstorm App:** A mobile app has been developed to capture crop loss happened due to hailstorm. Agriculture Officer will go to the field with mobile or tablet loaded with this mobile app. This mobile app is able to capture following parameters: [1] Photograph of field with latitude and longitude. [2] Name of Crop [3] Date of sowing [4] Date of likely harvesting [5] Source of irrigation.[**7] Crop Insurance mobile app:**Crop Insurance mobile app can be used to calculate the Insurance Premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer. It can also be used to get details of normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified area.**[8] AgriMarket:**AgriMarket mobile app can be used to get the market price of crops in the markets within 50 km of the device's location. This app automatically captures the location of person using mobile GPS and fetches the market price of crops in those markets which falls within the range of 50 km. There is another option to get price of any market and any crop in case person does not want to use GPS location.

Other innovations: [1]Greens Fed on Rainbow Waste: Hydroponics, as the name suggests, is a growing method based on use of mineral-enriched water, whereas aquaponics takes matters a step further, bringing together fish and plant farming in one recirculating system.At Bioaqua Farm at Blackford in Somerset – the largest integrated aquaponic farm in Europe – vegetables are grown and Rainbow Trout reared together in organic symbiosis, without chemicals or pesticides, but with the help of bees and worms.The fish provide most of the plant nutrition, by way of aquaculture effluent. In turn, fish waste metabolites are removed by nitrification and direct uptake by plants, with the suitably treated water then flowing back to the fish. In all, it is claimed this virtuous circle of reciprocity requires up to 95 per cent less water than traditional horticulture farming.For sustainable food production and agriculture, the aquaponics ecosystem principles also appear attractively scalable, from back gardens to commercial facilities**. [2]Power of a No-Salt Diet:**Water efficiency in farming and food production, whether for traditional rural irrigation, arid regions or urban farms, represents a key metric in the face of global population growth and climate change.Considered together, scarcity of freshwater resources and the fact that 71 per cent of the Earth's surface is nevertheless covered in water, therefore make a compelling argument for desalination. The stumbling block, historically, has been its energy-hungry nature and prohibitively high running costs relative to agricultural profit margins.The innovative solution offered by Sundrop Farms draws on one of the few renewable resources in even more abundant supply than seawater sunlight. Sundrop Farms harvests solar power to generate energy for desalination to supply hydroponic greenhouses.Requiring no freshwater, farmland or fossil fuels, this potential game-changer for sustainable farming is creating 300 jobs in Port Augusta, South Australia, with a ten-year contract won to grow tomatoes for Coles supermarkets. [**3] Dairy hubs:** Dairy hubs link smallholder farmers to dairy processors, cutting costs and putting money back into local communities. Through this model, farmers gain higher income, education and healthier animals, while the production of safe and affordable milk in developing countries increases. These hubs have already hadhuge success in Bangladesh and Pakistan, and are being trialed in India and east Africa. [4] **Fertiliser deep placement:** Traditionally, rural farmers apply fertiliser to crops by spreading the seeds by hand. Fertiliser deep placement (FDP) is a new way of distributing fertiliser that increases small holder yields by an average of 18 per cent and reduces fertiliser use by a third. FDP works by using a specialized fertiliser (called 'briquette') which releases nitrogen gradually. The fertiliser is placed 7-10 centimetres below the soil, which allows less nitrogen to be lost through runoff. [5] **New feeding systems:**A new way of feeding farm animals, which involves weighing and blending all foodstuff into a complete ration, makes sure all an animals' nutrient requirements are met. Using a 'total mixed ration' has been found to reduce labour costs, increase animal health and give farmers greater flexibility with feed ingredients. All these factors together improve farm profitability by reducing feed costs which make up 60-70% of total farm costs - and maximise milk production.**[6] Farm management software and training:**Finally, no development issue exists in isolation, and perhaps the biggest improvement for rural farmers comes from getting adequate training on animal care, pest management and crop development. New farm Management Software is available that calculates food rations and milking systems to make farm management as simple as possible.While this technology is not widely accessible for rural farmers, farm management training has been found to make a big difference to farming output. For example, providing cows with housing containing suitable bedding and food troughs has been shown to increase milk yield and drastically improve farm sustainability. [7] **Revitalising local innovation:** “The current top-down approach of investing heavily in scientific innovation but ignoring small-scale farmers erodes farmers' ability to adapt to climate challenges. Instead, they become mere recipients of external innovations.” **[8] Krystyna Swiderska, IIED:** Governments and donors invest millions to deliver 'climate smart agriculture'. Yet indigenous farming practices already conserve natural resources (water, soil, crop diversity) and use natural processes instead of fertilisers and pesticides, lowering greenhouse gas emissions. SIFOR has also identified specific innovations that indigenous farmers have developed to adapt to changing climate, such as adding calcium carbonate to soil around potatoes (for frost resistance), planting different maize varieties to reduce the risk of relying on single species, re-introducing neglected traditional varieties, and domesticating wild species.

Towards Sustainable development: The aquaculture sector of developing countries are under tremendous pressure due to the increasing market orientation of aquaculture of trade, the emergence of global markets and competition and increasing concern about food and environment. Diversification and intensification are some of the key factors for sustainable aquaculture development and therefore the regular information flow among farming communities, technical and marketing resources and other supplying institutions is a must for steady growth in the farm economy. Small holder farm families who comprise the majority of farming families are facing increased pressure to respond changing market demands and to adopt latest technological innovations. The agricultural decisions and transactions in the developed world are now manipulated through digital networks. The internet and mobile telephones in particular, are used by governments to provide services to citizens (e-government) and to provide a platform for citizens to interact with fellow citizens as well as experts. e-governence can make governance more efficient and more effective by improving governmental process (e-administration), connecting citizens (e-citizens & e-services) and building external interactions (e-society). E-citizens, e-services and e-society are relatively new inclusions within the e-governance as they rely on the new ICT. Access to information is clearly a key determinant for maintaining a successful farming business. Public extension systems require a paradigm shift from top-down, blanket dissemination of technological packages, towards providing producers with the knowledge and understanding with which they solve their own location specific problems.

Traditional and modern: The current top-down approach of investing heavily in scientific innovation but ignoring small-scale farmers not only misses the risks to farming communities' stock of knowledge, built up over generations, but also actively erodes farmers' ability to adapt to climate challenges. Instead, they become mere recipients of external innovations. This is especially problematic given the way that modern agriculture has eliminated the vast majority of crop diversity from our plates in little more than a century. According to the UN Food and Agriculture Organization, only about 30 crops now provide 95 per cent of the human diet. Governments need to recognise that innovation by farmers is key for food security. It is as important as scientific innovation. This means they need to invest in systems that support, encourage and protect the innovation that happens in farmers' fields and in partnership with scientists.One step would be to legally recognise more indigenous biocultural heritage areas such as the Potato Park and protect them as centres of innovation with secure land rights. In such areas, farmers can work jointly and equitably with scientists to improve local, but also global, food security by enriching the genetic basis for crop breeding, and developing new resilient crop varieties. Smallholders' fields, and the women and men who work them, are among the last refuges and guardians for what remains of the world's crop diversity. Conventional seed banks may store samples of many of the world crops, but the fields are living laboratories in which an army of innovators works daily. They need government and scientific recognition and support.

National Agricultural Market: National Agricultural Market (NAM) is a pan India electronic common market platform for agricultural goods launched by the central government. NAMintends to integrate the existing 585 Agricultural Produce Marketing Committees (APMC) that are at present conducting agricultural trade across the country. The APMCs are regulated by concerned state governments as agricultural marketing is a state subject.The move towards a national agricultural trading platform is a progressive step by the center and two factors have propelled the center to come out with the launch of NAM.First is the weaknesses of the existing agricultural marketing laws created by states and their lack of interest to follow center’s surgeons on these. The existing agricultural marketing situation creates lot of regulation and hurdles for farmers to directly sell in the market.Fragmented markets and large number of intermediaries in regulated markets (APMCs) gives only a fraction of the market price to the farmer. In this context, the best way is enabling the farmer to sell his product directly into the market. For that, the center has suggested modifications in the existing APMC law by producing a model APMC Act. But many states are not following the suggestions of the center. It is in this context that the new NAM become very important.Secondly, NAM utilizes the opportunities of technology for agricultural marketing as it is a techno-infrastructure platform. Farmers can sell their produce directly using electronic auction system. Selling of the produce through online auction beyond the traditional borders of the regional market may give them more price. Thus the national online auction system is the main attraction of the NAM. An electronic portal of NAM (e-NAM) has been officially launched recently.The center has allocated Rs 200 crores for the establishment of NAM in the budget 2016. Each APMC will be get Rs 30 lakh as a subsidy to establish the necessary infrastructure facilities such as VSAT terminals, power and broad band connectivity.

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Development of Millets Value chain in India: A successful case study

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Abstract

Millets are one of the most ancient foodgrain known to be cultivated in the history of mankind. Millets, also termed as Nutri-Cereals, are a group of small seeded grasses that are climate resilient and traditionally grown in resource poor agro-climatic regions of the country under marginal conditions of soil fertility and moisture level. But the production and consumption of these Nutri-Cereals have come down significantly in the country in the recent decades. Identification of a proper value chain model would help to revitalise the scenario in the country. An ideal value chain aims at bringing all the stakeholders under a single platform, starting from production to consumption of agricultural commodities. ICAR-Indian Institute of Millets Research has successfully developed and replicated a value chain model for the millets in India. This value chain has been able to enhance the demand for the millets and millets value added products throughout the country and thereby enhance the farmers' income in the millets growing region of the country.

Introduction

Millets, also termed as Nutri-Cereals, are a group of small seeded grasses that are climate resilient and traditionally grown in resource poor agro-climatic regions of the country under marginal conditions of soil fertility and moisture level. The millets family consists of major millets (sorghum or jowar, pearl millet or bajra and finger millet or ragi) and other small millets (foxtail millet, little millet, kodo millet, barnyard millet and proso millet). Millet crops are highly nutritious and contain a wide range of micronutrients that are essential for the human body. Despite all the above mentioned benefits of millets (both environmental adaptability and health), the production and consumption of all the millets have substantially come down during the last two-three decades, mainly due to limited productivity, low remuneration as compared to other competing crops, lack of input subsidies and price incentives, subsidized supply of fine cereals through PDS, high drudgery involved in their processing, change in the consumer preferences, negative perceptions of small millets as a food for the poor and policy neglect when compared to other crops (NAAS, 2013; Karthikeyan, 2016). Millets, once staple food crops in the country, has become the "**forgotten grains**" mainly due to changes in tastes and preferences of the consumers. In India, millets are grown on about 15 million hectare with annual production of 17 million tons and contribute 10 % to the country's food grain basket. It forms the backbone of dryland agriculture in many parts of India. Crop improvement and crop management efforts over years though have increased the productivity of millets, there is need to create demands for millets to check the decline in area under millets. Hence, there has been a focus is to generate demand of millets through value-addition of processed foods, feed and industrial products, processing of RTE and RTC foods from selected millet foods by various projects led by ICAR-Indian Institute of Millets Research (IIMR).

The value chain (Fig.1) consists of a series of activities that create and build value. Value chain analysis describes the activities that take place in any businesses and relates them to an analysis of the competitive strength of the business.

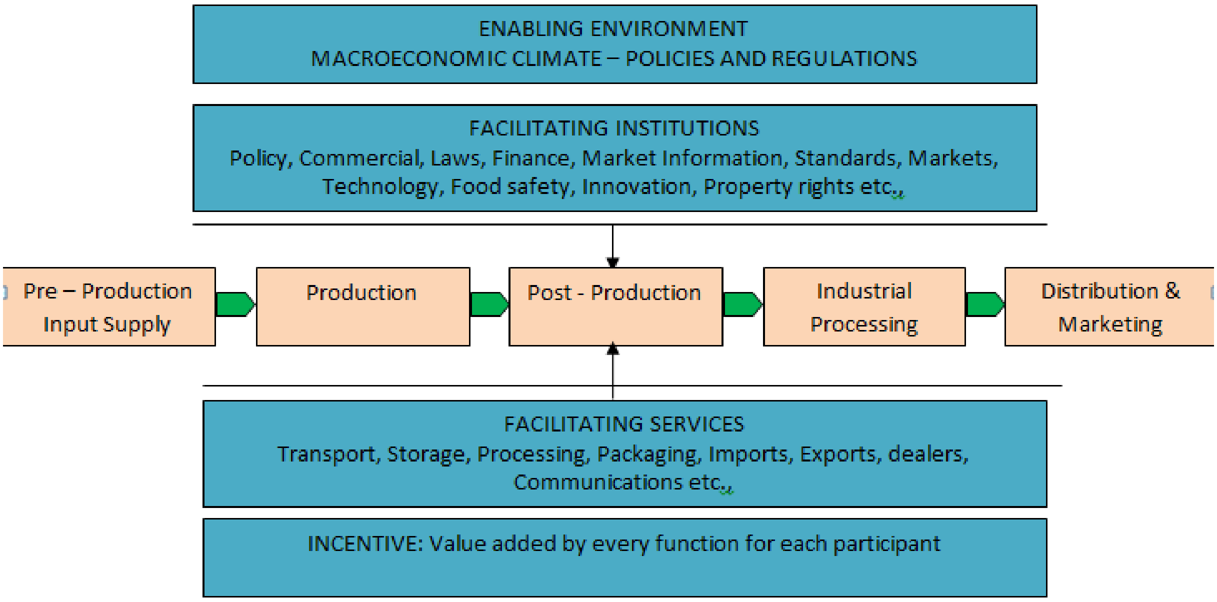

Fig 1: A generic Value Chain

The concept of value chain analysis was first developed by Porter (1985) and defined the "value chain" as a representation of a firm's value-adding activities, based on its pricing strategy and cost structure. The term value chain refers both to a set of interdependent economic activities and to a group of vertically linked economic agents, depending on the scope of the study the focus of the analysis can be on the activities or on the agents. Food and Agriculture Organisation (FAO) has stated that value chain starts with the production of a primary commodity, ends with the consumption of the final product and it includes all the economic activities undertaken between these phases such as: processing, delivery, wholesaling and retailing. A value chain is a set of activities that an organization carries out to create value for its customers.

Need for Value Chain Model in Agriculture

The activities of the value chain include raw material supplies, processing, marketing, distribution and support to final end user in the market place where the markets could be local, regional, or global (Kapinsky and Morris, 2001; 2008). The value chain approach helps to understand the dynamics of value creation at different stages of the value chain. Value chain analysis is a powerful tool for understanding the key determinants of competitiveness (Kapinsky, 2000).The traditional way of food production is being replaced by practices more akin to manufacturing processes, with greater co-ordination across farmers, processors, retailers and other stakeholders in the value chain. Moreover, the value addition and efficient marketing determine the success of most of the production-oriented development programmes.

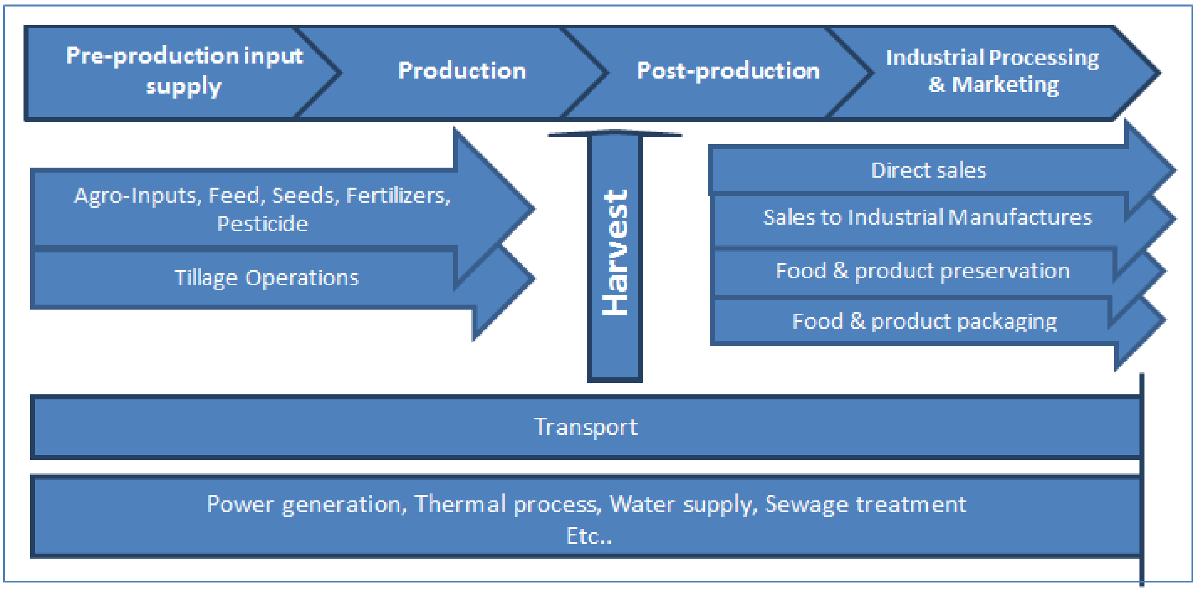

Fig 2: Agricultural/food Value Chain

Supply chain vs Value chain

Although used interchangeably, there is difference between these two terms value chain and supply chain. The supply chain model focuses on activities that get raw materials and subassemblies into a manufacturing operation smoothly and economically. A supply chain is simply a transfer of a commodity from one stakeholder to another in a chained manner. The value chain is the value addition at different stages of transfer. In different stages of value chain, different stakeholders add value to the product to increase or improve the value of the end product. In other words, a value chain analysis looks at every step from raw materials to the eventual end-user – right down to disposing of the packaging after use. That makes supply-chain management a subset of the value-chain.

Value Chain Development in Millets

Millet crops are grown in arid and semi-arid tracts of Asian, African and American countries which with low rainfall (200-600 mm) conditions. They are grown in areas where fine cereals like wheat and rice cannot be grown profitably. In these agrarian economies, livestock has become the backbone of business. Millet crops provide food, feed, fodder and bio-fuel values, and the dried vegetative parts are also used in making shelters, thus, are known for whole plant utilization. Although millets are being nutritiously rich, the consumption of it is declining significantly (Dayakar *et al*., 2014). ICAR-IIMR has come out with a value chain model to combat the problem of the declining trend and has been able to successfully replicate the model throughout the country.

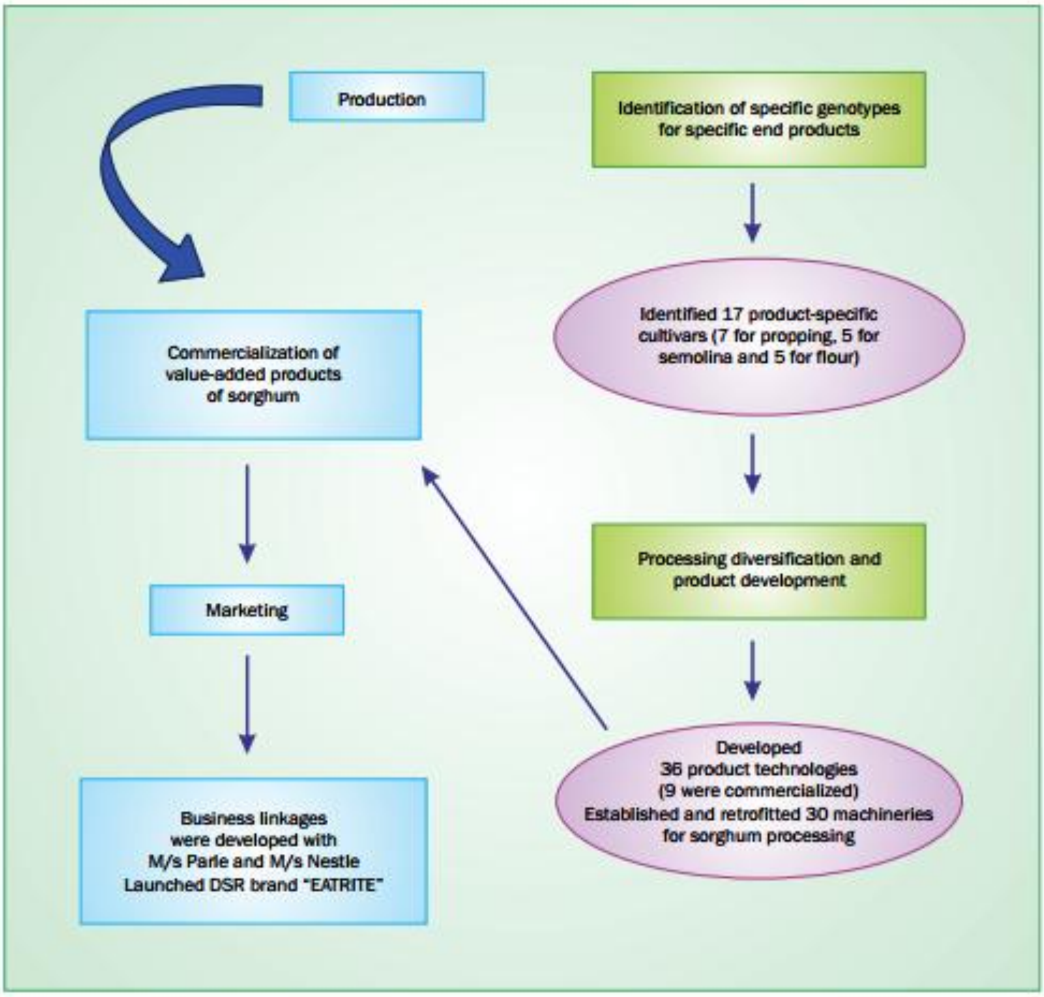

Fig 3: Value chain in millets – ICAR-IIMR

Constraints and challenges in Agro value chain

The constraints and challenges faced by the Agro value chain differ from crop to crop, place to place and determined by the factors such as resource endowment, socio-economic and political environment etc. However the general constraints and challenges are illustrated below:

- **External constraints:** Adverse macroeconomic conditions likehigh taxes, lack of institutional support; quality constraints: little understanding of processors' requirements.
- **Financial constraints:** Lack of capital to invest in assets, equipment and inputs that would improve quality; gender constraints: in comparison to men, women face higher disadvantages, particularly in terms of mobility, access to assets and to productive resources, and access to market information.
- **Infrastructure constraints:** Lack or inadequacy ofroads, electricity, weighing stations, warehouses and cold chains

- **Information constraints:** Limited access to market-related information (e.g. on prices, value chains, competitors, consumer preferences);
- **Skills and knowledge constraints**: Lack of business management skills of the famers-entrepreneurs.
- **Market constraints:** Low demand, a multiplicity of intermediaries (which increases the charges and shades the transparency of the operation).

Successful Value Chain of millets developed in IIMR, Hyderabad

There has been a drastic reduction in area over the year due to inconvenient, cumbersome and time-consuming preparation of food from millets, lack of processing technologies, lack of awareness of nutritional merits and also the government policy of disincentiveness towards millets and favouring of supply of fine cereals at subsidized prices. ICAR-Indian Institute of Millets Research (formerly DSR) led consortium under the NAIP liberal funding, has undertaken interventions to bridge the gaps on different aspects of on-farm production, processing diversification, nutritional certification, promotion and marketing of sorghum in the Indian market. The attempt enabled to bring all the stakeholders in production to consumption system value chain on a common platform and link poor dry land farmers with market as well as consumer. In this regard, the IIMR as the lead institute has built linkages with partners NIN, SAUs (ANGRAU) and ITC, a private institute.

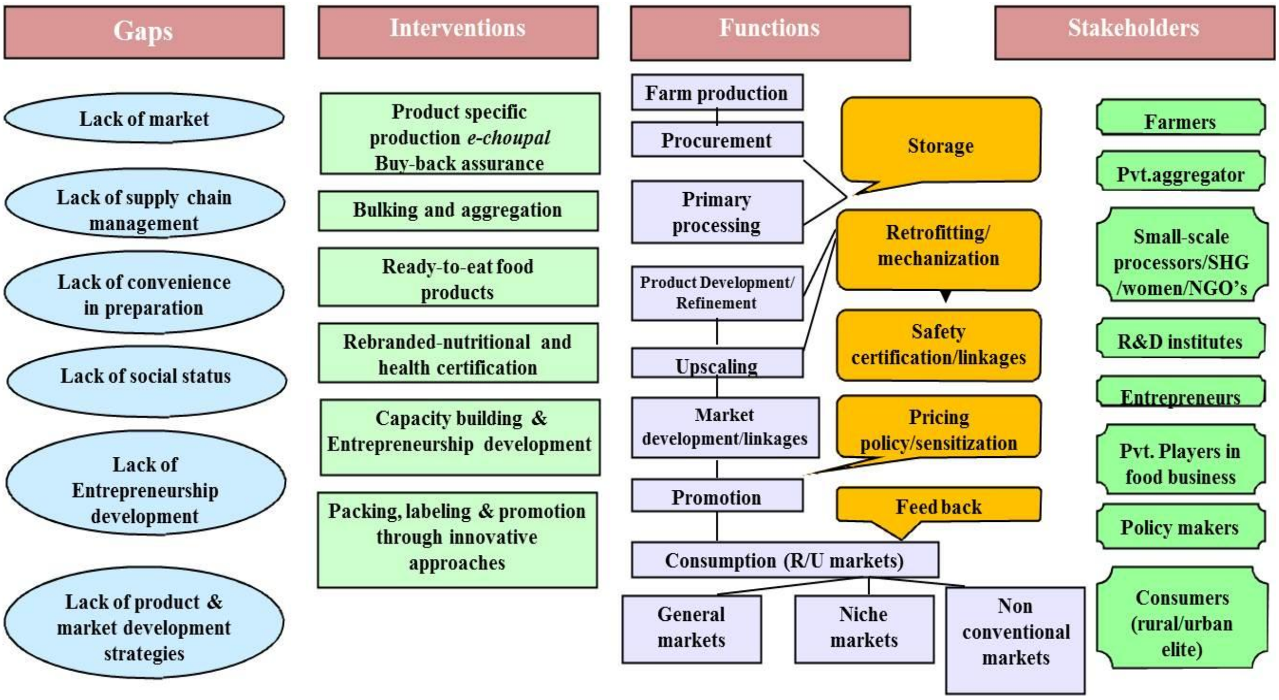

Fig 4: Gaps, Interventions and functions of value chain in millets – (NAIP)

Fig 5: Successful value chain of millets – IIMR led consortium; Partners: ITC ABD, NIN &PJTSAU (Formerly ANGRAU) an NAIP funded initiative

The impact of the whole value chain is summarized below:

Sl no.	Sub-Component/ Stakeholder	Value accrued (outputs) Tangible	Intangible	Indirect benefits	Outcome
1	Farmer-On-farm Production	1. **Productivity**: 27.5 qt/ha in kharif (53% higher than baseline) in the final year i.e. 2011. In Rabi, 19.5 qt/ha (38 % higher than baseline) in the final year i.e. 2011-12 2. **Netreturns**: Rs. 41570/ha in kharif (587% higher than baseline) in the final year i.e. 2011-12	• Change in the mindset of farmers • Backward integration model in place for future commercialization purposes by the private sector • PPP models success	Stabilizing the area under sorghum cultivation through shift from marginal lands to better lands in the project area	1. Demand for sorghum cultivation 2. shift from subsistence to commercial cultivation 3. Awareness creation on intensive sorghum cultivation, processing diversifications and market potential of farm level value addition
	Identification of cultivars / genotypes for specific end products	1. Number of product specific cultivars identified: 7 popping, 5 for semolina, 5 for flour 2. Database generated on generated on genetic characteristics of sorghum cultivars for product development: 42 elite cultivars.		Change in research strategies from productivity increase to breeding for end product specificity	Change in R&D stategu from traditional supply driven research to demand driven research
2.	Processing diversification and	1. Number of machineries retrofitted: 20	• Removed inconveniences in sorghum food	Increased the scope of food processing for all other millets through replication of	The processing diversification has removed inconveniences

	product development	2. Number of product technologies developed: 30 (IIMR)+ 6(PJTSAU) 3. number of product technologies commercialized: 9 (IIMR)+ 4(PJTSAU) 4. shelf life enhanced from 45 days (flour) to 180 days (extruded pasta)	preparation • Provide choices of nutritional food products to the consumers • Increased shelf life resulted to marketability of sorghum products • Attracted entrepreneurs to take up sorghum in their business	the sorghum technologies developed to other millets	and increased shelf life led to create demand for sorghum cultivation and consumption demand
3.	Entrepreneurship development	1. number of rural entrepreneurs (SHGs, rural women) 2. No. of Urban entrepreneurs trained:1000 4. Potential entrepreneurs who are now engaged in sorghum/ millets: 300 5. Made MoU with IIMR-30	• Entrepreneurs enthusiasm in sorghum food business increase after getting the first hand experience information	Through INSIMP at least 400 processing clusters are freely given across for Marketing sorghum/ millets value added products. They are technologically backstopped by NAIP developed by IIMR led consortium	Awareness and knowledge on sorghum and millet food processing increased
4	Government involvement- policy sensitization	1. Established sorghum centre of Excellence (CoE) at IIMR comprising 30 processing machineries worth around 3	• The subproject sensitize in Nov, 20110 brainstorming on millets promotion has led to shift in policy makers	1. from almost zero to INSIMP programme- launched successfully across the country in 2011	1. INSIMP a Rs. 300 cr developed project is a direct outcome of NAIP subproject.

		crores rupees 2. No. of millets processing clusters set up across the country: 400 (Approx.) 3. No. of beneficiaries (processors) technologically backstopped by IIMR:400 (approx.)	attitude for promotion of millets • Line depts. of State Govt. are now sensitized in millets nutrition for its promotion	2.Maintaining of millets in Public Funded welfare programmes 3. Three states of Maharashtra, Karnataka and Ap- inclusion of sorghum/millets in mid-day meal scheme tested	2. Inclusion of millets in PDS under food security bill was also coincided with the efforts on millets promotion through NAIP
5.	Commercialization and marketing	1. 9 (IIMR)+ 4 (PJTSAU) products commercially launched in Hyderabad 2. *Eatrite* and PJTSAU foods brands registered 3. 17 MoUs made with private entrepreneurs 4. Organized retail and unorganized retail targeted	• New sorghum products launched has received well by the consumers as more options are available for him a major deviation from traditional inconvenient roti made from *jowar*atta.		Offer an alternate choice commodity rich in nutrition and health benefits

Conclusions

Replication of successfully developed value chain model is very much important for the overall development of the millets scenario in the country. Since, the millets are being cultivated in the dryland conditions by the small and marginal farmers; development of value chain model will enhance the socio-economic status of them by raising the level of farm income. The millets farming situation in the country can be further improved by providing buy back assurance of the produce through various online platforms so that they are procured with market prices. The integrated extension services has to be provided by trained extension scientists, private extension personnel and input supply agencies in an integrated manner at all the critical stages of crop growth. Further formulation of policy measures exclusively for millets (including the small and minor millets) will also strengthen the millets production and consumption in the country. These policy measures should include inclusion of millets in Mead Day Meal Schemes, inclusion of all millets under MSP, proper procurement of millets and distribution through Public Distribution System (PDS). The policies formulated for the purpose of developing the millets sector in the country should aim at short run profit as well as long run sustainability which help in increasing the farmers' income in the coming years.

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"Indigenous Knowledge System (IKS)" –Myth or Reality in Conservation Agriculture

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Normally ITK is the knowledge that people in a given community havedeveloped over time and continue to develop it. Local or indigenous knowledge refers to the cumulative and complex bodies of knowledge, know-how, practices and representations that are maintained and developed by local communities, who have long histories of interaction with the natural environment (UNESCO, 2012). Indigenous knowledge develops within a particular community and maintains a non-formal means of dissemination. Such knowledge is collectively owned, developed over several generations and subject to adaptation, and imbedded in a community's way of life as means of survival.The term indigenous technical knowledge (ITK) "Local knowledge'' and "Traditional knowledge" have been used in the literature inter-changeably. It is synonymous to "Traditional Knowledge" "Folk knowledge" and "Wisdom of Elders"(Saha, et. al., 2006) and can be defined as,

"A sum total of knowledge based on acquired knowledge and experience of people in dealing with problems and typical situation in different walks of life".

It is the knowledge, which has been accumulated by the people over generations by observation, by experimentation and by handling on old peoples' experiences and wisdom in any particular area of human behavior. (Odhiambo-1990)

Indigenous knowledge is the systematic body of knowledge acquired by the local people through the accumulation of experiences, informal experiments, and intimate understanding of the environment in a given culture (Rajasekaran, 1993).

Some of the features relevant to ITK are, (Gairola, 2008)

- Locally appropriate and specifically adapted as per the requirement of local conditions.

-Restraint in resources exploitation needed for immediate survival.

-Having diversified production system without over exploitation of a single resource.

-Symbolizes the respect towards nature.

-Flexible for new interventions and integration of green technological advances.

-Inspires the social responsibilities.

Primarily traditional knowledge differs from modern knowledge in the manner of creation i.e. traditional knowledge is normally empirically validated therefore it is said that Modern Knowledge has been validated in laboratory of brick and mortar whereas traditional knowledge has been validated in the laboratory of life.

Traditional Knowledge system	**Scientific System**
All parts of the natural world are regarded as animate, all life forms as interdependent	Human life is generally regarded as superior, with a moral right to control other life forms
Knowledge is transmitted largely through oralmedia	Knowledge is transmitted largely through the written word
Knowledge is developed and acquired through observation and practical experience	Knowledge is generally learned in a situation, which is remote from its applied context
Knowledge is holistic, intuitive, qualitative and practical	Knowledge is essentially reductionist,quantitative, analytical and theoretical.
Knowledge is generated by resource users in a diachronic (long term) time scale	Knowledge is generated largely by specialist researchers on a synchronic (short term) time scale

Explanations behind perceived phenomena are often spiritually based on subjective	Explanation behind perceived phenomena are essentially rational and objective
Knowledge is used to make suitable decisionsunder variable conditions	Knowledge is used to put forward hypothesis and to verify underlying laws and constants

(Bisht and Bhatt, 2001)

According to Gupta and Patel (1993) Indigenous Knowledge has following advantages:

1. It has minimum risk factor
2. It relies heavily on genetic and physical diversity
3. It exploits optimum utility of local resources
4. It is environmentally healthy
5. It is readily available and easily understandable
6. It is labour intensive
7. It fits to local farming system and is adaptable to meet multipurpose needs
8. It is based on cultural values of community

Limitations :

1. Lack of replicability
2. Uneven distribution across individuals, communities & regions
3. Breakdown in the face of crisis or external intervention must be given proper attention

Reasons for protecting Traditional Knowledge

There are number of reasons why there is need to protect the Indigenous Traditional Knowledge.

1. To improve the livelihoods of ITK holders and communities- ITK is a valuable asset to indigenous and local communities who depend on ITK for their livelihood as well as to manage and exploit their local ecosystem in sustainable manner. For example, local communities depend on indigenous crop varieties for sustainable agriculture and for selection of superior genotypes from these.

2. To benefit national economy- ITK has been recognized as a valuable input into modern industries such as pharmaceuticals, botanical medicines, cosmetics and toiletries, agriculture and biological pesticides. Most of industries look for the time tested traditional knowledge information for developing novel products having commercial acceptability.

Hence, protecting ITK has the potential to improve the economy of many developing countries by greater commercial use of their biological wealth and increasing exports of ITK related products.

3. To conserve the environment- The traditional communities are intelligent and have made agriculture sustainable through their different agricultural practices. They create a balance between the environment and requirement.

4. To prevent biopiracy- Biopiracy refers either to the unauthorized extraction of biological resources and / or associated ITK or to the patenting, without compensation of spurious 'inventions' based on such knowledge or resources.(Gupta, 2008)

A situation where indigenous knowledge of nature, originating with indigenous people, is used by others for profit, without permission from and with little or no compensation or recognition to the indigenous people themselves.Developed countries are exploiting developing countries genetic resources and indigenous communities traditional knowledge in the name of patents on the inventions derived from those genetic resources. Example: use of indigenous knowledge of medicinalplants for patenting by medical companies without recognizing the fact that theknowledge is not new, or invented bythe patenter,*Neem* Patent: US patent office granted patent on a fungicidal product derived from seeds of the *Neem* The oil from *neem* has been used traditionally by farmers to prevent fungus. It was neither a novel idea nor was it Inventive. The Patent was finally revoked by the European Patent Office*Haldi* patent- In December 1993, a patent was filed by the University Of Mississippi Medical Center, MississippiApplicants received US patent 5,401,504 for the use of turmeric powder as a wound-healing agent.Basmati patent- Rice Tec (US Co.) obtained a patent (US 5663484) on a type of rice produced by crossing a strain of Indian basmati rice with an American variety;

Attempts to Protect ITK :

The Department of Indian Systems of Medicine together with the CSIR has launched a massive effort to document ITK available in all systems of indigenous medicines in all forms, written and oral and prepare a Digital Library (TKDL).

In 1998, World Intellectual Property Organization (WIPO) began a new set of activities designed to explore the Intellectual Property (IP) aspects of the protection of ITK. The main objective of these activities was to identify and explore the IP needs and expectations of the holders of TK in order to promote the contribution of the IP system to their social, cultural and economic development.

In 4th WTO Ministerial Meeting in Doha, 2001, one of the key issues raised that -there is need of amendments in the Trade Related Aspects of Intellectual Property Rights (TRAIP) Agreement, so that the members shall require to provide that an application for a patent relating to biological materials or to Traditional Knowledge.(Gupta, 2008)Mission Mode project on Collection, Documentation and Validation of Indigenous Technical Knowledge was launched in 2000 by Indian Council of Agricultural Research (ICAR) under the National Agricultural Technology Project (NATP) with the following objectives:

1. Identify, collect, classify and document ITK and its variants in different agro-climatic regions in respect of production systems, farming systems and situations;
2. Catalogue and characterize the information for developing a data base;
3. Validation of ITK though a quick screening method and through formal experimentation, wherever needed; and
4. Evolve a mechanism to protect property rights and facilitate the process of sharing the benefit by the farming community. (N. Prakash, S. S. Roy and S. V. Ngachan)

NIF was launched in 2000 by the Government of India as India's national Initiative to strengthen the Grassroots technological innovations and Traditional Knowledge. For the last seventeen years, the Honeybee Network and Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) have been scouting innovations by farmers, artisans, women, etc. at the grassroots level. The Gujarat Grassroots Innovations Augmentation Network (GIAN) scales up innovations, from the Honey Bee database of innovations, through value additions in innovations to sustain creativity and ethics of experimentation.(Source: http://nifindia.org/activity.htm). Following are the steps taken by these organizations

1. Scouting and documentation of innovations:
2. Knowledge dissemination:

3. Value addition and R&D:
4. Learning :

Economic, social and political factors are gradually uprooting many such untapped resources from their native habitats resulting in loss and erosion of very rich indigenous knowledge.Rapid pace of acculturation / urbanization has tremendous influence on the lives of indigenous communities.Modernization has resulted into loss of their peculiar culture and heritage.The knowledge survives through word of mouth particularly among the old generation. Documentation of their vital knowledge on different subjects is necessary before the old generation passes away.Documentation has great practical utility in almost every activity ofhuman life such as health, animal health, livestock management, food, agriculture, timber, dye, religious ceremonies, shelter etc.It provides useful clue for planning projects for conservation of biological diversity, sustainable uses of natural resources, indigenous health practices etc.The data is the intellectual property of the informant (individual or community). Benefit sharing should be there when data will be used for raising any benefit.(Girach, 2007)

There are sources of ITK hidden in our village, communities and countryside. The main sources are :

1. Farmers
2. Community leaders
3. Elder persons
4. Folklore, song and poetry
5. Ancient records
6. NGOs
7. Extension agencies
8. Published materials of different languages

(Satapathy et al, 2002)

Methods and Techniques of ITK collection :There are no fixed method for collection of ITK. It depends on type of ITK, situation, people, social system, cultural values and other aspects. (Dr. Pranab Kumar Ghosh Ms. BijoylaxmiSahoo 2011)

1. Interaction with community leaders or elders
2. Rapid Rural Appraisal
3. Case study
4. Key Informant Method
5. History
6. Interview method
7. Participant observation
8. Brain storming Games
9. Group discussion

ITK may be old, but it need not be outdated. In fact it can very well be compared withmodern practices in a number of situations.ITK is often considered to be unscientific andprimitive, whereas modern technologies are seen as advanced. Following are some common ITKs which are being used by farmers from time to time:

S. No.	Name of ITK	Purpose
	Agriculture (Package & practices and storage)	
1.	Application of farm yard manure	To improve soil health.
2.	Mixing urea and *neem*powder	To increase the efficiency of urea.
3.	Opening of furrow in standing crop	To conserve the rain water.
4.	Wider row spacing in pearl millet	To conserve rainwater and weed control
5.	Summer or pre monsoon tillage	To facilitate timely seeding and weed control.
6.	Top dressing of farm yard manure in late sown wheat	Enhances the germination and later ontillering and thus the yield of the crop.
7.	Coating of pulses with thin layer of neem oil	To protect pulses against insect infestation
8.	Dried pulse grains are heated by mixing wood ash/ cow dung ash/sand and stored in new earthen pot	To suppress the pest infestation germination during storage.
9.	Pouring of pulse grains into the structure and placing a layer of dry sand or cow dung and clay mix at the top to thickness of 20 cm.	The enclosed storage structure provides complete protection to the stored grain from external pests and insect infestation.
10.	Use of Eucalyptus and walnut leaves in grain storages	These leaves give pungent smell, which do not allow the attack of store grain insect pests.
11.	Use of cattle urine for controlling disease	The scientific reason for using this practice may be suppressing the growth of fungi which is responsible for the diseases.
12.	Use of garlic in storing pulses	To avoid the attack of pulse beetle particularly gram Dhora. Generally 100 gm. Garlic is used for storing 5kg pulses
13.	Polishing of pulses with mustard oil	By doing that the pulses are stored for one year without any spoilage.
14.	Repeated tillage during monsoon season	To conserve the soil moisture for sowing of winter crops.
15.	Mixed cropping of pearl millet, cluster bean and mungbean	Better utilization of soil moisture and reducing the risk of crop failure.
16.	Use of neem leaves in storage bins	To control insects.

(JasvinderKaur, 2014)

Rationale of ITKs in Groundnut Crop

a)Winter Ploughing : After the completion of kharif groundnut crop farmers are accustomed to have a winter ploughing by bullock drawn cultivator, plough or by hoe."oneploughing of winter is equal to four ploughing of summer".It was understood by Agronomists that it is possible bywinter ploughing to expose the eggs, pupa, pathogen and spores. It's sort of soil sterilization.

b) Multi-purpose tool (SANTI) :The mechanisation of Indian agriculture is in its early stages. Human power still predominates, although it is often augmented by animal and/or mechanical power. In the Saurashtra zone of the state of Gujarat, the bullock is the main source of energy. Groundnut is the main cash crop of the region. Work in the fields throughout the year requires more than two dozen implements varying in type and size. Farmers in this region use a multi-purpose tool which consists of a shaft to which some 17 different parts can be attached for different purposes. The tool can therefore be used for breaking up the soil, sowing, hoeing, etc.The tool, which was developed and is produced by local artisans, is made of iron. Farmers can quickly adapt it on the spot to change its purpose. The main shaft is a hollow pipe with a number of holes, enabling the farmer to change the distance between coulters (cutters), for example, or attach a longer or shorter blade. The attachments include coulters of different shapes for different purposes. This implement has several advantages over older tools. The V-shaped iron plate used during sowing prevents soil from collecting near the seed hole, for example, and thus increases the efficiency of the sowing operation. This multi-purpose farming tool is considered to be a best practice because it represents a contemporary, local innovation. For the farmer, it is 11 tools in one and thus very economical. Nowadays a shortage of skilled farm workers is an acute problem in this region. The tool helps to relieve this problem because it is easy to use and greatly increases the productivity of a single labourer. It also creates a friendly relationship with nature as it does not release any pollution. The rural artisans working at the grassroots level who make the multi-purpose tool benefit from the recognition they receive as well as from sales of the product. (*tttc-unesco-india-en)*

c) Dynamic of Soil Compactness (Dhada) :It is difficult to translate it in English. However, it is an important object of a series of interculturing operations. It indicates compacted sub soil layer. Through interculturing DHADA can be created as and when and where required.It was felt by farmers that compacted layer can be settled deeper or it can be moved upward. This is a wonderful art of manipulating soil physical properties with simple device interculturing.The rationale understood by SMS that different crops need different depths of DHADA. If it created properly it increases root soil contact nutrients availability, water availability and soil aeration. It is many folded.

d) Permanent Furrow: The farmers of the zone had adopted permanent furrow (6" wide x 8" deep) since long for groundnut crop.The respondents viewed that permanent furrow means the marking of furrows in the fields are fixed and those are used for cultivating, exposing, sowing, fertilizing, manuring and irrigating since so many decades.Hence the scientists have given the due weightage to physical, chemical and biological properties of the soils, in the furrows become super normal than in the rest of soils in between the furrows. It serves as a micro-watershed as the water flowing between the furrows automatically drains into the furrows. The soil around furrow can be kept porous and moisture can be conserved in the times of paucity of water.

e) Application Of Morum- Tanch: The farmers are incorporate morum or tanch (A kind of gravely soil) into the furrows of the field of groundnut.The rational perceived by the farmers that it is easily available at free of cost. There is a partial decomposition of basaltic trap which is a parent material of these soils. It contains majority of inorganic nutrients in the trace amount.It was opined by SMS that the TANCH improved water holding capacity and bulk density of soil, which is very much important in the dry farming groundnut. It also helps in loosening the soil and facilitated peg penetration of groundnut.

f) Sheep Penning As Manure Collection Practices :After the crop harvesting this practice is followed. In which the sheep and goats are kept in the field during nights. Entire field is covered in 4 to 7 days.The rationale perceived by the farmers that it collects inorganic and organic manures in the form of urine and dungs of goats and sheep at lower cost from local resources.Smith (1921) found out the analysis of sheep urine contains hippuric acid with organic matter. It is possible that the hippuric acid is released in the crop which increases the groundnut yield.

g) 'U' Band Around The Coulters : At the time of groundnut sowing 'U' band (iron or wood) is tied at the upper end of coulters.The rationale perceived by farmers that it covers the furrow after sowing.The rationale justified by scientists that it prevents the attacks of birds and insects pests even after successful sowing. It fills up the soil and levels the groundnut sown furrow.

h)Immature Coconut Water (Coconut Milk) Use : The coconut milk is either spread along with pesticide or alone. Its proportion varies from farmers to farmer.It was reported by farmers that it increases number of pods per plant of groundnut. Besides that it also keeps the crop healthy and green.This may be due to the kinetin alkoides contains (acidic in nature) in the water of coconut which works as a growth regulator as reported by scientists.

i) Butter Milk Spray: Farmers are spraying the butter milk (upper side water from vessels) in the groundnut standing crops for more yields.The rationale given by the farmers that it keeps the crop healthy and green.The rationale given by SMS that butter milk contains lactic acid which may work as a growth regulator as a result the yield can be increased.

j) Pest And Constellation: It is believed that there is a close relationship between onset of constellation and attack of pest in groundnut crop.When it was asked to reason out the cause of attack of pest in groundnut, the farmers were emphatic in stating the pests and diseases occur with the coincidence of three factors namely: rain in August, September (Magha, Purba, Uttra and Hasta) with bright sunny days and south east winds e.g. Aphid-Magha.According to SMS there is close relationship between temperature and humidity for occurrence of pest. It is a matter of research in depth.

Constraints in using ITK

- Education and exposure especially of the young generation to modern training have biased people's attitudes towards using ITK
- Some farmers feel it is time consuming, exhausting and sometimes dangerous to hunt for herbs in the forests and bushes
- ITK was reported as not effective in large scale production
- Some religious beliefs do not encourage traditional beliefs and technologies regarding them as demonic and superstitious
- Regressive government laws prohibiting some practices like growing cannabis, un-authorized tree cutting and rudimentary castration of livestock
- Depletion of most trees and herbs that are sources of local medicine
- Lack of standardization and documentation of indigenous technologies and practices

Conclusion

Indigenous technical knowledge plays an essential role in sustainable grassroots innovations. Such grassroots innovation largely differs across different sectors with respect to the characteristics, sources, actors involved etc. The knowledge base needed for different grassroots innovations is different, which in turn decides the involvement of particular set of actors. In case of traditional societies, the local indigenous individual is the major actor. In many cases, the indigenous communities are not well aware of the value of their indigenous knowledge which has been passing from generation after generation. Actors such as scientific institutions and NGOs could play crucial role in this regards for capacity building among the indigenous community and popularization of traditional methods and techniques.

In today's context, there is an urgent need to evaluate and popularize indigenous innovation. Government schemes and Research and Development activities should reach indigenous innovators. The paper documented only a few examples of ITK usage in India. There are many more such examples among the ethnic groups of India. As most of the traditional knowledge and technologies are undocumented, there is also a need for more research in this field. Otherwise, this valuable knowledge will be extinct in the near future.

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A Framework for development of e-Learning Module on Training for Extensionists

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Abstract

Training is embedded in human resource development. Training is an important area for the Extensionists both in terms of getting training for enhancing their competencies and providing training to their clientele for improvement in their knowledge, skill and behavior. e-learning technology has also emerged as a vital tool in the area of training. Nowadays, the computer network-based learning is widely used all over the world because of its potential and flexibility. However, the use e-learning module is low among the professionals in extension services. e-learning is defined as teaching and learning that are delivered, supported, and enhanced through the use of digital technologies and media. e-learning is a modern training approach which can be used to improve the efficiency and effectiveness of extension services. Lippert and Plank (1999) showed that the internet and e-learning can be a very effective approach in providing in service training within an extension organization. A learning module is a competency-based tool focused on what a learner will know or be able to do as a result of using the tool (Richard., 1990). Considering the potential of e-learning in extension, a Prototype-module on training was designed using MS- Power Point (2010). MS Power pointis an easy and effective way of developing an e-learning module. Designing of an e-learning module consisted of four phases. Phase one consisted of exploring Extensionist's proposition on the areas to be covered in the module on training in extension. Phase two consisted of development of a standardized procedure for developing e-modules. Phase three consisted of development and testing of prototype e-module. Phase four consisted of validation of the e-module. Through validation, the e-module was tested for its relevancy and utility for Extensionists. The e- learning modules was tested among 30 scientists and 30 Extensionists from KrishiVigyanKendras. For testing purpose, a testing instrument developed by Sunil V.G. (2006) was used with due modification and adaptation. The module was then published in CD-ROM format after suitable modifications and editing. Thus, e-learning

can overcome the barrier of time and space and can provide effective learning experience to the Extensionists.

Introduction

With the advent of information and communication technology, the world has become small place to live. Internet has massively connected the world removing the barrier of age, distance, time and socio-economic status. This technological revolution has created a new dimension in whole agriculture and extension scenario. There has been change in agriculture situation worldwide. Everyday new technologies are coming and knowledge in generated.For an extension professional to be competent in his field, needs to be updated with these developments. Here comes the role of training which can help the extensionists to acquire the desired knowledge and skills to be effective in his job. But due to various constraints like distance, time, funds, it becomes difficult for Extensionists to attend training programme elsewhere.Several studies indicated several inadequacies in training the extension professionals both in terms of content and organization (Vijayraghavan et al., 2005; Thanh and Singh, 2005). One of the ICT which can be used by agriculture Extensionists to develop their desired competencies is e-learning technology. E-learning is defined as teaching and learning that are delivered, supported, and enhanced through the use of digital technologies and media. It is a platform with flexible learning using Information Technology and Communication (ITC) resources, tools and applications, and focusing on interactions among teachers, learners and online environment (Codone, 2001). E-Learning in agriculture can assemble resources and knowledge from distant places that may otherwise be unobtainable. It can connect farmers with far away researchers and experts. It can also dramatically increase the numbers of farmers who can be reached by single training programs" (Berge and Leary.,2006).E-learning provides an opportunity for students to improve the learningexperience by ease of access, greater interactivity, and individual choice concerningthe pace and mix of learning. At the same time, it also offers advantages for teacherssuch as improved distribution of learning content, ease of update, standardization,and tracking of learner activities (Maxwell., 2012).Lippert and Plank (1999) showed that the internet and e-learning can be a very effective approach in providing in service training within an extension organization. A learning module is a competency-based tool focused on what a learner will know or be able to do as a result of using the tool (Richard 1990). However, the use e-learning module is low among the professionals in extension services. With the aim of encouraging active learning and development of the required competencies among the Extensionists, we designed interactive E-learning modules.

Methodology

Before designing of the e-learning module, focused group discussion was carried out with theExtensionists,Scientists and Assistant Professors of agriculture extension to decide about the topics to be included in the e-learning module.A questionnaire was developed based on the focused group discussion with the reliability coefficient alpha of 0.81. The questionnaire was administered to thirty Extensionists working in KrishiVigyanKendra. Based on the responses, the topics to be covered in the e-learning module on training was decided. It was decided to use MS PowerPoint (2010) for designing the e- learning module due to its simplicity and ability to perform various functions.Designing of an e-learning module consisted of four phases. Phase one consisted of exploring Extensionist's proposition on the areas to be covered in the module on training in extension. Phase two consisted of development of a standardized procedure for developing e-modules. Phase three consisted of development and testing of prototype e-module. Phase four consisted of validation of the e-module. Through validation, the e-module was tested for its relevancy and utility for Extensionists. Interactive PowerPoint presentations were developed in Microsoft office PowerPoint2010, using action buttons and hyperlinks according to the support guidelinesavailable on the Microsoft office website.The e- learning modules was tested among 30 Scientists and 30 Extensionists from KrishiVigyanKendras. A non-probability convenient sampling method was used to select the sample for testing the e-learning module. For this purpose, a testing instrument developed by Sunil V.G.(2006) was used with due modification and adaptation.The module was then published on CD ROM for the use. Alternatively, it can be designed as a website by using Google sites.

Results and Discussion

A total of four e-learning modules were developed on training namely 1) Fundamentals of training: basic concepts 2) Training process, 3) Instructional Methods and Aids and 4) Emerging trends in training.

Each presentation was divided into several sections.

- Learning objectives and learning outcomes were given in the beginning of each module
- Mouse click was disabled and use of arrow buttons to navigate through the e-learning module
- Action buttons and hyperlink were added to move to the next slide, previousslide, home and various sections.
- In the module, a quiz was inserted based on the previous learning of the module. Visual basics used to make the quiz.
- Use of real photographs to increase the likability.
- The module was saved in the PPSX file format. The advantage of this fileformat is that on double-click the presentation will not open in an editable format.A PPSX file automatically opens in a slide show mode rather than a normal view.
- For further reading, references were provided at the end in each section.

Table 1 shows ninety six per cent of the respondents were of the opinion that topic of training need assessment and characteristics of the trainers should be included in the training while ninety four per cents of the respondents wanted instructional aid to be included in the e-learning. Only 66 per cents of the respondents wanted to include principles of the training module. The topics having frequency above 50 per cents were included in the module.

Table 1: showing topics to be included in the e-learning module n=30

Sl.no	Topics to be included	Per cent
1	Training methods	89
2	Instructional aids	94
3	Principles of learning	66
4	Emerging areas in training	92
5	Principle of training	82
6	Training Need Assessment	96
7	Training process	87
8	Evaluation	68

9	Characteristic of a trainer	96
10	Training institution	75

The prototype module for enhancing the effectiveness of training in extension was tested among 60 respondents. Table 2 furnishes the statement wise analysis of the results. The data revealed that both the content and design part of the e-module was liked by majority of the respondents. Specifically, the information presented through the module and overall design was accorded highest per cent of agreement by the respondents. This was followed by the clarity of content in the module, well-structured content in the module, style of presentation. A general acceptability of e-learning module was indicated by relatively high scores of almost all aspects of e-module by the respondents.

Table 2: Statement wise analysis of the respondents' opinions about e-learning module during testing (n=60)

Sl. No	Statement	Agree		Neutral		Disagree		Mean Score (Out of 3)
		f	%	f	%	f	%	
1	Learning objectives are clearly written	56	93.33	4	6.67	0	0	2.94
2	Good introduction to topic	49	81.66	11	18.33	0	0	2.82
3	Able to move forward and backward of contents	51	85.00	8	13.33	1	1.67	2.84
4	Able to move out of the content	53	88.33	7	11.67	0	0	2.88
5	Systematic presentation of ideas	55	91.66	5	3.37	0	0	2.92
6	Content presentation suits interactive learning style	52	86.67	8	13.3	0	0	2.87
7	The module is interesting	56	93.33	4	6.67	0	0	2.93
8	The module helps you to do	45	75.00	15	25.00	0	0	2.75

	reflection							
9	Module is user friendly	48	80.00	12	20.00	0	0	2.80
	Average Mean Score					**2.86**		

Conclusion

e-Learning is a potentially viable and cost-effective way to facilitate knowledge development among agricultural professionals and farmers but is still not widely employed. e-learning can overcome the barrier of time and space and can provide effective learning experience to the Extensionists. Use of MS Powerpoint provides an excellent way to develop very efficient e-learning modules. It is easy to use and provides all audio-video features to be incorporated in the learning module for effective learning. There are some challenges to be overcome to make e-learning programme a success. The internet is a lynchpin of any E-learning project, so internet connectivity needs to be improved. While preparing any E-learning module, it is essential for moderators to determine its compatibility on different devices for better access for the end-users otherwise it would become difficult for the users to get a better learning experience. Nevertheless, it will be worthwhile to further explore the scope of E-learning, especially in rural areas for both farmers and Extensionists.

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A study on e-readiness of extension functionaries in agriculture extension dissemination

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Abstract

The benefits of utilization of ICT as an e-Learning media for agricultural extension and training purposes are well documented by many researchers. ICT use for extension activities will ultimately transform extension officers into catalysts, who play their roles of empowerment in community organisations, human resource development, problem solving and educating farmers. Extension organisations have a key role in between communication technologies, providing technologies and services, and the client groups they serve. Agriculture Extension functionaries have a significant role in bridging the technological gap between the existing scientific knowledge base and information and knowledge of the farmers. Therefore it becomes utmost important to assess the e readiness of extension functionaries in agriculture extension dissemination. In this study e-readiness is defined as physical, motivational, and literacy readiness of extension personnel to use ICTs in agricultural extension system. The objective of present study was to investigate the preparedness of the extension professionals and extension organizations to implement ICT enabled extension services for farming community. The present study was conducted in southern states and Union territories in India to measure the to measure the e-readiness of the public sector agricultural extension functionaries towards use of ICTs. Sample consisted of 300 agriculture

officers and allied departments fromTelangana , Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Odisha, Union Territories of Andaman & Nicobar Islands, Puducherry and Lakshadweep selected randomly.Structured Interview schedules, questionnaires and check lists were used to collect the data. The results revealed that majority of the respondents were men, middle aged and medium knowledge on ICT. More than 60 percent of officers perceived positively on the usage of ICT tools for dissemination of farm information.The study helped in identification of gaps and constraints involved in the implementation of e extension initiatives in agriculture and allied sectors in the dissemination of technologies.

Introduction

India is mainly an agricultural country. Agriculture is the most important occupation for most of the Indian families. Agriculture plays a vital role in the Indian economy.Extension functionaries bare the responsibility of transferring the technical know how ,to farmers. Agricultural knowledge sharing created by information flow helps in developing different agricultural sectors.

Agricultural extension/education considered ICT issues as the most important topics for quite a long time. (Poole, 2000) examined the conventional ICT's like radio and television as the most important means of establishing a strong link between the farmers and their respective market demands, which are their major area of interest. And the information gap among the farmers and other beneficiaries are bridged up through providing additional sources by the modern ICT's like satellite, computer, internet service providers and telephone systems. Both ICT's are used for addressing developmental issues and reducing poverty, and are adopted by target audience.

Agricultural Extension, in the current scenario of rapidly changing world has been recognized as an essential mechanism for delivering knowledge (information) and advises as an input into modern farming (Jones, 1997). Agricultural Extension has to reorient itself beyond the narrow mindset of transfer of technology packages. Instead, it has to rejuvenate its vigour for “transferring knowledge (or) information packages” as the input for modern farming. In such case, extension will become more diversified, knowledge intensive, and demand driven. This requires extension system to be at cutting edge level and master many trades for which the ICTs can help. It is in this context, there are many possibilities for potential application of the ICTs in Agricultural Extension (Zijp, 1994)

Information and Communications Technology (ICT) is an umbrella term that includes computer hardware and software; digital broadcast and telecommunication technologies as well as electronic information repositories such as the World Wide Web or those found on CD-ROMs. It represents a broad and continually evolving range of elements that further includes television (TV), radio, mobile phones, and the policies and laws that govern these media and devices. ICTs are often used in plural sense (ICTs) to mean a range of technologies instead of a single technology.ICTs consist of activities that facilitate the capturing, storage, processing, transmission, and display of information by electronic means.

e-readiness has various meanings to different people in different contexts, and for a variety of aims. The main emphasis of e-readiness is to assess a country's ability in improving and supporting digital business and ICT services. It is necessary to define e-readiness according to the purpose of the research. In this study electronic readiness of an organization is defined as the readiness and capability of an organization to receive, apply and profit from ICTs. In today's digital world, ICTs play a major role in an organization's progress and help to succeed in competition.

e-Readiness (electronic readiness) assesses the quality of a country's ICT infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit. According to APEC (1999) e-readiness is the degree to which an economy or community is prepared to participate in the digital economy. McConnell International (2000) defines e-readiness as the capacity to participate in the global digital economy. In 2010, e-readiness was renamed as the digital economy (EIU, 2010). E-readiness assessments can therefore be seen to serve as a useful starting point for developing countries. Hence the present study was taken up to assess the e-readiness of extension functionaries in agriculture extension dissemination.

The specific objectives

i. To assess the knowledge levels of extension functionaries on the ICTs.
ii. To find out the perception of extension functionaries towards the use of ICTs in agricultural extension dissemination

. **Materials and Methods:**

Ex-post facto and exploratory research design was followed for the study. The study was in six southern states i.e., Telangana, Andhra Pradesh,Tamilnadu, Kerala, Karnataka, Orissa and Union Territories i.e., Andaman and Nicobar, Lakshadweep and Puducherry. A total number of 300 officers of the client departments of EEI will be selected randomly for the study. The extension officers who attend the training programmes (On and off campus programmes of EEI) organized by EEI during the years 2014-15 (December 2014 to February 2015) and June – September 2015 will be selected. The data was collected from development officers using the following inventories:

- Interview schedules
- Questionnaires
- Check lists
- Focused group discussions
- Interview
- Documentation
- Questionnaire
- Interactions
- Brain storming

Results and Discussion:

It is evident from the table that majority of the respondents were middle aged, Graduates, Agriculture officers and men. It is also observed from the tale that majority of the people are middle (56.67%) aged followed by old (28.33 %) and young (15.00 %). With respect to gender majority of the respondents (60.00 %)were male followed by female (40.00%).It could be seen from the table.1 that majority of the respondents belong to the category of Agriculture/Animal husbandry officers /Horticultural officers / officers category (56.67%) followed by Assistant Director and Joint Director category. Hence while implementing e- extension programmes the profile of the officers need to be considered.

Table -1: Personal Profile of the Extension officers.

N=300

S.No	Characteristic	Category	Number	Percentage
1.	Age	Young	45	15.00
		Middle	170	56.67
		Old	85	28.33

2.	Gender	Male	180	60.00
		Female	120	40.00
3.	Education	Graduate	220	73.33
		Post graduate	80	26.67
		Doctorate	-	
4.	Designation	Agricultural/Animalhusbandary/ Horti/officer	170	56.67
		Assistant Director	125	41.67
		Joint Director	5	1.66

Awareness on ICT tools:

The results revealed that out of the 10 ICT tools listed, extension officers indicated cent percent awareness on mobile telephony, television programmes and radio programmes and tele /video conferencing followed by video recordings (82.33 %), kisan Call centres (75.00%) Internet kiosk (8.67 %) and multimedia enabled interactive material (6.00 %). Majority of the officers aware of the usage of sending Short Message Services (SMSs), video recordings and kisan Call centres. But very less percent of the respondents were aware of the Internet kiosks and Multi media enabled interactive material. The extension functionaries should be aware of the recent tools be used for agricultural extension. Hence there is an immense need for creating awareness on innovative ICT tools for creating awareness among extension officers to enhance its usage.

Table- 2: Awareness of the extension officers on ICT tools.

N-300

S.No	ICT tools	Frequency	Percentage
1.	Mobile Telephony	300	100.00
2.	Internet kiosk	26	8.67
3.	Online web portals/ sites	81	27.00
4.	Kisan Call centres	225	75.00
5.	Television programmes	300	100.00
6.	Radio programmes	300	100.00

7.	Video recordings	247	82.33
8.	Tele /Video conferencing	300	100.00
9.	Multi media enabled interactive material	18	6.00
10.	Any other	22	7.30

Knowledge levels of Extension officers about ICT tools

Based on the knowledge scores the extension officers were grouped in to three categories and distributions were given below. It can be observed from the table.3 that majority of the respondents (55.67%) had medium knowledge on Information communication technologies followed by High (25.67%) and High percentage (18.67%).Extension functionaries should able to access afford and exercise the ICT tools and techniques and should have necessary skills to get himself/ herself updated with the ICTs.The prerequisite for incorporating ICTs in agricultural development is e-ready extension scientists. The e-ready extension functionaries can take care of wide range of information needs of the farmers. Extension agents should be able to able to access,afford and exercise the ICT tools and techniques. He / she should update herself with the necessary skills to use appropriate ICT tools.

Table.3: Distribution of respondents based on ICT tools.

N=300

S.No.	Category	Frequency	Percentage
1.	Low knowledge (Up to 4)	56	18.67
2.	Medium knowledge (5 to 6)	167	55.67
3.	High knowledge (7 and above)	77	25.67

Table 4: The perception of extension functionaries towards the use of ICTs in agricultural extension dissemination.

N=300

S.No.	Category	Frequency	Percentage

1.	Favourable	155	51.67
2.	Undecided	67	22.33
3.	Unfavorable	78	26.00

Majority of the respondents had favourable perception towards the use of ICTs in agricultural extension dissemination (51.67%) followed by unfavouable (26.00%) and undecided (22.33%). The results indicating that majority of the respondents were aware of the advantages of the use of ICTs in agricultural extension dissemination and they are willing to use ICTS in extension. Hence there is a massive need for upgrading the digital literacy of the extension professional in southern India through various capacity building activities. Knowledge, skill and attitude of the extension functionaries are the three important domains which need to be considered for creating e-readiness among extension functionaries and organizations.

Conclusion:

In the present scenario of rapidly changing world, agricultural extension is considered as a essential system for dissemination of innovative technologies for the farmers. In this context agricultural extension has to reorient itself for meeting the growing demands of the people. Hence it is high time for extension organizations to strengthen themselves with more diversified, knowledge intensive and demand driven. ICTs provide an opportunity for refurbish extension system in India.Hence congenial environment need to be created for the e ICT enabled extension. At individual and organizational level.

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ALIGNING AGRICULTURAL EXTENSION STRATEGIES FOR REALIZING THE TARGETS OFSUSTAINABLE DEVELOPMENTAL GOALS (SDGS)

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ABSTRACT:

Securing inclusive social and economic development as well as environmental sustainability are the avowed objectives of all nations and these are the vital elements of the Sustainable Development Goals (SDGs) set by United Nations. There is no denying the fact that without a strong and sustainable agricultural sector, it will not be feasible to realise the goals. More than just its direct impact on hunger and malnutrition, our food system is also linked to other development challenges being addressed in the SDGs. Agriculture has a direct link with different aspects of Sustainable Development Goals (SDGs) like poverty eradication; food and nutritional security; formal, non-formal and lifelong learning opportunities; women's empowerment; sustainable consumption and

production; climate resilience; sustainable use of natural resources; conservation of biodiversity; etc. It is also an established truth that the philosophy, principles, approaches and methods of extension education have played a pivotal role in agricultural development across the globe. Extension system has evolved in tandem with the development perspective of India. It has been facilitating the attainment of developmental targets and therefore, it could be an appropriate means for achieving the targets of Sustainable Development Goals. In September 2015, the member countries of United Nations agreed on 17 goals with 169 targets that set the agenda for sustainable development interventions over the next 15 years. It is interesting to note that most of the goals and targets relate with what the extension profession has been advocating and practicing for a long time. However, there are four important concerns, where agricultural extension can play a major role namely enhancing food and nutritional security, sustainable livelihoods, resilience to climate change and peace and wellbeing of the farming community.

I.INTRODUCTION

Extension education, by its importance, seems to be tested again as crucial means for realization of sustainable development goals. This paper has made an attempt to relate the roles of agricultural extension in achieving the Sustainable Development Goals (SDGs). Though extension find its roots in practical dissemination and application of knowledge, essence of its philosophy and principles was reflected right in the beginning in Community Development Programme in India in 1952 wherein stress was laid more upon development of human resources. It was followed by major interventions like National Extension Service (1953), Intensive Agricultural District Programme (1961), Intensive Agricultural Area Programme (1964), High Yielding Varieties Programme (1965), National Demonstration Programme (1966), Small and Marginal Farmers Development Agencies (1969-70), Krishi Vigyan Kendras (1974), Training and Visit System (1974), Agricultural Technology Management Agencies (1985),etc.

It was evident in all these efforts that believed and proven that empowerment of individuals was the key to successful deployment of development endeavours. Later empowerment of group was highlighted. Therefore development of inner capabilities of persons / farming communities remained at the heart of extension. However, in the present changing context besides human capabilities, enabling environment too is important. The Sustainable Development Goals encompass several domains of development like social, economic and environment. Besides individual competencies; institutional arrangements, linkages and convergence; and enabling policy support system would hold key to development. Presently, the Indian extension system is said to be pluralistic in nature with a number of agencies involved in the delivery of extension services. There are public, private and third sector actors along with information communication technology (ICT) based initiatives proactively involved in information and technology dissemination in agriculture and allied sectors. Some of the extension actors are involved in the provision of support services also. It has brought added responsibility to public extension like quality assurance along with provision of technical backstopping, and ensuring coordination / convergence between different actors in pluralistic extension system.

II.SDGS WHEREIN AGRICULTURAL EXTENSION COULD MAKE DIRECT CONTRIBUTION

Although different aspects of extension work highlight one or more of the goals, there are eight of them they appear to have the clearest relevance. They are:

Goal 1 on eradicating poverty;

Goal 2 on ending hunger and achieving food security and improved nutrition and promotion of sustainable agriculture;

Goal 4 on lifelong learning opportunities;

Goal 5 on women's empowerment;

Goal 6 on sustainable management of water;

Goal 12 on sustainable consumption and production;

Goal 13 on combating climate change; and

Goal 15 on sustainable use of land and forests and combating desertification, soil degradation and biodiversity loss.

These goals have been described in details as follows

2.1 Goal 1: End poverty in all its forms everywhere - role of Agricultural Extension

Almost 80 per cent of the world's extreme poor live in rural areas where most are dependent on agriculture. Agriculture is the single largest employer in the world. Agricultural growth in low-income and agrarian economies is at least twice as effective as growth in other sectors in reducing hunger and poverty (FAO, 2015).

Based on Tendulkar Methodology it was found that in 2011-12 about 21.92 percentage of Indian population lived in below Poverty Line. Situation of rural India is worse as compared to urban India. In rural India about 25.70 percentage and in urban area 13.70 percentage lived in below Poverty Line (GOI, 2017, data.gov.in). Poverty is not only the lack of income and resources to ensure a sustainable livelihood but also it reflects a lack of opportunities and capabilities in many inter-linked areas, including insecure access to food, education, employment, healthcare, drinking water and sanitation, political participation, etc.

Progressive decline of the share of agriculture in the overall GDP without any concomitant reduction of number of people still dependent on agriculture, provides several leads to address rural poverty. Gradual decline of farm holdings makes a majority of small and marginal farming quite unviable. The share of farm income in total rural household income has been decreasing in all regions. There is a need for more inclusive rural development processes promoted through policies that address the income and employment constraints faced by resource poor people, ensure increased access to infrastructure, energy and basic social services and strengthened social protection mechanisms (FAO, 2013).

Agricultural Extension interventions are essential to have strengthened rural institutions, with producer and local community organizations to ensure more equitable and secured access to productive resources, improve the functioning of labour and markets and facilitate knowledge and technology transfer. This also calls for strengthened policy and legal frameworks for co-management of natural resources, improved governance of tenure of land, fisheries and forests, and innovative approaches to rural entrepreneurship. Economic growth should translate into off-farm and non-farm rural employment opportunities for men, women and youth. Care is needed to create maximum synergies between social protection and rural development policies.

Many empirical studies show that agricultural growth is relatively more important than growth in other sectors because: 1) the incidence of poverty tends to be higher in agricultural and rural populations than elsewhere, and 2) most of the poor live in rural areas and a large portion of them depend on agriculture for a living.

Farrington et al., (2002) made an effort to summarise the results of a cross-country study on agricultural extension and its potential contribution to poverty reduction. This endeavour concludes that poor people pursue a changing range of livelihood strategies; transaction costs, risk and vulnerability have a particular influence on them. This implies an extension approach geared broadly to livelihood contexts rather than narrowly to crop or livestock production. Extension needs to address vulnerability as well as productivity; and, rather than over-promote diversification, offer a range of new options from which poor households can choose according to their circumstances. Livestock rearing has significant positive impact on equity in terms of income and employment and poverty reduction in rural areas as distribution of livestock is more egalitarian as compared to land. In India, over 70 percent of the rural households own livestock and a majority of livestock owning households are small, marginal and landless households. Small animals like sheep, goats, pigs and poultry are largely kept by the land scarce poor households for commercial purposes due to their low initial investment and operational costs. In the recent decade, demand for various livestock based products has increased significantly due to increase in per capita income, urbanization, change in taste and preference and increased awareness about food nutrition . Diversification into livestock, and increasing livestock productivity should form part of a strategy for poverty reduction and agricultural productivity growth because a large share of the rural poor keep livestock and the demand for livestock products is growing rapidly in developing countries (Otte et al., 2012). Jensen (1999) studied the importance of poultry as a means in poverty alleviation and food security. The author reported that, the accessibility to literature, documents, guidelines, manuals, etc. are the main constraints. A successful model has been developed in Bangladesh in which the main elements are: community group formation, establishment of an enabling environment, and capacity building for establishing and maintaining a smallholder poultry sector.

Revitalizing India's rainfed regions necessitates the strengthening of diverse local production systems to improve food and nutrition, and income security, promoting measures for in-situ conservation and efficient use of rainwater, increasing the efficiency of resource use, strengthening extensive livestock production systems depending wholly or partially on common lands and crop residues and an increased investment on decentralized and local institutional capacities. In addition, there is need to focus attention on improving livelihoods and strengthening capacities of smallholders, pastoralists, women and other marginalized communities.

Initiatives in rainfed agriculture should be in particular focus on improving access to critical inputs and knowledge, supporting collectives of resource poor farmers and other marginalized communities, and improving nutrition and food security. Efforts shouldbe made to facilitate convergence of programmes at the district level, and strengthen 'last mile delivery.' Extension services would need to respond accordingly to the emerging scenario.

In view of the importance of small ruminant and back-yard poultry rearing for the livelihoods and income security of resource poor farmers in rainfed regions, access to critical inputs and facilities for the establishment of collectives of smallholder livestock rearers should be strengthen. In the rainfed regions, common lands are a critical resource meeting the fodder and grazing requirements of smallholders. Initiativesshould support the regeneration and community management of these lands.

Extension interventions focused on reducing post-harvest losses, and on promoting hygiene and food safety standards will help to increase economic validity of farming. Initiatives should focus on promoting water use efficiency, and support for local crops such as coarse cereals and millets. In addition to being climate resilient, these crops are important for the nutrition and food security of communities in the rain-fed regions, and also provide valuable fodder. Improving soil health and thereby the productivity of rainfed regions should be other priority areas. The household farms should be the smallest planning unit for interventions (Planning Commission, 2011). A diversification of livelihood opportunities based on resources available will support to strengthen the risk-bearing capacity of smallholders from uncertain and rain-dependent crop farming, for which extension services need to be geared up on micro agro eco systems.

Many times decisions on investment and selection of beneficiaries in agricultural extension are biased. If only the area with high agricultural potential gets more attention and large farmer get maximum benefit from the extension programmes than neither the basic purpose of extension system will be solved nor the targets of poverty alleviation will be achieved

India, based on per capita income, stands among those countries with the highest recorded inequality rates. These inequalities are structural in nature and have kept entire groups trapped. Poor people are unable to take advantage of opportunities that economic growth offers. The XII FYP takes cognizance of this inequality by emphasizing on regional imbalances, focussing on neglected areas and bringing fundamental changes to planning, programming and programme delivery. Besides, the programmes under the agricultural ministry, a host of programmes in other nodal ministries support food and nutrition security, inclusion, poverty alleviation and address rural distress. These are, for example: MNREGS, and NRLM under the Rural Development, MDM with Education, ICDS the Women and Child Development, PDS with Consumer Welfare, Food and Public Distribution and the BRGF with the Panchayati Raj. Convergence strategy can help to achieve equality at different level based on micro agro eco situations.

2.2 Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture- role of Agricultural Extension

FAO, (2002) defines Food security as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. From this definition, four main dimensions of food security can be identified, physical availability of food, economic and physical access to food, food utilization, the stability of the other three dimensions over time. There is more than enough food produced today to feed everyone in the world, yet close to 800 million are chronically hungry. Globally about one in nine, suffer from hunger; more than one in four children under the age of five are stunted (too short for their age) due to chronic under nutrition; more than two billion people suffer from one or more micronutrient deficiencies or “hidden hunger” (FAO, IFAD and WFP. 2015).Of the estimated 805 million people experiencing chronic hunger globally, around three quarters live in rural areas and are overwhelmingly dependent on agriculture for their food and livelihoods. Though many study predicted that hunger levels are likely to decrease by hundreds of millions by 2030, but some region like, sub-Saharan Africa and demographic group like, rural women may still be most at risk.

Significant economic growth, impressive science and technology, large social security schemes and record food grain production notwithstanding, close to a quarter of Indian population do not get sufficient food to meet their daily nutritional needs. The Global Hunger Index -2016 of IFPRI labelled hunger status if India as 'serious' and ranked 97 out of 118 developing countries. The calorie intake of poorest quartile continues to be 30 to 50 percent less than the top quartile of the population (FAO, 2013).

National Family Health Survey (2015 -16) reported that in India 38.4 per cent children under 5 years are stunted (height-for-age) (31.0 % in urban, 41.2 % in rural); about 21.0 per cent children under 5 years are wasted (weight-for-height); about 7.5 per cent children under 5 years are severely wasted (weight-for-height); about 35.7 per cent children under 5 years are underweight (weight-for-age) (29.1 % in urban and 38.3 % in rural); Body Mass Index (BMI) of 22.9 per cent women and 20.2 per cent of men is below normal; 58.4 per cent children of age 6-59 months are anaemic; among the women from age group 15-49 years 53 per cent are anaemic

As the affordability of food largely relates to income, ensuring access to food remains one of the key pillars of food security and the wider anti- poverty agenda. Tackling hunger is not only about boosting food production; it's also about increasing incomes and strengthening markets so that people can access food even if a crisis prevents them from growing enough themselves.Besides poverty, lack of income or livelihood opportunities, lack of training or skill development, mismanagement of resources, loopholes in safety nets, poor governance, and demographic pressures are the contributory factors to hunger and malnutrition. Poverty and hunger are widespread among smallholders and agricultural workers in the rural areas and worsening. The problem is aggravated by low productivity, erosion of the natural resources base, unviability of small farms, poor institutional back-up for Agri-services and marketing, lack of overall investment in farm sector, and the disconnect between agricultural growth and nutrition outcomes. Lack of entitlement and access to productive assets and other resources – especially for women, poor and disadvantaged groups belonging to lower social and economic hierarchy, and those inhabiting the resource-poor areas – exacerbates the crisis.

The challenges to food production and availability are being compounded by recurrent droughts and monsoon failures, climate change and continued spate of price rise. Despite India's successes in averting famine since independence, endemic hunger continues to afflict a sizable proportion of the Indian population, leading to underdevelopment of body and mind that affect the overall wellbeing of individuals.

The evidence that there is a large variability both in terms of the extent of the problems as well as response to development interventions - even within the districts and blocks - makes it more worrisome (FAO, 2013).

The problem of hunger, malnutrition and food insecurity is multi-faceted and includes food availability, access, stability and utilization. There are a number of social, economic, institutional, environmental and political issues that need to be considered while addressing this complex problem. Agriculture, horticulture, livestock, forestry, fisheries, social and other sectors as well as the overall economy have to contribute in multiple ways to advance food security and nutrition. A common and comprehensive understanding of the underlying issues and challenges is necessary to forge a sustained and coherent approach amongst various stakeholders and design appropriate policy interventions (FAO, 2013).

Food and nutrition security depends on effective actions across sectors including all chains in the Agri-food system, maternal health, childcare and feeding practices, water and sanitation, administration of social sector safety nets, coordination and efficient implementation of various schemes and public services. Such governance system may stress upon inclusive, transparent, accountable and evidence-based policy processes, supported by appropriate legislation and well-functioning institutions (FAO, 2013).

Agricultural Extension plays fundamental role in food and nutrition security. The main areas of priority comprise of the key concerns that affect agriculture production and food management system in India are:

a) Design and develop pilot programmes to enhance the farm productivity in Eastern India including the North East and assist in their implementation;

b) Initiate and advocate for Zero Hunger challenge in specific districts/ blocks under rainfed conditions, and draw lessons for efficient implementation of the NFSM;

c) Design and implement pilots to improve productivity and widen livelihood options such as poultry and small ruminants for poor and marginalized sections in resource-poor ecosystems in selected rainfed areas;

d) Production strategies, institutional interventions and evidence-based policy advice to make small holder agriculture, livestock and fisheries sustainable and competitive; and

e) Gather, analyze and highlight food and nutrition security issues through active knowledge generation, communication and sharing of global best practices and information.

The current thinking around the world has been to include poor households as a target for development and keep the focus on using market-led approaches. While these two development objectives are not mutually exclusive, most current development activities either focus on the poor, where scale and market inclusion are challenges or focus on value chains, which do not meaningfully include the participation of resource-poor households. Improved market access - especially by small and marginal farmers, and disadvantaged sections of the society – is necessary for maintaining production incentives, permitting household specialization and enabling the movement to high-value products and to value-added activities.

The low availability of and access to timely and needed knowledge, information, and infrastructure often prevents a large number of small and marginal farmers from participating in markets. Often information is skewed in favour of better “networked” individuals or organizations, which often force disadvantaged farmers to sell their harvests below fair value. By giving smallholder farmers access to technologies and connecting them to markets, they will have options for a more profitable and resilient agriculture towards achieving food, nutrition and economic security.

There are large numbers of small and marginal farmers, and agriculture labourers, who do not generate sufficient surpluses to sell in markets. Enhancing productivity at farm levels, diversifying cropping patterns to meet changing consumers’ choice, and ensuring that these farmers and agriculture labourers get a remunerative price for their produce will promote inclusiveness.

Rainfed areas have vulnerable natural resource base and are several times under-invested as compared to irrigated areas. There is a need to enhance and make more effective and sustainable use of public investment, orient agricultural policies and programmes to respond to increasing feminisation of agriculture, build capacities for location-specific, decentralized governance and knowledge systems, and shift from conventional “production per hectare” thinking as the sole measure of performance to an approach that can integrate livelihoods (agriculture and rural non-farm), availability and access to food, ecosystem and human health (FAO, 2013).

Food availability to BPL families & supply and distribution apparatus in disadvantaged areas as per food quality standards is a major concern. More attention to expand income and livelihood options is required to increase access and affordability of food. Horticulture, dairy, poultry &nutri-cereals provide excellent opportunities for economic profit as well as nutritional security. Promotion of fortificationand propagation of nutrient-dense foods can help to get essential minerals and reduce hidden hunger. But awareness and reach are the crucial. In KVK network SMS Home Science can play an important role in this issue. CIWA (ICAR-Central Institute for Women in Agriculture, Bhubaneswar) Network programmes could be strengthened and focused on nutritional issues. Extension professional working at different level should be sensitized in nutritional and food safety issues. Training institutes should be reoriented to meet the need of field functionaries. Status of food security can be improved at thelocal level by promoting local resources (e.g. village ponds), use of underutilized sources home scale kitchen gardens, promotion of balanced diet especially in vulnerable groups and regions, promotion of nutri-cereals & nutri-gardens, etc. Ensuring availability of the foods is not the end. Adequate attention should be paid towards the food safety issues. Awareness among the producer as well as consumers should be increased.

Agriculture Technology Management Agency (ATMA) scheme and Krishi Vigyan Kendras(KVKs) to promote Farm Women's Food Security Groups (FSGs) , at least 3 per block, should be formed each year. These FSGs should serve as "Model Food Security Hubs" through establishing kitchen garden, backyard poultry, goatery, animal husbandry & dairying, mushroom cultivation, etc.

1.3 Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all - role of Agricultural Extension

Quality education is the foundation to improving people's lives and sustainable development.Major progress has been made towards increasing access to education at all levels and increasing enrolment rates in schools, particularly for women and girls. In some countries, however, stunting and malnutrition prevent children from going to school, compromising their learning ability and depriving them of a better future. The vast majority of primary school age children who do not attend school are from rural areas. Among them, millions of children are trapped in child labour in agriculture. School food programmes not only promote school attendance but can improve a child's nutrition and general health while helping to increase the income of community farmers.

Distress seasonal migration is a growing phenomenon in almost all arid parts of India. Drought and lack of work in villages force entire families to migrate for several months every year in search of work merely to survive. Children accompany their parents, and as a result drop-out rates go up. Migrants comprise the most vulnerable sections of society, and especially those that also belong to Scheduled Caste and Scheduled Tribe groups (Smita, 2008). Rural people, especially youth and women, have very limited access to sound learning opportunities. Yet, equitable access to quality education, vocational skill based training and lifelong learning are key to ensuring sustainable agricultural development and inclusive rural transformation.

Estimates indicate that only about 2 per cent of the existing workforce has undergone formal skill-training and about 15 per cent of the existing workforce has marketable skills, whereas 90 per cent of jobs in India are skill based and require vocational training (Simon, 2014).

The government of India has announced a target of skilling 500 million individuals by 2022, of which the National Skill Development Corporation (NSDC) is responsible for skilling 150 million individuals. Agripreneurship has potential to generate growth, diversifying income, providing widespread employment and entrepreneurial opportunities in rural areas (Bairwa etal, 2014). Realizing the importance of agripreneurship development and formal vocational training of rural youth in agricultural development especially from the point of view of food security of the country, ICAR has initiated a programme on “Attracting and Retaining Youth in Agriculture” (ARYA). The objectives of ARYA project are (i) to attract and empower the youth in rural areas to take up various agriculture, allied and service sector enterprises for sustainable income and gainful employment in selected districts, (ii) to enable the Farm Youth to establish network groups to take up resource and capital intensive activities like processing, value addition and marketing, and (iii) to demonstrate functional linkage with different institutions and stakeholders for convergence of opportunities available under various schemes/program for sustainable development of youth. ARYA project is being implemented in 25 States through KVKs, one district from each State. In one district, 200-300 rural youths will be identified for their skill development in entrepreneurial activities and establishment of related micro-enterprise units in the area of Apiary, Mushroom, Seed Processing, Soil testing, Poultry, Dairy, Goatry, Carp-hatchery, Vermicomposting etc. KVKs will involve the Agricultural Universities and ICAR Institutes as Technology Partners. At KVKs also one or two enterprise units will be established so that they serve as entrepreneurial training units for farmers. The purpose is to establish economic models for youth in the villages so that youths get attracted in agriculture and overall rural situation is improved.

The Ministry of Agriculture and Farmers Welfare, Government of India, in association with NABARD has launched a unique programme, Agri-Clinics and Agri-Business Centres (ACABC). This scheme aims at creating gainful self-employment opportunities to unemployed agricultural graduates, agricultural diploma holders, and intermediate in agriculture apart from science graduates with post-graduation in agriculture related courses for supporting agriculture development and supplementing the efforts of public extension.Committed to this programme, the Government is now also providing start-up training to graduates in Agriculture, or any subject allied to Agriculture like Horticulture, Sericulture, Veterinary Sciences, Forestry, Dairy, Poultry Farming, Fisheries, etc. Those completing the training can apply for special start-up loans for venture. Till December, 2016 total 51413 candidates have been trained and 21077 Agri-ventures have been established in the country under this scheme (Annual Report 2016-17, Ministry of Agriculture & Farmers Welfare, Government of India).

Farmer Field Schools (FFSs) provide people-centred learning experiences that promote the empowerment of farmers through education. Regular group discussion and training sessions are conducted in the villages for a group of 25–30 farmers by expert facilitators during the cropping season. Unlike most previous integrated pest management (IPM) training held in the country, in FFSs the curriculum is developed in collaboration with farmers to address their most relevant agro-ecological problems with locale-specific solutions. Fine-tuning of the production technology based on the location specific conditions and resources available with the farmers enhances the adoption rate. The FFS approach is a direct response to the needs of the farmers. Unlike other extension tools FFS is a season long two-way communication between the farmers and the facilitator who may be an extension or research worker.

Mancini et al., (2007) evaluated social and economic impact of cotton Integrated Pest Management Farmer Field School (IPMFFS) in Dharwad District of Karnataka State and in Warangal District of Andhra Pradesh. This study found that IPMFFS households and production systems were perceived by the participants to have become more economically resilient than Non-IPMFFS control groups when faced with adversity. In the participants view, IPMFFSs also led to enhanced individual and community social well-being, a benefit valued in particular by the women participants. The study tested a new application of the sustainable livelihoods conceptual framework as a tool for evaluation. Pananurak, P. (2010) assessed the impact of Farmer Field Schools in Cotton Production in China, India and Pakistan. The result showed that in all three countries the FFS training is effective. On the input and environmental side, FFS farmers use less pesticide and choose those with lower toxicity. Knowledge advancements due to FFS participation positively affected cotton yield and gross margin in India and China.The results found in this study suggest that FFS training in IPM should be undertaken, but thetargeting of program implementation remains an issue that needs to be given more attention.

Ministry of Agriculture & Farmers Welfare has introduced Skill Training of Rural Youth (STRY) under Sub-Mission on Agricultural Extension (SMAE) of National Mission on Agriculture Extension & Technology (NMAET). STRY aimed at imparting skill-based training to rural youth on Agri-based vocational areas in compliance with National Policy on Skill Development & Entrepreneurship-2015 in agriculture & allied areas to promote employment in rural areas. Training activities are implemented through SAMETIs at State level & coordinated through ATMA at District level.

2.4 Goal 5. Achieve gender equality and empower all women and girls - role of Agricultural Extension

Gender equality is a necessary foundation for a fair, peaceful, prosperous and sustainable world, but it is also a fundamental human right. Women's empowerment is a powerful multiplier of well-being and a prerequisite for sustainable development.Across all regions, rural women face greater constraints than men in access to land, fertilisers, water for irrigation, seeds, technology, tools, credit, extension services, profitable cash crops, output markets and rural institutions. Women often experience discrimination in rural labour markets and tend to be responsible for the bulk of unpaid care work within their households and communities. All this significantly hampers women's capacity to contribute to agricultural production and rural development.

Women represent about half of the total agricultural labour force in developing countries, are typically the guardians of household food security, and act as the main caregivers in rural areas. Women account for an estimated two-thirds of the world's 600 million poor livestock keepers. Out of the 56 million of overall employment in fisheries and aquaculture, women represent 19 percent of employers in the primary sector and approximately 50 percent in secondary sectors (still no mechanism in place to systematically collect statistics on women's engagement in the secondary sectors). Rural women are far more likely than urban women to be illiterate, unemployed, suffer domestic violence and live without adequate social protection coverage. It is estimated that endowing women and men with the same access to resources could raise total agricultural output in developing regions by 2.5 percent to 4 percent and reduce the number of undernourished people by 12 percent to 17 percent globally (FAO SOFA 2010-11).

Research shows that when rural women are empowered to have equal access as men to productive and financial resources, income opportunities, education and services, there is an increase in agricultural output and a significant reduction in the number of poor and hungry people.Research also indicates that when more income is put into the hands of women, child nutrition, health and education improves.

Though women's contribution in all forms of agriculture is significant, they do not have equitable access to land and water, farm services such as credit, inputs, training and extension, and marketing services. The role of women to household food security is well recognized too. Information on women's contribution, resource needs and constraints however is scanty. The full integration of women into all planning processes is essential to foster harmonious and sustainable development (FAO, 2013).

Directorate of Extension (DOE) is the nodal agency in the DAC, MOA&FW to strengthen agricultural extension services and net-working of training infrastructure in the country. National Gender Resource Centre in Agriculture (NGRCA) has been established which serves as a focal point for convergence of all gender related issues within DAC, MOA&FW and is to review, monitor and assess the gender contents and impact of various on-going programmes of DAC, MOA&FW and make recommendations on appropriate improvements in their strategy and design.

The Modified Extension Reforms Scheme was introduced in 2010 with the objective of strengthening the extension machinery and utilizing it for synergizing the interventions under the umbrella of Agriculture Technology Management Agency (ATMA). ATMA is decentralized farmer-driven and farmer accountable extension system through an institutional arrangement for technology dissemination at district level. In order to promote gender mainstreaming under the Scheme, ATMA Cafeteriam, 2010 continues to support activities in line with the following policy parameters:

- ✓ Minimum30 per cent of resources meant for programmes and activities are required to be allocated to women farmers and women extension functionaries
- ✓ Thirty per cent of the farmer representatives on the ATMA Governing Board (GB) have been reserved for women farmers to ensure that their interests are fully represented. Representativeness of farm women has been ensured in Farmers Advisory Committees at block, district, and state level .
- ✓ One post for Gender Coordinator is created with the responsibilities of ensuring flow of benefits under all schemes to women farmers, collection of gender dis-aggregated data, conducting studies and action research in critical thrust areas, promote Farm women's Food Security Groups and prepare training module to ensure household food security, documentation of the best practices/ Success Stories/ Participatory Material Production related to women in agriculture, block-wise documentation, prioritization and addressall farm women's needs and requirements in agriculture and all allied sectors, report to State Coordinator in r/o gender related information

National Institute of Agricultural Extension Management (MANAGE, 2007) identified Strategies for Mainstreaming Gender

1. Male extension workers can be trained to work more closely with women in settings that are culturally acceptable, such as women groups. Such groups can also improve access to infrastructure. The stereo-typed attitude of male agents should be changed with regular gender sensitization courses
2. Promotion of technologies to reduce energy and time spent, particularly the household and farm production activities. Extending the technological innovations such as weeders, paddy threshers, winnowers, sprayers, harvesting tools, parboiling units, maize sellers, dal making machines etc., will reduce the burden of women.
3. Increasing the bio-mass production to meet fuel needs, planting of fast growing fodder in common lands and developing mechanisms for sharing the fodder helps women in saving lot of time and devote this time for income generating activities.
4. Innovative credit programmes using non-traditional forms of collateral and local institutions (women groups) can ensure that women are able to obtain access to credit.
5. Gender Analysis of activities, resources, constraints, implications and benefits should be understood using Participatory Approach. This information should be taken into consideration for needs assessment. The ability of staff members /

extension functionaries to do this has to be built up. Identifying the right training and extension needs of women is one of the most important steps in initiating any developmental programme.

6. Giving women farmers more access to meetings, trainings, exposure visits and demonstrations and organizing training programmes based on the needs of the women. Institutional and village based trainings to be organized as per the convenience of the women farmers.
7. Where severe fragmentation of land exists, collective farming should be encouraged by women.
8. Active women can be selected, trained and provided with inputs and credit to practice improved technologies. Their fields can be used as demonstration plots for training other women.
9. Recruiting more women extension workers from rural areas and training them.
10. Female para-extension agriculturists, who are relatively less educated, can be posted in their own villages with short crash courses on agriculture.
11. Appointing female supervisors and Subject Matter Specialists (SMSs).
12. Using women as contact farmers or farmer friends.
13. Proper health care support for girls and women.
14. Most of the micro enterprises undertaken by women are based on the skills and raw material available rather than considering the market needs and market dynamics. In-depth marketing study would help identify effective marketing strategy for products. Cooperative marketing of products and assigning brand names for the products would also be helpful in finding sustainable markets.

Central Institute for Women in Agriculture (CIWA), Bhubaneswar has initiated a good number of research projects with focus on gender empowerment. It has an excellent network on gender research through State Agricultural Universities and ICAR Institutes. The outcome of these research projects could be made use of by the development departments.

2.5 Goal 6. Ensure availability and sustainable management of water and sanitation for all - role of Agricultural Extension

How to increase food production using less water is one of the great challenges of our times. Evidence suggests that two-thirds of the world population could be living in water-stressed countries by 2025 if current consumption patterns continue.Water scarcity, poor water quality and inadequate sanitation negatively impact food security, and the livelihood choices and educational opportunities for poor families across the world. Drought afflicts some of the world's poorest countries, worsening levels of hunger and malnutrition.

Crops and livestock already account for 70 percent of all water withdrawals, and up to 95 percent in some developing countries. Water withdrawal for irrigation and livestock will increase as global population growth and economic development drive food demand up. Dietary trends point to a global increase in consumption of food that requires more water to be produced, like meat.

Efforts should be taken towards ensuring water use in agriculture in more efficient, productive, equitable and environmentally friendly manner. This involves producing more food while using less water, building resilience of farming communities to cope with floods and droughts, and applying clean water technologies that protect the environment, monitor water resources use efficiency and level of stress, supporting economic development, and ensuring water resources are still available for future generations and to support ecosystems.

As per the land use statistics 2013-14 out of about 141.4 million hectares of net area sown in the country, about 68.2 million hectares (or 48.23 %) is presently covered under irrigation (Annual report, 2016-17MoA&FW, GOI). Substantial dependency on rainfall makes cultivation in un irrigated areas a high risk, less productive profession. Empirical evidences suggest that assured or protective irrigation encourages farmers to invest more in farming technology and inputs leading to productivity enhancement and increased farm income. Giving high priority to water conservation and its management Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation (**'***HarKhetkopani'*) and improving water use efficiency (**'***Per drop more crop'***)** in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities.

Strategies to extend the coverage of irrigation ('*Har Khet ko pani'*):

a. Creation of new water sources through Minor Irrigation (both surface and ground water)
b. Repair, restoration and renovation of water bodies; strengthening carrying capacity of traditional water sources, construction rainwater harvesting structures

c. Command area development, strengthening and creation of distribution network from source to the farm
d. Groundwater development in the areas where it is abundant, so that sink is created to store runoff or flood water during peak rainy season
e. Improvement in water management and distribution system for water bodies to take advantage of the available source which is not tapped to its fullest capacity (deriving benefits from low hanging fruits). At least 10% of the command area to be covered under micro/precision irrigation
f. Diversion of water from thesourceofdifferent location where it is plenty to nearby water scarce areas, lift irrigation from water bodies/rivers at lower elevation to supplement requirements beyond Integrated Watershed Management Programme (IWMP) and MGNREGS irrespective of irrigation command.
g. Creating and rejuvenating traditional water storage systems like *JalMandir* (Gujarat); *Khatri, Kuhl* (H.P.); *Zabo* (Nagaland); *Eri, Ooranis* (T.N.); *Dongs* (Assam); *Katas, Bandhas* (Odisha and M.P.) etc. at feasible locations.

Strategies to improve water use efficiency ('*Per drop more crop'*)

a. Promoting efficient water conveyance and precision water application devices like drips, sprinklers, pivots, rain-guns in the farm
b. Construction of micro irrigation structures to supplement source creation activities
c. Secondary storage structures at tail end of canal system to store water when available in abundance (rainy season) or from perennial sources like streams for use during dry periods through effective on-farm water management
d. Water lifting devices like diesel/ electric/ solar pumpsets including water carriage pipes, underground piping system
e. Extension activities for promotion of scientific moisture conservation and agronomic measures including cropping alignment to maximize use of available water including rainfall and minimize irrigation requirement
f. Capacity building, training and awareness campaign including low-cost publications, use of pico projectors and low-cost films for encouraging potential use water source through technological, agronomic and management practices including community irrigation
g. The extension workers should be empowered to disseminate relevant technologies under PMKSY only after requisite training is provided to them

especially in the area of promotion of scientific moisture conservation and agronomic measures, improved/ innovative distribution system like pipe and box outlet system, etc. Appropriate Domain Experts will act as Master Trainers

h. Information Communication Technology (ICT) interventions through NeGP-A to be made use in the field of water use efficiency, precision irrigation technologies, on-farm water management, crop alignment etc. and also to do intensive monitoring of the Scheme

2.6 Goal 12. Ensure sustainable consumption and production patterns - role of Agricultural Extension

A growing global population with accelerating urbanization and a deteriorating natural resource base means more people to feed with less water, farmland and rural labour. Satisfying expected increases in water, energy and food needs means shifting to more sustainable consumption and production approaches, with agriculture and food systems made more efficient and sustainable.A striking fact is that every year the world loses or wastes about a third of the food it produces while close to 800 million people on the planet are chronically hungry.To feed the world sustainably, producers need to grow more food while reducing negative environmental impacts such as soil, water and nutrient loss, greenhouse gas emissions, and degradation of ecosystems. Consumers must be encouraged to shift to nutritious and safe diets with a lower environmental footprint.

Reducing food losses and waste is gathering increasing global interest and action, with governments, research institutions, producers, distributors, retailers and consumers all presenting views on how to adapt our systems to save food.

Jha et al., (2015) assess the harvest and post-harvest losses of 45 crops and livestock produce. The study found that the losses in cereals were estimated to be in the range of 4.65% (Maize) to 5.99% (Sorghum). Harvesting, threshing and storage at farm and wholesale level contributed more towards losses. The total losses in pulses ranged from 6.36% (Pigeon pea) to 8.41% (Chickpea). Harvesting, threshing, storage at farm and processing units were identified as major contributors in total losses. Use of improper threshers, delayed harvesting and improper storage practices were probably the reasons for losses in pulses.For fruits, the losses ranged from 6.70% (Papaya) to 15.88% (Guava). Harvesting, sorting/grading, transportation, storage at wholesaler and retailer levels were the main operations and channels where losses were found to be high. Thelosses in vegetables varied from 4.58%

(Tapioca) to 12.44% (Tomato) owing to harvesting, sorting/grading, transportation, storage at wholesaler and retailers levels. The estimated annual value of the post-harvest losses of major agricultural and livestock produce is about Rs 92651 crore (calculated using production data of 2012-13 and wholesale prices of 2014).

The contribution of storage losses in thetotal loss was considerable, especially in fruits and vegetables. Cold chain, multi-commodity cold storages and low-cost short duration structures such as ICAR-CIPHET evaporative cooled storage structure, Zero Energy Cooling Chamber, etc. are essential in checking the loss of fruits and vegetables. Improvements in infrastructural and transport facilities were found to be helpful for reducing the post-harvest losses. Development of cold chain and construction of cold store with the pace of production are essential. Proper processing, value addition, storage of marketable surplus and excess produce during glut period in production catchment have potential to reduce the losses and stabilize the prices as well. Improvements in farm operations are essential and needs to be addressed immediately. R&D interventions are needed for controlling losses during harvesting, threshing, sorting/grading and retailer level storages. The problem of insect-pest particularly in pulses and oilseeds storage need to be dealt with integrated pest management strategies. Location of markets, marketing practices, handling methods and policies needs to be looked into for changed scenario of demand and supply pattern.Training, demonstrations, incubation and entrepreneurship development, skill development and appropriate publicity of proven post-harvest technologies coupled with favourable policies may help in this regard. Investment in post-harvest infrastructure and mega Food Park is the need of hour for further reduction of losses.The losses were found to be higher in eastern plateau and hills region (Tribal belt of India comprising Jharkhand, Chhattisgarh, Odisha, the eastern part of Maharashtra) and east coast (coasts of Odisha, Andhra Pradesh and Tamil Nadu). Proper training to farmers and other stakeholders and infrastructure, therefore, are essentially required in these regions.

Vision 2025 - CIPHET stated that only 2 per cent of the horticultural produce is being processed as compared to more than 80 per cent in Philippines and Malaysia for domestic consumption as well as for export. Therefore the sensitization of farmers/producers isnecessary about the importance of quality, reduction of cost at every level through reduction in losses, appreciation of good farming practice and need for understanding and observation of codes and standardsfor maintaining high quality of raw produce so essential forstorage, further processing and packaging. Continuedresearch and developmentsupport to agriculturalsector with respect to engineering and technology inputs should be provided. For thehigher production of milk, eggs and quality meat products, thedesign of animal and poultry shelters, fishponds, slaughterhouses, etc. need to be improved on scientific lines. In this context, R&D efforts for feed and fodder management are also expected to assume greater importance.

2.7 Goal 13. Take urgent action to combat climate change and its impacts - role of Agricultural Extension

Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly.People are experiencing the significant impacts of climate change, which include changing weather patterns, rising sea levels and more extreme weather events. The greenhouse gas emissions from human activities are driving climate change and continue to rise. Poorest people are most affected by climate change.

Temperature rises, changing rainfall patterns and extreme weather events pose a real threat to global food production, but agriculture has a major role to play in responding to climate change. Investments in all sectors of agriculture can simultaneously support climate change adaptation and mitigation while improving rural people's livelihoods.

In the immediate future, climate change will affect food security, water availability, agricultural incomes, livelihood security, including shifts in crop production zones of across the world. Throughout the 21st century, climate change impacts are projected to slow down economic growth, make poverty reduction more challenging, further corrode food security, and prolong existing and create new poverty traps. In India, the projected countrywide agricultural loss in 2030 would be more than US$7 billion, which will severely affect the earnings of a large part of the population if cost-effective climate resilience measures are not implemented effectively (ECA, 2009).

Adaptation to climate change is information-intensive as farmers, herders, fishers and foresters need the ability to understand local climate impacts and vulnerability, which determine planting cycles and other management interventions.

Without mitigation or adaptation measures, agricultural production may fall by as much as 2 percent each decade by the end of this century as a consequence of rising temperatures.Agriculture and deforestation account for about a quarter of global greenhouse gas emissions from human activities.Efficient soils provide the largest store of terrestrial carbon; their preservation or increase could contribute to climate change mitigation.From farming to forestry and fisheries, agriculture greenhouse emissions have nearly doubled over the past 50 years and may increase by another 30 percent by 2050.

Millions of people across the world who depend on the production, marketing and consumption of crops, livestock, fish, forests and other natural resources are subjected to disasters and crises. Disasters are increasingly frequent and steadily more complex, as the supporting mechanisms from public and private systems are often inadequate and not very responsive. Food and nutrition threats to livelihoods comprise of four main categories (FAO, 2013).

a) Natural disasters are the resultants of natural hazards, which cannot be eliminated, impacting complex social-economic-political systems. They include extreme weather, tsunamis and earthquakes, and drought. India has vast experience of drought, so at the macro-scale the Government has progressively improved the resilience of the national food system. The drought year of 2009, which was more extensive than that of 2002-3, nonetheless had less impact on domestic cereal availability than had the earlier year, despite global cereal price spikes. Drought response, however, at district, block and especially local scales should become more precise and timely if livelihoods of marginal, small and particularly rainfed farmers are not to be damaged over the medium term. Implementation and local institutions also remain weak. While short-term tsunami relief was well-handled in 2004-5, the livelihoods of coastal, especially small artisanal fishing communities, have not yet recovered.

b) Food chain emergencies arise from transboundary or technological threats (e.g. transboundary plant, forest, animal, aquatic and zoonotic pests and diseases, food safety events, chemical, radiological and nuclear emergencies and industrial pollution). India has long been an essential and effective partner in Desert Locust information and control systems nationally and globally, using expertise honed in the 1980s and 90s to quickly manage the latest plagues of 2004-6. The successful model of surveillance, epidemiological analyses, international on-line data sharing and coordinated response, however, has not been adequately extended to other transboundary threats, particularly of animal (including zoonotic) diseases like Highly Pathogenic Avian Influenza, Peste de Petits Ruminants, Newcastle disease, and Foot and Mouth Disease. Veterinary services do not sufficiently reach the majority of small ruminant –holding communities, nearly all in rainfed areas, where over 70% of managers are women.

c) Socio-economic crises are becoming more frequent (e.g. the 2008 global food price crisis and more recent financial shocks). India is a founding member of the global Agricultural Monitoring and Information System, a G-20 initiative. The past year's innovation of a quarterly national Agricultural Outlook is already gaining wide praise. Extending the benefits of this kind of monitoring and forecasting to State, district and local communities to increase their resilience is the next challenge.

d) Violent conflicts persist at local levels. About 20% of India's districts, nearly all rainfed, are affected by insurgency, and this definitely is related, both as cause and effect, to weak resilience in local food scarcity systems.

The potential adaptation strategies in agriculture are developing climate-ready cultivars which are tolerant to multiple stresses (drought, flood, salinity, heat, disease and pest infestation) as well as efficient water and nitrogen user; diversification of crop and livestock varieties (Sing et al., 2014); changes in land use management practices; adjustment of planting dates to minimize the effect of temperature increase and avoiding heat stress at flowering period; use of resource conserving technologies (e.g. zero tillage, direct seeded rice, laser assisted precision land levelling, brown manuring with Sesbania, unpuddled mechanical transplantation of rice, raised bed planting, site-specific nutrient management, etc.); Integrated Pest Management (Sendilkumar, 2012); efficient water management (e.g. drip, sprinkler and laser aided land levelling); Integrated farming system; waste land management and rainwater harvesting (reduce run-off loss and recharge groundwater); adoption of agroforestry (Prasad et al., 2014); mixed cropping (Sing et al. (2014); better weather forecasting and crop insurance schemes (Sendilkumar, 2012);harnessing Indigenous Technical Knowledge (ITK) of farming community. Disaster preparedness on a local community level could include a combination of indigenous coping strategies, early-warning systems, and adaptive measures (Paul and Routray, 2010).

IPCC (2014) suggested that adaptation is place and context specific. There is no single appropriate approach for reducing risks across all settings. Planning and implementation of adaptation can be enhanced through complementary actions across levels, from individuals to governments. Decision support is most effective when it is sensitive to context and the diversity of decision types, decision processes, and constituencies.

Overall, India has evolved out of the short-term relief-response-dominated dependency trap in which most countries are still stuck. India also maintains and mobilizes food stocks, such as of rice and wheat, which it can then send to nearby countries, including during official bans of commercial exports as in the 2008-9 food price panics and spikes. Domestically, India has a well developed and resourced National Disaster Management Authority. Its stated objective currently is to expand from a traditional concentration on a tested suite of reactive strategies centred on concepts like "famine relief" which has been codified since 19thcentury, toward strategies for preparedness, building back better and more holistic rapid response. The Government's position, as demonstrated clearly after the 2004 Indian Ocean tsunami, is neither to request nor accept traditional offers of short term disaster relief from international partners (FAO, 2013).

While FAO's global plan "adheres to the 'twin-track' approach of taking immediate steps to support food security and nutrition, while simultaneously addressing the underlying factors driving disasters and crises" India's competence and performance in the immediate, relief-oriented steps of disaster management are already of world standard.

Special attention should be paid on strengthening India's national, state, and local preparedness, early warning and response, and analyses towards building (back) better systems to ensure livelihoods that are more resilient. An essential part in every area is the local community's knowledge, experience, and adaptive capacity. Building and strengthening local institutions, keyed to their local environment, but linked to larger networks at block and district levels, is a necessary priority for increasing resilience. There are four current and potential areas of this support:

a) Better systems-based forecasting of drought in [near] real-time at district, block, and village levels, so that government support can be better and earlier targeted towards protecting livelihoods in drought-afflicted areas; facilitate for MGNREGA (or RKVY) to build better water harvesting or water conserving/managing public works;

b) Livelihoods-oriented recovery and rehabilitation for building back better production systems and restoring resources as in case of local coastal artisanal fishing communities following tsunamis and cyclones;
c) Improving monitoring, forecasting and response/ mitigation of risks associated with trans boundary threats from animal diseases and plant pests applying lessons and practices from Desert Locust to other threats such as Highly Pathogenic Avian Influenza; and
d) Designing (piloting) a national strategy for bovine animal identification to enable India better to define/establish and defend Foot-and-Mouth Disease – Free Zone to improve epidemiological analyses, forecasting, response to outbreaks, as well as international market access.

2.8 Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss - role of Agricultural Extension.

Healthy ecosystems protect the planet and sustain livelihoods.Terrestrial and inland freshwater ecosystems, in particular forests, wetlands, mountains and drylands, make vital contributions to biodiversity and provide myriad environmental goods and services. They contribute to decent livelihoods while providing clean air and water, conserving biodiversity and mitigating climate change. Forests and rangelands sustain a range of industries, generate jobs and income and act as a source of food, medicine and fuel for more than a billion people.

However, across the globe, natural resources are deteriorating, ecosystems are stressed and biological diversity is being lost. Land use changes, including deforestation, result in a loss of valuable habitats, a decrease in clean water, land degradation, soil erosion and the release of carbon into the atmosphere. They contribute to the loss of valuable economic assets and livelihood opportunities.

The SDGs move beyond pure conservation to recognising the importance of sustainable management of natural resources in ensuring the long-term survival of our planet. Achieving the SDG targets requires data and assessments of the state of the planet’s resources, so that policy responses are based on sound evidence.

The sustainable use of agricultural biodiversity is likely to be particularly beneficial for small-scale farmers, who need to optimize the limited resources that are available to them and for whom the access to external inputs is lacking due to financial or infrastructural constraints. Benefits on a large-scale can also be achieved by focusing on improvements relevant to large commercial farmers and conservation agriculture has already been effective in this respect.

Galluzzi et al., (2011) recognized number of approaches that use biodiversity for food and agriculture to achieve sustainable increases in productivity and provide a sounder ecological basis for agriculture. The use of multi-species and multi-breed herds and flocks is one strategy that many traditional livestock farmers use to maintain high diversity in on-farm niches and to buffer against climatic and economic adversities. Species combinations also enhance productivity and yields in aquatic systems. Crop rotations, intercropping and growing different varieties of a single crop have all been shown to have beneficial effects on crop performance, nutrient availability, and pest and disease control and water management. Multi-cropping, intercropping, alley farming, rotations and cover cropping are all ways of combining crop species that have positive effects on productivity and yield stability. Integrated pest management practices are well-established and have been adopted by millions of farmers throughout the world. Successful programmes have shown, for example, that conserving arthropod biodiversity by helping increase local understanding of how agroecosystems function is a key ingredient of effective pest management in rice production. These diversity-rich approaches, together with others such as increased use of agroforestry species, the further development of home gardens, the use of fish–rice systems and the improved maintenance of pollinator diversity, demonstrate the contribution that biodiversity for food and agriculture can make. At the same time a richer diversity of products from diverse production systems can make a significant contribution to improving the nutritional status and health of both the urban and rural poor around the world.

It is incorrect to think of people-forest relationships in terms of a one way relationship, with people simply using or depending on forest resources. It is important to recognise the active involvement of people in forest management (Fisher, et al., 1997).The National Forest Policy 1988 of the Government of India envisaged people's involvement in conservation, protection and management of forest. It emphasized that forest produce must go first to the people living in and around forests. With the active support of local organizations people's participation in forest management, was initiated and is generally known as Joint Forest Management (JFM) in India. Now, it is recognized that participatory management of forests is key to sustainable development for people and forests. Lal et al., (2016) investigated the various factors responsible for low participation of locals in the planning, implementation and maintenance of JFM programmes in the tribal district (Kinnaur) of Himachal Pradesh. The main factors responsible for low participation of locals in JFM activities were lack of awareness about participatory forest management (66%), lack of co-ordination with forestry officials (64%), non-availability of routine funds (56%), lack of training and visit programme (56%), clash between agriculture and JFM activities (54%), etc. Farmer's knowledge about Joint Forest Management (JFM) in Uttarakhand (Mishra and Bharadwaj, 2007) indicated that knowledge of the respondents about activities and anticipated benefits of Joint Forest Management is quite low. The reasons of low level of knowledge were improper campaign for popularization of the Programme, low education of the respondents, their business and less interaction with Village Forest Committee (VFC) members.

India is among the first countries in the world to have passed legislation granting Farmers' Rights in the form of the Protection of Plant Varieties and Farmers' Rights Act, 2001. India's law is unique not only because of its far-reaching rights for farmers, but also in that it simultaneously aims to protect both breeders and farmers. This attempt to evolve a multiple rights system could, however, pose several obstacles to the utilization and exchange of plant genetic resources among farmers. India has framed a unique legislation, but still faces the task of implementation (Ramanna, 2006).

III. CONTEXTS AND CHALLENGES

Indian agriculture has been entrusted with the onerous task to feed 1.25 billion people (FAO, 2013). As against 6-8 per cent of overall annual economic growth, the agriculture sector grew by 2.5%, 2.4% and 3.3% respectively in the 9th, 10th and 11th Plan periods. The crop sector grew by 1.8 to 2%, although horticulture, animal husbandry and fisheries have registered 4.5 to 6% growth. While the share of agriculture in overall GDP has declined from 23.4% in the IXth Plan to 14.2% at the end of XIth Plan, continued dependence of crores of rural people on agriculture indicates that a vast rural populace did not benefit from the runaway growth of the overall economy. This calls for urgent strategies to meet the development needs of crores of small and marginal farmers and other disadvantaged groups for more inclusive and faster growth.

The major gains made in food production have seriously eroded the natural resource base across major food producing states. Land, water, soil health and biodiversity resources are under pressure due to competing demands for other uses. Across the country, ground water aquifers are depleting fast and in many cases this is irreversible. Continuing imbalance in the application of fertilizers has adversely affected soil health. Thus any plan to increase production to meet the rising demand for food requires a proactive transition to more sustainable agriculture.

Average farm size in India has now shrunk to 1.30 hectares. Small and marginal farmers now comprise 83% of total land holdings occupying about 41% of area under all operational holdings. In India, nearly 60% of cultivable area is in rainfed ecosystems typically characterized by vulnerable natural resource bases and supporting 40% population that is predominantly poor; these lands contribute to 40% of food grain output and sustain about 60% of the livestock population. Focussing on water conservation and sustainable utilization is the key for development of such areas. It calls for alternative thinking in policy framework, investment and delivery mechanisms to focus on development of rainfed areas and their people by adopting resource conservation techniques.

Given the millions of livelihoods dependent on agriculture, innovative approaches are required so that this sector helps in achieving food security and reducing poverty. This requires formulation of well-articulated policies, development of appropriate infrastructure, setting up institutions, encouraging investment in rural areas, and adopting sustainable management of resources which would benefit the local communities by generating income and providing employment opportunities.

Both medium to long term investments in water and agriculture for adaptation and mitigation are required to be assessed through an ecosystem approach for climate-smart agriculture. As water and agriculture are intrinsically connected, interventions in one sector or system may have implications for others.

Small ruminant rearing is a key livelihood activity for small farmers and landless families. Around 70% of goats and sheep are reared by such poor groups with strong involvement of women. Women's participation in agriculture has been going up due to several socio-economic factors. Therefore, there is need for intensive capacity building and empowerment efforts for women and women's groups at every level that includes re-orienting farm services to improve their access to credit, technology, inputs, markets and gender-friendly mechanization.

Overall, the key principles guiding new approaches to improving sustainable production systems should derive from increasing resource use efficiency, management of ecological, social and economic risks, identifying and enhancing the role of ecosystem services, and facilitating generation and access to required information.

IV.CONCLUSION AND WAY AHEAD

In 'mixed economies' like India, where public and non public sector entities exist in competition or cooperation, a pluralism in agricultural extension can be well translated to the welfare of the farmers. Given the scale and complexity of Indian agriculture, with many small farmers, remote regions and varied farming systems, a pluralistic extension system will reach farmers more effectively than a single method of funding and delivery. Opportunity for choosing among competitive service providers notwithstanding, coordination of different actors remains the major challenge. Experiences from the field point out that convergence can be operationalized through farmers' organizations of various formats on demand basis, to be facilitated by both public and private extension service providers. Further, federating them will add to their sustainability.

Vertical silo approach to the development process has its limitations of not impacting on the larger areas or population. Therefore, convergence of programmes and schemes horizontally, down the lines is required especially below of the blocks and built on communities' local knowledge. The major challenge therefore would be to reorient the district and the block functionaries for the task and provide them opportunities for experience sharing across the departmental boundaries. There should be coherence between MNREGA conservation works and agricultural development interventions. Resource conservation technologies promoted through IWMP should be backed up by integrated farming interventions for obtaining better synergy. The C-DAPs must provide adequate opportunities for inter-departmental learning and indicate clear line of action for convergence at the field level so as to obtain greater and meaningful partnerships of the departments and communities.

The extent of funding support for agriculture, rural development, and conservation of natural resources, fisheries, environment and forest, PRI programmes during the XIIth Plan period has gone up substantially. However, what matters is how effectively these programmes are designed, drawn up and delivered to the targeted population for intended results (FAO, 2013).

A few suggestive steps as mentioned could strengthen the approach and reach of extension in attaining development agenda.

Getting closer to the farmer, penetrating the District, Taluk and Village: Both at national and sub-national level, departments have often been found to underserve the purpose of the farmers and communities – specially the small and marginal farmers. Many state departments do not have a clear organogram reaching out to the farmers at the village level; and if at all, they do, these are mostly on papers. Designing and supporting one or two state departments and making them fit-for-purpose will go a long way in devising a model- among others- for appropriate Staffing levels; ways to being proximate and accessible to farmers with strategy to penetratee and deliver till the last mile; and making farm extension realistic and equitable. Making the State apparatus more accessible to farmers would be the driving motivation for a partnership like this.

Initiating demonstration pilots in select blocks with a mix clientele: This is for innovations and convergence sites for maximum impact on the poorest. It may include working on supporting MGNREGS across the spectrum i.e. from shelf of projects planning, to workers' institution building, model work-site facilities building, building processes and institutions of accountability and grievance redressal i.e. social audits, vigilance committees and responsive Employment Generation Scheme administration capacities. These could be done with a focus on the project portfolios with community asset building, promotion of commons, land remediation, water-sheds enhancement, environmental services and food security impact.

Designing sustainable pilots by developing appropriate linkages: institutional convergence with MGNREGA, NRLM, KVK, ATMA, C-DAPs with other partners (such as GEF, WB, IFAD) will be vital for for livelihood promotion, upstream-downstream dialogue, conducting adaptive research in select districts and blocks.

Advocate for Zero Hunger challenge: Initiating a pilot model in specific districts/ blocks under rainfed conditions, and draw lessons for efficient implementation of the NFSB. Harnessing the evidence on local food security circuits including innovative and alternative approaches to deliver food security, supporting pilots, demonstration and scaling up to create an enabling learning environment for improved, effective, sustainable and equitable access to and management of food and nutrition by the poor and disadvantaged groups

Supporting collectivisation of farmers/ producers: small farmer's organization through innovative partnership to be designed and developed for better access to input and output markets as well as rural empowerment for the small and marginal farmers from disadvantaged groups

Better systems-based forecasting : it is a kind of early warning system and [near] real-time forecasting model for drought-afflicted areas at district, block, and village levels to draw useful global best practices and lessons from FAO's IPC, so that government support can be better mobilized and targeted towards protecting livelihoods; facilitate integration of food distribution and agricultural services; harnessing the ppotential for MGNREGA (or RKVY) to build better water harvesting or water conserving/managing public works for greater resilience.

Creating Convergence with a new optic and framework and renewed effort to achieve better and harmonised results, for areas such as, working with the National Rural Livelihoods Mission on small ruminants, poultry, market access et al in resource-poor ecosystems in selected rainfed areas; bringing in global experiences and best practices to build selective partnerships for more effective implementation of flagship schemes and programmes, such as NRLM, MGNREGS, PDS, MDM, ICDS, BRGF, RKVY; and supporting structure, institutions and processes for better convergence with nutrition determinant factors like drinking water and sanitation, ICDS and the school feeding programme of MDM at the point of delivery i.e. closest to the ground at village and panchayats.

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DISRUPTIVE TECHNOLOGIES - BIG DATA AND INTERNET OF THINGS IN STRENGTHENING EXTENSION ADVISORY SERVICES

Shaik N.Meera

Future EAS needs to strategize convergence of big data with disruptive technologies such mobile/cloud computing, Internet of Things (IoT), location based social (LBS) networks etc. Highly personalized extension advisories are possible in India only when EAS embraces big data analytics and linking them to unique *Aadhaar (12 Digit unique identification number of Indian citizens)* numbers of farmers. Supplemented with the digitized land records and soil health status linked with GPS coordinates, the future of input supply can undergo a radical transformation. Big data in EAS will integrate information provided by farmers, players in the agri-food chain and markets (e-National Agricultural Market), which can be used to enhance productivity, reduce risk, increase resilience and improve profitability. This will bring new values to farming with the small and marginal farmers getting maximum benefit out of such strategies.

Last two decades have witnessed several digital pilot projects in India. Now there is a need to bring rapid transition so as to remain relevant and cater to the emerging - information and service needs of farmers. With the proposed EAS framework, it is expected that farmers will be in a position to pull the knowledge and services on real time basis from a variety of sources. If this is realized, from seed to harvest, post-harvest to storage and marketing, every farming decision can be supported with the digital extension strategies.

DISRUPTIVE TECHNOLOGIES

A disruptive technology is an innovation that creates a new market and value network, and eventually disrupts an existing market and value network, displacing established markets, leading firms, products and alliances. The term was defined and phenomenon analyzed by Clayton M. Christensen beginning in 1995.

I see this in relation to extension systems in two ways. a) Bringing disruption in an extensionists' functioning that includes transformed services, new innovations in the extension processes and b) Emergence of new players in EAS with disruptive innovations. Through farmers' perspective, it is a situation where extension systems cease to function in the usual manner, and starts responding to rapid changes that may transform the very nature of the organization. A disruptive innovation in agriculture will allow small and marginal farmers' access to technologies and/or services that were historically inaccessible to them or accessible at higher costs only. For instance, rural communities are now able to access e-commerce goods and other services such as railway tickets, as digital platforms to these are available. Similarly, goods (agri-input, credit) and services (extension advisory, marketing) are yet to be accessed in agriculture, as there is no disruption.

There is a difference between bringing improvements to the existing extension system with digital technologies and bringing radical transformations into the very nature of extension services. To explain in easy terms, personal computer (PC) displaced the typewriter and forever changed the way we work and communicate. We are not talking about improving the efficiency of type writer here. Instead, we have witnessed a new form of communication and publishing. Social networking has had a major impact in the way we communicate. It has disrupted telephone, email, instant messaging and event planning. Smartphones with mobile apps disrupted pocket cameras, MP3 players, calculators and GPS devices among many others.

Cloud computing has been a hugely disruptive technology in the business world, displacing many resources that would conventionally have been located in-house or provided as a traditionally hosted service. The next and most radical generation of mobile communications – fifth generation (5G) – is three years away from now (http://www.gsma.com/network2020/technology/understanding-5g/). The 5G may radically change the technologies and business models of the mobile telecommunications industry. It will have positive consequence in primary sector like agriculture and extension systems will have to gear up to develop frameworks for best use.

THINKING BEYOND CONVENTIONAL DIGITAL EXTENSION PILOTS

Are we ready for digital disruption in extension? Or do we continue to initiate new digital extension pilots? The moot point is eventually how fast we can disrupt (in a positive way) the way extension organizations work. Are extension systems working towards capitalizing on the potential efficiencies, cost-savings or new opportunities created by low-margin disruptive technologies?

Online and mobile banking makes it possible to almost completely bypass the physical bank entities and human bank teller. Amazon, Flip Kart and Olx have revolutionized the classified advertisements and person-to-person sale of all matter of items, including farm equipment. Big basket has changed the way we buy fresh vegetables and fruits.

Initially big organizations dismiss the value of a disruptive technology because it does not reinforce current organizational mandates. I see similar indifference in extension organizations as well. Improving the efficiency of extension systems had been attempted with a series of digital pilot projects in India (Meera, 2013).

One such digital pilots rolled out in 2016, at the national level in India, is eNAM (www.enam.gov.in/). We are aware of National Agriculture Market (NAM) - a pan-India electronic trading portal which networks the existing agriculture produce market committees (APMC) to create a unified national market for agricultural commodities. The NAM Portal provides a single window service for all APMC related information and services, including commodity arrivals and prices; buy and sell trade offers and provision to respond to trade offers, among other services. While material flow (agriculture produce) continues to happen through *mandis*, an online market reduces transaction costs and information asymmetry. This is an essential condition for disruption. But not a sufficient one.

Uber app is one of the best examples of disruptive force seen in the taxi industry that could be used to understand the disruption in EAS (Box 1).

Box 1: Uber app
The app allows a user to submit a request for a ride. Uber-approved drivers in the area are notified by the app and respond. Payment is not passed from rider to driver – it's done via the

app which accesses the user's credit card. The app also makes use of smartphone GPS capability to show you exactly where and how far away the prospective Uber ride is. The app itself and the technology behind Uber are quite simple, but it provides a completely new approach that challenges how taxi services have been obtained for decades.

Now replace the word Uber App with Input supply App. Replace taxi industry with the supply chain management (specific to input supply). Keep in mind the farmer's need to access extension advisory with integrated supply chain management. You have the answer! Now please read further:

Input supply App can become a disruptive force in the supply chain management in agriculture. The app allows a user to submit a request for a specific input based on the personalized advisory. Approved input suppliers in the area are notified by the app and they respond. Payment is not passed from farmer to input dealer – it's done via the app which accesses the farmers *Adhaar* Card / Unique ID card linked to bank account number / credit card / subsidy vouchers (please see Zoona vouchers program, Box 2). The app also makes use of smartphone GPS capability to show you exactly where and how far away the prospective input dealer / field officer of a private company is. The app and the technology are quite simple, but provides a completely new approach that challenges how input supply services have been obtained for decades. This is disruption!

Box 2: Zoona Vouchers in Zambia
Electronic Prepaid Vouchers for Input Purchases was piloted in Zambia that enables farmers to pre-pay for inputs. This system was developed by Zoona, a Zambian company that develops and offers electronic financial transactions systems. Each prepaid card contains a code that is electronically registered at the point of purchase, together with the farmer's unique national identification and mobile phone number. Upon registration, the network sends the farmer an SMS that validates the purchase and notifies them of the date and location where the inputs can be picked up. Prepaid vouchers can help input supply companies to increase sales during the period that farmers/ customers have resources available. The electronic registration of farmers' prepaid vouchers and their profile also enables companies to compile a database of customers for targeted SMS-based marketing, information and product promotion. Participating retailers can benefit by stimulating sales during traditionally slower periods. Farmers benefit by purchasing seeds at a discount and by gaining assurance that they will have the seeds they need during the planting season.
(Source: http://pdf.usaid.gov/pdf_docs/PA00J7PB.pdf)

Now you replace the word Input supply App with Farm Marketing App. Farm Marketing App can become a disruptive force in the way farmers sell their produce. The app allows sellers to submit a request for selling a specific produce / commodity. Approved buyers in the area are notified by the app and respond. Payment is not passed from buyer to farmer– it's done via the app which accesses the buyers *Adhaar* Card / Unique ID card linked to bank account number / credit card. The app also makes use of smartphone GPS capability to show farmers exactly where and how far away the prospective buyer is. Similarly it will show buyers how many prospective sellers are available in nearby villages and how to virtually pool the marketable surplus (remember the Olx experience?). The app is quite simple, but it provides a completely new approach that challenges how agricultural marketing services have been addressed for decades. This is disruption!

Individuals are the backbone of innovation and many entrepreneurs are doing innovation in their own ingenious ways with disruptive technologies. Often recognized as what is called "Jugaad Innovation", it is a very flexible, frugal and un-structured method of generating original ideas and solutions. We have enough of pilots, but what we need is a disruption in EAS.

BIG DATA IN AGRICULTURAL EXTENSION

Big data is extremely large data sets that may be analyzed computationally to reveal patterns, trends and associations, especially relating to human behavior and interactions. I guess if there is one sector that can harness this functionality to the maximum, it would be agriculture. Within agriculture, EAS can do wonders with big data analytics. The EAS intentionally or unintentionally work on empirically driven data - but such data, information and knowledge continuum, could not be managed till now, because the data was not digital.

Big data is being used to arrive at shocking and seemingly innocuous conclusions like “a car painted orange is highly likely to be in good shape for a used car deal” or when airline ticket prices are going to be favorable to the buyer. We can have several applications such as estimating rainfall or market prices by manipulating numerous data points.

Farmers have been managing their land with extension advisories coming from multiple sources. But neither the extension advisories nor the decision making is based on the microscopic analysis of data from each farm. If such huge data is collected, collated and processed with big data analytics and real time advisories are pushed, then we can realize much talked about personalized advisories.

From pre-production (credits, input supplies) to production (varietal to management) and to post-production (processing and marketing), extension systems can harness big data platforms for better and informed decision making. Agriculture may not immediately come to mind when considering opportunities for the application of big data particularly in Asia and Africa where small and marginal farmers dominate. But to begin with, it can offer solutions to EAS and private agri-business firms. Micro level data (such as soil health status, soil temperature, rainfall, moisture content) pooled at the village, block, district and regional level could serve as the big data for planning agricultural interventions. **Extension informatics (personal, field history linked to advisory) can be achieved with predictive modeling. Remember that Google advertisements are customized based on your search history and access IP? Can you achieve this for providing personalized/ plot specific advisories?**

Data visualization (visual representation of data in charts and graphs) has become popular in recent years. Organizations have invested in the production of data visualization, committing to the belief that visualization is an effective form of communication. Imagine the use of such visuals at the joint director agriculture office at district level or private sales executive at regional level, to plan the demand and supply, and product (varietal) targeting, based on empirical data.

Connecting extensionists’ smartphones to a cloud-based analytics engine, can give farmers customized products and increase efficiency of their services. This technology will be more suitable for developing countries, characterized by the pre-eminence of small farms with very low investment capacity and which rely on intermediaries to a greater extent than farms in developed markets. Better market, crop and input information could boost yields and returns for farmers. For private firms, inventory tracking and product traceability with GPS vehicle tracking (telematics – like in case of ePDS) will result in better supply chain management.

The big data analytics in extension will bring significant changes in the personalized, field specific solutions along with pre-production to post-production service needs of farming community. It will lead to higher yields, lower input use per hectare and lower cost of cultivation. For example, the magnitude of yield improvement from commercial precision fertilizer application, according to various agribusiness market participants, ranges from 10 to 15 per cent. If effectively implemented (in combination with Internet of Things (discussed below), this will help small and marginal farmers in every step from credit access to marketing.

INTERNET OF THINGS (IOT)

According to *Industry Trend Analysis - IoT & Big Data In Agribusiness: Driving Future Sector Growth - NOV 2016***,** the integration of Internet of Things (IoT) and big data technology in agriculture will pick up in the coming years, and be a major factor behind future improvement in global yields. (http://www.agribusiness-insight.com/industry-trend-analysis-iot-big-data-agribusiness-driving-future-sector-growth-nov-2016)

'Internet of Things' (IoT) is defined as connecting 'things' that can passively or actively monitor, collect and exchange data over a wired or wireless communication network. The IoT can have positive consequences on farm production, soil health, water, nutrient management, pest management, traceability and tracking, supply chain management, processing, transportation, storage, retailers, inventory management, food safety etc. The IoT can provide farmers with on-demand information based on the differential contexts that can be sensed through a network of IoT sensors. Large scale utilization of IoT systems in extension organizations will optimize efficiency of advisories and supply chain management.

Dairy and livestock farmers have been using radio frequency identification (RFID) to enable tracking of individual animals' health and levels of production for quite a few years. There are many other potential areas for development, including sensor networks to monitor soil and crop conditions, equipment monitoring and automation (self driven planters/ harvesters etc.). These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices.

While in developed countries (particularly where landholdings run into '000 of hectares), these technologies are used by farmers directly, recommending the same for developing countries with smaller landholdings (with no need to remotely monitor fields), is like barking up the wrong tree. I see potential of the IoT more at the level of extension professionals (both public and private) rather than at field/ farmers' level. For example, customized advisories can be planned for a village/ cluster of villages based on sensor data received on irrigation (channels), pests surveillance/management, weather based agro-advisories, real time contingency plans, animal disease out breaks etc.

For instance, municipal dustbins with sensors send alerts to garbage collectors (truck drivers) to pick them up. Similarly sensors can send alerts to extension professionals about the possible outbreak of a pest / any other exigency under its jurisdiction. This is one way of reducing the higher costs of face to face contact methods of extensionists and will appropriate the human resources in extension systems.

To facilitate the purchase of farm inputs and selling of farm products, the smartphones of buyers' and sellers' can be equipped with IoT technologies such as Near-Field Communications (NFC), that facilitates the purchase of products without using cash. Mobile internet and low-cost sensors could enable farmers to interact directly with the consumers, cutting off middleman. Kenya has developed M-Pesa kiosks in the rural communities for mobile money transfer.

With the use of IoT, decision makers can undertake appropriate agricultural interventions through large scale extension programs. These technologies can be integrated with a central system and help disseminate relevant personalized advisories to farmers. This can be used to identify pest outbreaks and map other trends. IoT systems can track farmers requiring transport to carry their farm products to distant markets. Similarly IoT will help consumers and traders with traceability of agricultural commodities.

LOCATION BASED SOCIAL MEDIA (LBS)

The inclusion of mobile positioning in social networking services that lets people know where they are at any given time may be termed in short as Location Based Social Media (LBS). **LBS media monitoring could be used for segmentation of data from social networks (e.g., Facebook, LinkedIn and Twitter) by geographical location to identify patterns. For EAS,**

LBS networks present unprecedented large-scale check-in data to describe a farmer's (extensionist's) mobile behavior in spatial, temporal and social aspects. Based on the trends, contingency action plans and time critical advisories can be made available to farmers.

Several LBS could be provided - such as resource tracking along with dynamic distribution, finding nearest farmers willing to transport together to fetch higher market prices, weather fore-warning, proximity-based notification (push or pull) of extenionists/ experts targeted advertising

THE FRAMEWORK

There is never going to be a blueprint for how to proceed with disruptive technologies in extension. As stated by Hall (2016), what is clear is that business as usual is the anti-thesis of disruptive innovation, and as evident from e-commerce sector, in the early stages of disruption, the lower-performing technologies only meet the needs of a small segment of existing customer base. In most of the digital pilot projects initiated across the globe during 1990 - 2002, this was witnessed in agriculture sector.

As new technologies evolve, its efficiency improves and the innovation meets the needs of additional customers across the industry. Eventually, the original firms are driven out as the disruption meets the needs of the mainstream market. In the case of EAS, the disruption may not be to the magnitude of e-commerce (though in agri-commerce this may be seen).

The EAS Framework for harnessing disruptive technologies may be explored with three distinct areas viz., pre-production, production and post-harvest (Please see Fig 1)

Pre-production:
Weather details, aberrations, climatic factors, crop selection etc., in extension advisory provision depend largely on remote sensing, geographic information systems, management information systems, predictive modeling solutions and high impact knowledge management models. This also requires harnessing big data analytics and at times IoT (for e.g., advisories based on soil temperature, humidity). Mix of farming systems, various government schemes, access to credit and insurance could be handled with the emerging technologies to give personalized solutions to farmers and here, digital networking solutions will be of great help.

Production:
Sowing apps, cooperative land preparation, input management, water fertilizer management and pest management can be effectively handled by developing sensory devices, proximity devices, e-commerce/ m-commerce platforms/ applications, digital networking solutions, big data analytics, smart mobile apps and high impact knowledge management solutions.

Post-harvest:
Marketing, food processing, packing, storage and transportation will play an important role in future farming. Perhaps these factors will drive global agriculture in the coming years and this will have a bearing on the way small scale farmers operate. Digital cashless transactions, transactions linked to unique IDs and bank account numbers, linking credit and marketing with bio-metrics will give EAS leverage over the past efforts. Digital networking solutions, risk sharing systems for agricultural lending, agricultural value chain networks, e-vouchers distributed through mobile interfaces, will transform EAS strategies in the developing world.

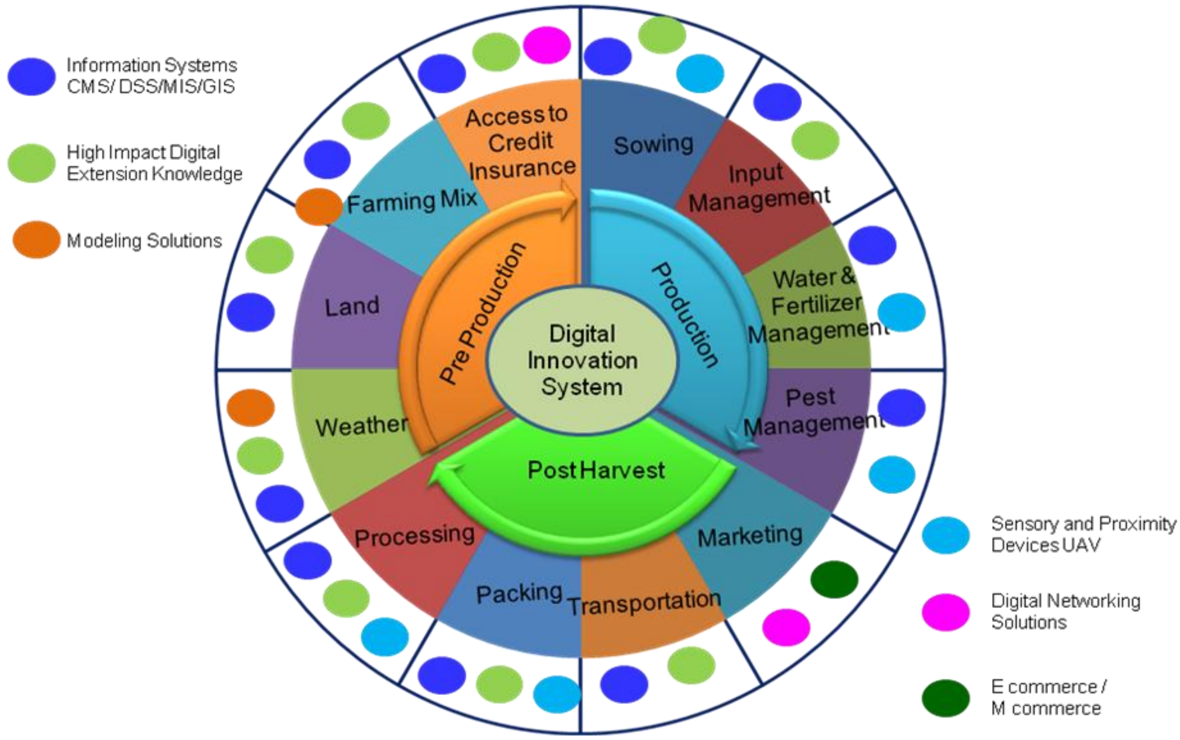

Fig 1: Digital Framework for Disruption in EAS

I will discuss the disruptions in each of the EAS services in a separate blog, but for the time being I may like to give an example of eNAM.

Initiatives like electronic National Agriculture Market (eNAM) portal that provide a single window service for all market-related information and services is an essential, but not sufficient condition for bringing disruption. Anyone with basic understanding of agricultural marketing would know that price information (or price prediction as well) is only an essential condition but not sufficient condition for realizing the benefits to smallholder farmers. If a farmer gets to know about higher price in a distant market, it is not economical to lift his produce to such market. In such cases there is a need for market disruption (with the technologies discussed) to realize the benefits to farmers. This can be realized in many ways.

Virtual pooling (that was tried to some extent in ITC's e-choupal in India) will help pool the marketable surplus within farmers in proximity, who wish to collectively market in distant markets. Who knows there may be commission agents/farmers with digital skills - transforming themselves to take advantage of this win-win situation (remember local retailers taking advantage of online marketing). Together with virtual polling, a series of e-Voucher platforms across the country could enable extension agencies to provide specific non-cash services. Such e-Vouchers are much easier to track than cash vouchers, and they also help avoid fraud, which is a common problem with paper vouchers. Think about joining this with the online soil health cards, Nutrient Manager App, optimum fertilizer recommendation and fertilizer supply, using e-Vouchers. This will dramatically improve fertilizer demand and supply dynamics.

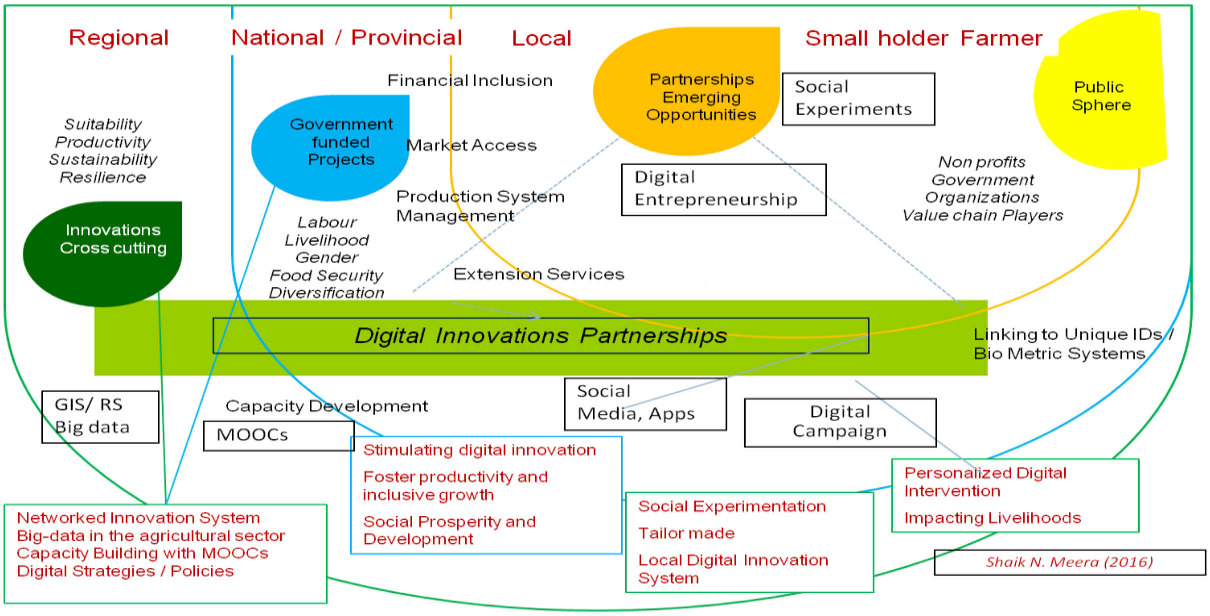

Fig 2: Digital Framework for Disruption in EAS

Another interesting aspect to look is the effect of product imagery and experience with the upcoming technology in virtual reality environments. Apart from 3D, virtual reality is going to be a huge player in e-commerce in agriculture, both for farmers and private organizations. When all support systems are in place, I guess the market disruptions may happen that would ultimately help farmers and consumers alike.

Google is a good example of how innovative companies drive digital disruption across many industries. It was a simple website search engine few years back. Now Google has changed dynamics in many industries such as media, retailing and banking. With many new initiatives like fibre-to-home, home automation, Google Car and Google Glass, the company continues to drive creative disruption in telecoms infrastructure, utilities and the insurance industry. In a similar way, disruptive technologies may offer new expanded opportunities for extension system, to evolve into a completely unimaginable service providing organizations. At provincial or nation level GIS / Remote sensing / big data can bring disruption for productivity, suitability and sustainability dimensions. Similarly the Massive Open Online Courses (MOOCs) strategies are capable of bringing disruption in capacity building within extension advisory systems. Provincial and local EAS organizations can focus on financial inclusion, market access, production system management and core extension services with a number of disruptive innovations. For this a series of social experimentation within extension organizations (public and private) is required that catalyses local digital innovations systems. Digital extension strategies would accelerate the impact of extension advisory, when they provide highly personalized, time critical services to the farmers. The disruption may positively impact the very nature of EAS if only extension policies could be flexible to make structural and functional adjustments (Please see Fig 2).

DOING THE RIGHT THING IS WRONG?

Clayton Christensen, in his book, 'The Innovator's Dilemma', argued that successful executives tend to follow the path of past successes in their decision making. This helps sow the seeds of their own demise by allowing other firms that innovate to move beyond the status quo. He therefore defined the innovator's dilemma as "doing the right thing is the wrong thing". If we really feel there is a need for radical change in EAS, disruptive technologies provide better opportunities.

To begin with, a few private firms started exploiting prescriptive planting strategies that have the potential to disrupt the agricultural industry. For example, there are big data applications to precisely understand where in one of the 25 million mapped agricultural fields in the USA, to plant what type and volume of seed, to achieve the desired crop yield. Monsanto's FieldScripts product combines an extremely detailed database of 150 billion soil observations, 10 trillion weather-simulation points and hundreds of thousands of seed-yield data points. Monsanto's planting machines, which can steer themselves using GPS, can plant a field with different varieties at different depths and spacing according to the climate data. Farmers who have trialed Monsanto's system claim it has increased yields by around five per cent over two years. All these do not mean that the same could be replicated at farmers' level in South Asia or in many other developing countries. But within EAS, these strategies could well be deployed, or other forms of disruptions suiting South Asian conditions could be explored.

ITC Infotech's Digitaligence services and solutions are designed to meet the growing needs of the Banking and Financial Services industry, providing cutting edge insights, superior customer experience and engagement, and delivering an 'anywhere, anytime' service to consumers. In a similar way if we were to think about disruptive technologies in extension advisory, then what would the opportunities be? If disruptive technologies are a combination and integration of telescopic, microscopic, processor and remote functionalities, we need to think how these four functionalities will help extension in creating disruption.
http://www.itcinfotech.com/digitaligence/

Investing in disruptive innovations in agriculture can boost garnering and harnessing new ideas. Governments should support entrepreneurs whose business models can further strengthen and promote digital agriculture. Many start ups are coming up that can initiate digital disruption in EAS. The vision of digital disruption is exciting and pathways to prosperity need to be clear.

The success of disruptive technologies such as IoT and big data analytics for rural development depends on the participation and support of both, public and private bodies. Support could be in terms of finance, standards development, data sharing and access, analytical tools and technology.

FINAL REMARKS

Whether one likes it or not, disruptions are likely to happen (or already happening) in the extension processes, activities and methods. Perhaps, disruption may not happen within EAS immediately. My main intention behind writing this blog is to provoke thought process about disruption in the extension processes rather than bringing disruption in the organizational structures. A series of such disruptive extension processes will surely transform the very nature of EASs. Until then keep thinking and explore what best could be done by us.

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DOCUMENTATION AND CLASSIFICATION OF FARMERS INNOVATIONS AND RE-INVENTIONS IN ANDHRAPRADESH AND TELANGANA

Shireesha Devarakonda and Sreenivasa Rao I

ABSTRACT

In this study 216 farmer innovations and re-inventions were identified in different farming situations of Andhra Pradesh and Telangana regions through informal interview with innovative farmers who were identified in the selected 3 districts and also from non sample area through secondary sources. A total of 216 farmer innovations and re-inventions were documented in this study out of which 164(75.92%) farmer innovations and re-inventions belonged to the selected sample area of the study and the rest 52 (24.08%) collected from secondary sources. Among the them 67(31.02%) belonged to wetland farming situation whereas 66(30.55) were from dry land and 64 (29.63%) from garden land and few 19(8.80%) of them were from hill area. Majority of them i.e.160 (74.07%) of them belonged to farmer innovations and the rest 56 (25.93%) of them belonged to farmer re-inventions.

Out of 216 documented innovations and re-inventions Majority of them i.e., 63 (29.17%) belonged to the discipline Agronomy followed by Agricultural Engineering, Horticulture, Plant protection, Veterinary and Agro forestry. Majority i.e., 52 (24.07%) farmer innovations and re-inventions were related to developed or modified farm implements and also majority i.e.77 (35.64%) were belonged to cereals. It could be inferred from the study that more number of farmer innovations and re-inventions were belonged to paddy (31.02%) crop. These documented innovations and re-inventions may be tested, verified, standardised and search for the possibility of blending with modern technologies and extrapolate them in the similar agro-climatic conditions for sustainability in farming.

(**Keywords:** farmer innovators, innovations, re-inventions, Innovation Development Process)

INTRODUCTION

Farmer innovations and re-inventions are the products of farmers informal experimentation. Benefits accrued from such innovative ideas need to be widely shared across the country. Valuable ideas and techniques generated by them largely go unnoticed owing to lack of proper documentation and opportunities for wider dissemination. Unfortunately, the farm scientists and extension personnel are still struck up in the concept of "empty vessel fallacy" with regard to farmers and undermining the role of farmers in Innovation Development Process (IDP) in research as well as in transfer of technology. The innovative farmers are strategically important to design, develop and implement any research and development programme of Indian Agricultural Research (Ayyappan, 2010).

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Keeping in view the above, a study has been conducted in Andhra Pradesh and Telangana States with the following specific objectives:

1) Documentation of the farmer innovations and re-inventions existing in different farming situations.
2) Classification of Farmer innovations and Re-inventions.

MATERIALS AND METHODS

In this study 216 farmer innovations and re-inventions were identified in different farming situations of Andhra Pradesh and Telangana regions through informal interview with innovative farmers who were identified for the purpose of giving information on farmer innovations and re-inventions in the selected 3 districts i.e., East Godavari, Khammam and Kadapa of sample area and through secondary sources from c non sample area.

RESULTS AND DISCUSSION

i) Documentation of the farmer innovations and re-inventions existing in different farming situations.

Over generations of farming, farmers have been experimenting several alternative solutions to solve their problems in the farm and home. The in built "trial and error" mechanism of the farmers was the basis of the amassed wealth for the generation of farmer innovations and re-inventions. Although, this precious wisdom has been left untouched for the past few decades, many farmers still possess and experiment continuously in carrying out their farm activities.

In the present investigation the farmer innovators were selected on the basis of having developed especially promising technologies. Although the selection was deliberately made to include a wide range of technologies and individuals (women and men, young and old) in different farming situations like wetland, dry land, gardenland and hill area; these people are broadly representative of what considers 'good innovators'. All the identified and documented farmer innovations and re-inventions by the researcher were presented in the Table 1.

ii) Classification of farmer innovations and re-inventions.

In this part classification of documented 216 farmer innovations and re-inventions were done as under following sub headings

Classification of farmer innovations and re-inventions based on sample area and non samplearea.

It could be observed from the table 2. that a total of 216 farmer innovations and re-inventions were documented in this study out of which 164 (75.92%) farmer innovations and re-inventions belonged to the selected sample area of the study and the rest 52 (24.08%) are from non sample area which are collected from secondary sources like print media, electronic media and documented by other organisations etc.

Here in this study the researcher got 24.53 per cent of the total farmer innovations and re-inventions from secondary sources, but the remaining i.e., 75.47 per cent from a small sample of Andhra Pradesh and Telanagana states and it is evident that a large number of farmer innovations and re-inventions will definitely exist in the farming community. This is the responsibility of the Government, SAU's and other institutions concerned to agriculture and allied areas to scout, identify, collect and document the valuable wealth of farmer innovations and re-inventions which are considered to be cost effective, location specific, easy to adopt and sustainable.

Classification of farmer innovations and re-inventions according to farming situations.

It could be noticed from the table 3. that among the 216 farmer innovations and re-inventions documented 67(31.02%) belonged to wetland farming situation whereas 66(30.55) were from dry land and 64 (29.63%) from garden land farming situation and few 19(8.80%) of them were from hill area farming situation.

The findings indicated that the indiscriminate use of wetland farming situation can lead to a reduction in their environmental, cultural and economic values. Thus the farmers are experimenting efficiencies in farming through innovative ideas in wetland farming situation for innovations that are beneficial to both environment and farming.

Farmers in order to overcome the problems like low and precarious rainfall, pest and disease incidence and difficulty in farming practices for crop production on dry land farming, garden land farming including other animal husbandry areas are continuously innovating for water and food, therefore informal experimentation in such areas is an effort by the farmers to improve income, labour, land and water productivity for rural households.

Some of the farmer innovations and re-inventions were also noticed from the hill area farming situation. As the farmers face the problems of soil erosion and overgrazing, as well as to observe cross compliance requirements in the hill areas. Farmers will experiment for careful management to ensure a productive and sustainable farm.

Thus the farmer innovations and re-inventions are the result of long term interventions by the farmers themselves. The advisory system (Scientific and Research experts) and the vocational trainers (Extension personnel) need to be more involved into the farmer innovation and re-invention projects in different farming situations, in view of supporting the farmers empowerment and enhancing their capacities on technical take up and their adaptive and innovative attitudes.

Classification of farmer innovations and re-inventions according to farmer innovations and re-inventions

It was revealed from the table 4. that out of 216 farmer innovations and re-inventions documented for the purpose of investigation, majority i.e.160 (74.07%) of them belonged to farmer innovations and the rest 56 (25.93%) of them belonged to farmer re-inventions.

Results furnished that most of the informal experimentation of the farmers involved were major modification of current practices or even completely novel are farmer innovations and there were also few experiments which were minor modification of the existing technology in common or external practices are farmer re-inventions. In this study it was very clear that majority of them were farmer innovations i.e. new practice or implement or combination of latest ideas blending with traditional practices. Hence it is inferred that farmers are not passive adopters of the farm technologies but can act as informal scientists of agriculture and allied sectors in solving their problems faced in farming.

Classification of farmer innovations and re-inventions based on discipline

Table 5. indicated that majority i.e., 63 (29.17%) out of 216 of the documented innovations and re-inventions belonged to the discipline Agronomy followed by 57(26.38%) Agricultural Engineering, 47 (21.76%) Horticulture, 38 (17.60%) Plant protection, 6 (2.78%) to Veterinary and 5 (2.31%) belonged to Agro forestry.

Based on the results it was evident that nearly 77 per cent of farmer innovations and re-inventions belonged to three disciplines i.e., agronomy, agricultural engineering and horticulture. It is obvious that farmers are having many problems related to different cultivation practices, farm implements and pest and disease management. This gives clear picture that the scientists of these three (3) disciplines have to bestow their attention to farming community for quick solutions to their research problems that means sometimes they may get ready made answers from farming community to avoid wastage of expenditure on research. Thus linkages between actors are essential because people move and take technologies and ideas with them (Gault, 2008).

Classification of farmer innovations and re-inventions according to nature of practice.

The table 6.indicated that majority i.e., 52 (24.07%) farmer innovations and re-inventions were related to developed or modified farm implements, 34 (15.75%) related to pest and disease management, 28(12.98%) from testing and modification of seed rate, sowing, irrigation technique, planting distance and cropping pattern, 27 (12.50%) related to Soil fertility enhancement and mulching practices, 19 (8.80%) from crop production practices and 16 (7.40%) related to organic farming practices. The documented 9 (4.16%) farmer innovations and re-inventions were from the category of new methods of compost preparation, 6(2.77%) each were from botanical pesticides and Vermicompost technology aspects, 5(2.31%) from informal trials or introduction of new crops or varieties, 4(1.85) were from new formulations of animal feed, 3 practices (1.72%) each were from shifting cultivation and animal husbandary, 2 practices (0.92%) from organic seed treatment, whereas 1 practice (0.46%) each were from rain water harvesting and farmers turned entrepreneurs aspects.

It was evident that majority of the farmer innovations and re-inventions were from farm implements. In view of the above result the Agricultural Engineers, Farm machinery companies and other stakeholders related to farm machinery have to consider the developed or modified implements by farmers for further development and commercialisation in large scale for the benefit of farming community as they were cost effective and suits to the location specific problems. The next major categories were pest and disease management, crop production practices, shifting cultivation, soil fertility enhancement and mulching practices. These are areas where lot of potential farmer innovations and re-inventions were generated by the farmers, hence the researchers from the concerned research centres have to consider these for validation and recommendation for large scale multiplication. And also should concentrate considerations on intellectual property rights. Another key aspect of innovation systems thinking is that of learning cycles and self reflection, which is seen as an integral part of the innovation process, and which also requires institutional support (Hall *et al.*2003).

Classification of farmer innovations and re-inventions based on crop economic botanical classification

It could be noticed from the table 7 that among the 216 farmer innovations and re-inventions documented out of them i.e.77 (35.64%) were belonged to cereals, 33(15.27%) were belonged to fruit crops, 27 (12.50%) were belonged to vegetables and 21(9.73%) were related to general agriculture followed by 14 (6.48%) were from commercial crops where as pulses (4.63%), animal husbandary (3.24%), 6(2.78%) each were from forestry crops and vermicompost technology, 4 (1.86%) each were from millets, and oil seeds, 3(1.40%) each from spices & condiments and fodders and only one (0.46%) belonged to fibre crops.

These results suggest that more number of farmer innovations and re-invention existed on cereals, fruit crops and vegetables. It is therefore important for the identification of farmer innovations and re-inventions by the concerned scientists to examine and to learn experiences of farmers in cereal, fruit crops and vegetable production and this may be utilized to advance the existing practices for ensuing sustainability, and food security.

Classification of farmer innovations and re-inventions in different farming situation related to different crops

It could be inferred from the table 8 that more number of farmer innovations and re-inventions were belonged to paddy (31.02%) followed by general agriculture (9.73%), vegetables (9.27%), where as 9(4.16%) each were belonged to millets, cotton and coconut. A considerable number of farmer innovations and re-inventions 7(3.24%) also existed on each from mango oil palm and animal husbandary, 6 (2.78%) each from banana, forestry crops and vermicompost technology, 5 (.31%) each were from black gram & green gram and sugarcane, 4(1.86%) each were from bengalgram, groundnut and chillies, maize (3.45%) and 3 (1.40%) each were from turmeric chillies and fodders. A few number of farmer innovations and re-inventions also existed on sorghum, onion, pomegranate, grapes, wheat, ragi, bengalgram, castor, cucurbits and jute.

Paddy is a staple crop for the most of sampled farmers has got the highest number of farmer innovations and re-inventions (71). This indicates the interest, that farmers pay towards the crop and its prime position in cultivation. Crops such as vegetables, maize, cotton and coconut are cultivated extensively in some pockets of sample area and for the farmers these are equivalent to staple crop. So they have consciously developed certain innovations and re-inventions through continuous experiments in their farming situation for increasing yields. By identifying innovative ways to increase production, improve organisation or reduce dependence on external inputs, farmer innovations and re-inventions have significant potential to improve the quality of life for farming families and reduce their impact on the environment.

CONCLUSION:

The study findings demonstrated that farmers in the selected sample area are continually experimenting, adapting and innovating in order to find new and better means of production and to address challenges.

Farmer led innovations and re-inventions relating to new crop, new area, new on-farm / off - farm based secondary agriculture etc. must be identified, tested, refined and advocated for large scale adoption for greater benefit to our farming community. Out scaling of such innovations and re-inventions, based on their techno – economic feasibility, relevance and utility would be the key for inclusive growth of farming community. This investigation serves to highlight the importance of establishing Agricultural Innovation Systems that bring together, in different ways, the many actors involved, including farmers, scientists, extension workers and private sector organisations.

It is therefore suggested that efforts should be made to capture and document these innovations and re-inventions which were proved to have scientific rationality to assist in better understanding of farmers capacity in natural resource management and wisely integrating it with science so as to bring quick and positive impact on the rural communities

Table 1: Documentation of the farmer innovations and re-inventions existing in different farming situations.

S.No.	**Title of the Farmer innovation or reinvention**	Name and Address of the farmer	Farmer innovation/ Re-invention
Wet land farming situation (Sample Area)			
1.	Modified tractor drawn paddy leveller	J. Srinivas Reddy Pandurangapuram(V)	Re-invention

		Nandyala(M), Kurnool District.	
2.	Organic pesticide with 10 types of tree leaves	A. Sami Reddy, Pandurangapuram(V) Nandyala(M), Kurnool District.	Innovation
3.	Mixing the neem cake with urea to reduce the fertilizer and pesticides in rice	B.Krishna Reddy Pandurangapuram(V) Nandyala(M), Kurnool District.	Innovation
4.	Completely avoided pesticide spraying and reduced the pest incidence in paddy by early sowing	Y.Pandurangareddy Sanjeevanagar(V) Nandyala(M), Kurnool District.	Innovation
5.	Non Pesticide Management(NPM) in paddy	Mekala Subbha Reddy Nehru Nagar (V), Gosapadu(M), Kurnool District	Innovation
6.	Organic pesticide in Paddy	S.Rama Subba Reddy Thogarchedu (V) Panyam(M), Kurnool District	Innovation
7.	Preparation of cow tea	Surikuchi Saradhi Mukkamala (V) Ambajipet(M), East Godavari District	Innovation
8.	Preparation of Amino liquid	S.Subramanyam Mukkamala (V) Ambajipet(M), East Godavari District	Innovation
9.	Pasting of bunds in rice crop with	S. Ramachandrudu	Innovation

	polythene covers to avoid drainage	Mukkamala (V) Ambajipet(M), East Godavari District	
10.	Innovative idea of rat control in paddy field	Posuri Surapuraju Palivela (V) Kothapet(M), East Godavari District Ph.No.9493278286	Innovation
11.	Raising of rice nursery on polythene sheets.	Yalla Satyanarayana Yelisivalli(V) Uppalaguptham (M) East Godavari District Ph.No.9951678081	Innovation
12.	Wooden marker in System of Rice Intensification (SRI)	Gundam Ramakrishna Yelisivalli(V) Uppalgutham (M), East Godavari District Ph.No.8106506826	Innovation
13.	Organic farming methods in paddy	Sri J. Krishnam RajuAthreyapuram (V) Athreyapuram(M) East Godavari Dist. Ph.No.9493818887	Innovation
14.	Inoculation of microbes in the FYM	S.Subramanyam Mukkamala (V) Ambajipet(M), East Godavari District Ph.No.9912292324	Innovation
15.	Organic pesticide	D. Veerabadhra Rao Yelisivalli(V) Uppalgutham (M), East Godavari District Ph.No.08856-229611	Innovation
16.	Direct seeding of paddy	A.Venkateshwarlu Rao Asnaguthi (V)	Innovation

		Wyra(M) Khammam dist. Ph. No.9010732527	
17.	Organic pesticide for BPH control	A. Srinivasa Rao Asnaguthi (V) Wyra(M) Ph.No.9493038385	Innovation
18.	Modified drum seeder	D. Shailesh Babu Khanapur (V) Wyra (M) Khammam dist. Ph.No.9440839012	Re-invention
19.	Organic farming in paddy	D.Padmanabiah Khanapur (V) Wyra(M) Khammam dist.	Innovation
20.	Reduction of fertilizer dosage in paddy	Veerapaneni Kishore Khanapur (V) Wyra(M) Khammam dist.	Re-invention
21.	Direct seeded aerobic rice cultivation with alley ways formation	Ch. Muralidhar Rao Main road,Somavaram, Wyra (M) Khammam Dist.	Innovation
22.	Application of all the fertilizers in the first ploughing rather than split doses in paddy	P.Ramesh babu Nuthankal (V) Khammam Dist. Ph.no. 9581043778	Innovation
23.	Organic farming	Anumula Ramireddy Muthugudem (V)	Innovation

		Khammam rural Ph.no. 9440354113	
24.	Modified drum seeder	Imam Saheb Nelakondapalli (V) Mudigonda(M) Khammam dist.	Re-invention
25.	Modified cono weeder	Imam saheb Nelakondapalli (V) Mudigonda(M) Khammam dist.	Re-invention
26.	Modified drum seeder	N.Venkata Varma Gogubaka (V) Charla(M) Khammam dist. Ph.no.9966673318	Re-invention
27.	Location specific rice cultivation method- Aerobic rice cultivation	K. Nageshwar Rao Thimminenipalem (V), Chintakani (M) Khammam dist. Ph.No.91770776489	Innovation
28.	Saline soil reclamation	Sri. Shesha Reddy Singavaram village, C.Belagal mandal, Kurnool district Ph.No: 9989643730	Innovation
29.	Complete avoidance of chemical fertilizers and pesticides	Shri. S.Zubedabee Thadakanapalli (V) Kallur (M) Kurnool Dist. Ph No. 9000400988	Innovation
30.	Blast control material in rice with locally available	N.Nageshwar reddy Kothakota(v)	Innovation

		C.Belagal (M) Kurnool district Ph.No. 9440225193	
31.	Overcome cyclone loss by growing long duration paddy variety	Muppuna pawan kumar Peddapuram (V) (M) East Godavari Dist. Ph.No. 9963336876	Innovation
32.	Manure from rice mill wastage	Meka Ramesh Babu Kummari Veedi Peddapuram (M) East Godavari Dist. Ph.No. 9701578333	Re-invention
33.	Direct sowing of paddy with drum seeder	P.Viswanatham J.Thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph.No 9390479971	Innovation
34.	Modified drum seeder	P.Viswanatham J.Thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph.No 9390479971	Re-invention
35.	Usage of bone powder as manure in farm	S.Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Re-invention
36.	Organic pesticides (Neemasthram)	S. Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
37.	Organic pesticides (Agniasthram)	S. Himavanth Rao Medipally (V)	Innovation

		Mudigonda(M) Khammam dist. Ph.No.9866563556	
38.	Organic pesticide (Dasapathra kashayam)	S. Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
39.	Liquid compost	N.Venkata Verma Gogubaka (V) Charla(M) Khammam dist. Ph.No.9966673318	Innovation
40.	Organic amino acids with eggs	S. Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
41.	Organic amino acids with fish	S. Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
42.	Crop diversification (Paddy to Grapes)	G Aadinarayana Reddy Konidhedu (V) Panyam(M) Ph No. 8985703775	Re-invention
43.	Experiment on Direct sowing (Conventional method) of paddy cultivation.	D Chinna hussain, Bheemavaram (V), Nandyala (M). Kurnool District. Ph No: 9959521026	Innovation
44.	Innovative idea of rat scaring in rice nursery	Posuri Surapuraju Palivela (V)	Innovation

		Kothapet(M), East Godavari District Ph.No.9493278286	
45.	Usage of pseudomonas and jaggery for the control of blast in rice.	D.Veerabadhra Rao Yelisivalli (V) Uppalgutham (M), East Godavari Dist. Ph.No.08856-229611	Innovation
46.	Zero phosphorus sowing in paddy to reduce zinc deficiency	D.V.Subha raddy Bhalapanur(V), Panyam(M), Kurnool District. Ph No: 9704329236	Innovation
47.	Done experiment in rice field with zn application	N.Saagesh reddy Nandipalli (V) Mahanandi (M) Kurnool district 9573342961	Innovation
48.	Botanical pesticide	Mr.Veera Reddy Nandipalli (V) Mahanandi (M) Kurnool district	Innovation
Dryland farming situation(Sample Area)			
49.	Modified tractor drawn seed cum fertilizer drill	A.Chinna Sesi Reddy Subbareddypalem (V) Nandyal (M) Kurnool Dist. Ph.No. 9705595896	Re-invention
50.	Organic material to reduce the smell of poultry yard	A.V. Subba Reddy Pandurangapuram (V) Nandyal (M)	Innovation

		Kurnool dist. Ph.No.9951483126	
51.	Mixing of organic material (Documentation:50) in the animal feed	A.V. Subba Reddy Pandurangapuram (V) Nandyal (M) Kurnool dist. Ph.No.9951483126	Innovation
52.	Modified the 13 inches spaced tractor drawn seed drill to 9.5inches seed drill made in 2 rows for groundnut sowing	VBhuvaneshwar Reddy Panduranga puram(V) , Nandyala(M), Kurnool District. Ph No:9989976218	Re-invention
53.	Prepared an organic fungicide	K.Sudhakar Reddy Subbareddypalem (V) Nandyal(M) Kurnool district Ph.No.9705595896	Innovation
54.	Seed treatment with ash in jowar	A. Srinivasulu Thogarchedu (V) panyam(M), Kurnool District. Ph No:9908918221	Innovation
55.	Application of tobacco +cow curd solution for pest control	Posuri Surapuraju Palivela (V) Kothapet(M), East Godavari District Ph.No.9493278286	Innovation
56.	Bio gas plant with only cow urine	Garimela Mithili Kotovariagraham(V) Ambajipet(M),	Innovation

		East Godavari Dist. Ph.No.7382496185	
57.	Innovative method of sugarcane cultivation	Garimela Mithili Kotovariagraham(V) Ambajipet(M), East Godavari Dist Ph.No.7382496185	Innovation
58.	Usage of neem + amino solution as pesticide and growth promoter.	D.Veerabadhra Rao Yelisivalli(V) Uppalguptham (M), East Godavari Dist Ph.No.08856-229611	Innovation
59.	Use of biogas for the running of irrigation motor	Adabala Rajmohan Vyagreshvaram(V) Ambajipet (M), East Godavari District	Innovation
60.	Zero tillage in sweet corn cultivation	V. Koteshwar Rao Gollapudi (V) Wyra(M) Khammam District	Innovation
61.	Zero tillage maize	Sheik Lalahmed Khanapur(V) Wyra(M) Khammam District 9963907937	Innovation
62.	Designed a manually operated Intercultivator with 2 adjustable blades	D.Satyanarayana Nacharam (V) Enkuru (M) Khammam District	Innovation
63.	K-6 ground nut variety with different seed rates	N.Madhava rao	Innovation

		Thimminenipalem (V) Chintakani (M) Khammam District Ph.No 9490144431	
64.	Zero tillage maize marker	K.Nageshwar Rao Thimminenipalem (V), Chintakani (M) Khammam District Ph.No91770776489	Innovation
65.	Growing of fodders organically with wastage of vermicompost	Anumula Ramireddy Muthugudem (V) Khammam rural Ph.no. 9440354113	Innovation
66.	Organic seed treatment	Anumula Ramireddy Muthugudem (V) Khammam rural Ph.no. 9440354113	Innovation
67.	Manually operated Multipurpose seed drill	Peddigolla Yellappa Gudur (V) Gudur (M) Kurnool district Ph.No.8985290482	Innovation
68.	Sticky insect traps	G.Thimmarusu Gudur village, Gudur manadal Kurnool district	Innovation
69.	Innovative cultivation practice in groundnut	G.Thimmarusu Gudur village, Gudur manadal Kurnool district	Innovation
70.	Innovative method of insect trapping in cotton	Shri. Macharla bhasker	Innovation

		Gudur (V), Gudur (M) Kurnool district	
71.	Manually operated plough and intercultivator in wide spacing crops	Shri. C. Linganna Police station Road Gudur(V), Gudur (M) Kurnool district	Innovation
72.	Sprinkler irrigation in vermicompost unit	Shri. P.Ramayya Vemugodu (V) Gondugandla(M) Kurnool district PhNo. 9948099004	Re-invention
73.	Modified drum seeder	P. Viswanatham J.Thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph,No 9390479971	Re-invention
74.	Paddy as intercrop in sugar cane	P. Viswanatham J.Thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph,No 9390479971	Innovation
75.	Designed a weeder for sugarcane crop and also intercropping	P. Viswanatham J.Thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph,No 9390479971	Re-invention
76.	Control of monkey menace in sugarcane by wearing of bear dress	Doddi Suribabu Boddavaram (V) Kotananduru (M) East Godavari Dist.	Innovation
77.	Feeding oxen with juice of Palmyra	Adabala Rajmohan	Innovation

	palm tree fruits	Vyagreshvaram(V) Ambajipet M), East Godavari Dist.	
78.	Organic pesticide for cotton sucking pests	Vempati Srinivava Rao Asnaguthi (V) Wyra(M) Ph.No.9493038385	Innovation
79.	Designed a small scale vermicompost unit for the benefit of farmers	Anumula Ramireddy Muthugudem (V) Khammam rural Ph.No. 9440354113	Innovation
80.	Manually operated vermicompost grading machine	Anumula Ramireddy Muthugudem (V) Khammam rural Ph.No. 9440354113	Innovation
81.	Power operated vermicompost grading machine	Anumula Ramireddy Muthugudem (V) Khammam rural Ph.No. 9440354113	Innovation
82.	Organic pesticide for the control of *Spodoptera* and *Helicoverpa*	S.Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
83.	Sugarcane bud extraction machine	Subash Chandra Bose Nagulavancha (V) Chintakani (M) Khammam dist. Ph.No.9440606766	Innovation
84.	Modified inter row spacing in cotton	Sheik Lalahmed Khanapur(V) Wyra(M) Khammam dist. 9963907937	Re-invention

85.	Sugar cane raised bed cultivation	Subash Chandra Bose Nagulavancha (V) Chintakani (M) Khammam dist. Ph.No.9440606766	Innovation
86.	Organic amino acids with meat	S. Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
87.	Organic syrup (tonic) for high yield	S.Himavanth Rao Medipally (V) Mudigonda(M) Khammam dist. Ph.No.9866563556	Innovation
88.	Raised seed bed system and single row sowing in maize	T.Ramreddy Kothapally(V), Nandyal (M), Kurnool district Ph.No.9704269357	Innovation
89.	Pesticide mixing with neem oil as sticking agent	M. Madhu letty Pooluru(V) Nandyala(M), Kurnool District. Ph No:9441761487	Innovation
90.	Recycling of farm waste through preparation of vermi compost.	Garimela Mithili Kotovariagraham(V) Ambajipet(M), East Godavari District Ph.No.7382496185	Innovation
91.	Completely eradicated YMV in his field	Ch.V.V.Prasad Velangi (V) Karapa(M)	Innovation

		East Godavari Dist. Ph.No.9866100777	
92.	Azolla farming to feed animals	Garimela Mithili Kotovariagraham(V) Ambajipet(M), East Godavari District Ph.No.7382496185	Innovation
93.	Vermicompost hatchery	Smt.Vijaya Gollapudi (V) Wyra (M) Khammam dist.	Innovation
94.	Preparation of decompost with madhuvam(bacteria)	Anumula Ramireddy Muthugudem(V) Khammam rural ph.no. 9440354113	Innovation
95.	Attached a dynamo to the tractor to operate the irrigation pump during power cut.	Kongara Satyanarayana Magantivariveedi Near police station Peddapuram (M) East godavari district Ph. No. 9492962238	Innovation
Garden land farming situation(Sample Area)			
96.	Application of organic material(Documentation. 50) for raising of pomegranate seedlings	A.V. Subba Reddy Pandurangapuram (V) Nandyal (M) Kurnool dist. Ph.No.9951483126	Innovation
97.	Innovative technique of irrigation in chilli crop in heavy black cotton soils	J. Madhu Sudhan Panduranga puram(V), Nandyala(M), Kurnool District.	Innovation

98.	Innovative technique of irrigation in chilli crop on slopy lands	J. Srinivas Reddy Panduranga puram(V) Nandyala(M), Kurnool District. Ph no:9908068696	Innovation
99.	Use of panchagavya in crops of *Cucurbitaceae* family helps in double the yield	A. Sami Reddy Pandurangapuram (V) Nandyal (M) Kurnool district Ph.No.9866518823	Innovation
100.	Intercropping with fodder crops in coconut	Garimela Mithili Kotovariagraham(V) Ambajipet(M), East Godavari Dist. Ph.No.7382496185	Innovation
101.	Organic pesticide	Posuri Suraparaju Palivela (V) Kothapet(M), East Godavari District Ph.No.9493278286	Innovation
102.	Organic pesticide for pest and diseases management in Ridge gourd	D.Veerabadhra Rao Yelisivalli(V) Uppalgutham (M), East Godavari District Ph.No.08856-229611	Innovation
103.	Green mulching	D.Veerabadhra Rao Yelisivalli(V) Uppalguptham (M), East Godavari District Ph.No.08856-229611	Innovation
104.	Innovative model of Organic farming	S.Zubedabee Thadakanapalli (V)	Innovation

		Kallur (M) Kurnool Dist. Ph No. 9000400988	
105.	Organic mulching in onion crop.	S.Zubedabee Thadakanapalli (V) Kallur (M) Kurnool Dist. Ph No. 9000400988	Innovation
106.	Compost preparation	G.Srinivas Nagulapuram village Gudur mandal Kurnool district Ph.No.9908870361	Re-invention
107.	Prepared an organic pesticide	G.Srinivas Nagulapuram village Gudur mandal Kurnool district Ph.No.9908870361	Innovation
108.	Bajra powder and ash dusting in field	B.Vijay Singh Naagulapuram (V) Gudur (M) Kurnool district Ph.No.9618860760	Innovation
109.	Pig manure for the control of pests in vegetable crops	Meka Ramesh Babu Kummari veedi Peddapuram (M) East Godavari Dist. Ph.no. 9701578333	Innovation
110.	Using lemon leaves as pesticide	Meka Ramesh Babu Kummari veedi Peddapuram (M) East Godavari Dist.	Innovation

		Ph.no. 9701578333	
111.	Turmeric and garlic juice as pesticide	Meka Srinivas Kummari veedi Peddapuram (M) East Godavari Dist. Ph.no. 9701578333	Innovation
112.	Intercropping of paddy in coconut orchard for fodder purpose	Adabala Rajmohan Vyagreshvaram(V) Ambajipet (M), East Godavari District	Innovation
113.	Oil palm intercropping with sugarcane	A. Veeravenkata Rao J.Thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph.No. 9704979452	Innovation
114.	Modification of Chopping Machine	K.Shivaram Prasad Suranga Veeksham(V) Thondangi (M) East Godavari district Ph.No. 9550769717	Re-invention
115.	Modification of power tiller blades	K.Shivaram Prasad Suranga Veeksham (V) Thondangi (M) East Godavari district Ph.No. 9550769717	Re-invention
116.	Usage of mechanical devices in the field	K.Shivaram Prasad Suranga Veeksham(V) Thondangi (M) East Godavari district Ph.No. 9550769717	Innovation
117.	Organic fungicide for the control of powdery mildew	S.Himavanth Rao Medipally (V)	Innovation

		Mudigonda(M) Khammam dist. Ph.No.9866563556	
118.	Intercropping in mango orchard	M.Ramakrishna Chennaram (V) Nelakondapalli (M) Khammam dist.	Re-invention
119.	Innovative idea of farm pond	Dr.P.Sriramulu Guduru(V), Guduru(M), Kurnool District.	Re-invention
120.	Banana stubbles usage in vermicompost preparation	D.C.M Hussain Hallinagar(V), Mahanandhi(M), Kurnool District. Ph. No:9989334249.	Re-invention
121.	Organic + Inorganic fertilizer management in Banana and turmeric cultivation	G.Abdulla Khan Kalva(v) Orwakal(M) Kurnool district Ph.No.8500776619	Re-invention
122.	Innovative idea of Agripreneurship.	D. Chandra Shekar Kothapalli (V) Dornipadu (M) Kurnool district	Innovation
123.	Preparation of micro nutrient solution	Cheppalli Rami Reddy Gopavaram (V) Nandyal (M) Kurnool district Ph.No.9704019039	Re-invention
124.	Prepared the compost for reduction of turmeric rhizome wilt	Sri. Murali Krishna Srinagar (V) Mahanandi (M)	Innovation

		Nandyal (T) Ph.No.8886844456	
125.	Jaggery application increases the growth of the chilly plants	A.Srinivasulu Thogarchedu (V) Panyam(M), Kurnool District. Ph No:9908918221	Innovation
126.	Intercropping of vegetables in coconut orchard	Garimela Mithili Kotovariagraham(V) Ambajipet(M), East Godavari Dist. Ph.No.7382496185	
127.	Non Pesticide Management in Mango	Vakiti dhanalaxmi Thadakanapalli (V) Kallur (M) Kurnool district Ph No. 9959865278	Innovation
128.	Shifting cultivation	Peddadi jaggababu Katravulapalli (V) Jaggampeta (M) Kurnool district Ph. No. 9908989113	Innovation
129.	Oil palm intercropping with greengram	N.Neeladriverma Gogubaka (V) Charala (M) Khammam dist. Ph.no.9441424289	Innovation
130.	Recycling of organic waste from the coconut orchard	Adabala Rajamohan Pulletikurru (V) Ambajipet (M) East Godavari district	Innovation

		Ph.No.9848110978	
131.	Green mulching in coconut orchard	Adabala Rajamohan Pulletikurru (V) Ambajipet (M) East Godavari district Ph.No.9848110978	Innovation
132.	Multi Storey Cropping	N.V.S.Dora Babu Ainavalli (V) Ainavalli (M) East Godavari district Ph.No. 08856-225568	Innovation
133.	Recycling of organic waste	N.V.S.Dora Babu Ainavalli (V) Ainavalli (M) East Godavari district Ph.No. 08856-225568	Innovation
134.	Intercropping **(** Coconut + Cocoa+ Cauliflower)	N.V.S.Dora Babu Ainavalli (V) Ainavalli (M) East Godavari district Ph.No. 08856-225568	Re-invention
135.	Intercropping **(** Coconut + Banana+Papaya)	Sri J. Krishnam Raju Athreyapuram (V) Athreyapuram (M) East Godavari district Ph.No. 9493818887	Re-invention
136.	Intercropping in coconut	S.Ramachandridu Mukkamla (V) Ambajipet (M) East Godavari district Ph.No. 08856-227084	Re-invention
137.	Burning the stubbles in the mango and banana field as light traps	Cheppalli Rami Reddy Gopavaram(V)	Innovation

		Nandyal (M) Kurnool district Ph.No.9704019039	
138.	Introduced spineguard cultivation and gaining more yields	Mannepalli Ravi H.No.6-1-101 Gopalaraomarket Kothagudem, Khammam dist	Innovation
139.	Due to the loss faced by the paddy crop farmer turned to relay cropping	Maaram subramanyam Yagantipalli (V) Banaganapalli (M) Kurnool district Ph.No. 8985032540	Innovation
140.	Incorporation of castor cake and neem cake near the pit of banana plant	Mopuri Venkateshu Panyam (V) (M) Kurnool district Ph No. 9866308431,	Re-invention
141.	Intercropping of tapioca with greengram, black gram and soya bean	P.Viswanatham J.thimmapuram (V) Peddapuram (M) East Godavari Dist. Ph.No 9390479971	Innovation
142.	Recycling of vegetable crop wastages from his field	M.Rasool sahib Kalva (V), Orwakal (M) Kurnool district Ph.No.9553107481	Innovation
143.	Organic way of controlling termites in mango and sapota orchards	P. Jakeer hussain Panyam (V) Panyam(M) Kurnool district Ph.No.9908700467	Innovation

144.	Raised bed system of sowing in turmeric and mixing of castor cake and neem cake with fertilizers	G.Umamaheshwar rao Srinagar (V) Mahanandi (M) Nandyal (T) Ph.No.9490751584	Innovation
145.	Intercropping of mango orchard with turmeric and sugarcane	Cheppalli Rami Reddy Gopavaram(V) Nandyal (M) Kurnool district Ph.No.9704019039	Re-invention
Hill area farming situation (Sample Area)			
146.	Modification of drip system in unlevel lands	Mopuri Venkateshu Panyam (V) (M) Kurnool district Ph No. 9866308431	Re-invention
147.	Crop diversification Coconut to Supper wood (wood used in wood carving)	D. Chandra Shekar Kothapalli (V) Dornipadu (M) Kurnool district	Innovation
148.	Innovative multiple cropping	D. Chandra Shekar Kothapalli (V) Dornipadu (M) Kurnool district	Re-invention
149.	Organic herbal solution "Thunder"	Mr.V. Krishnud Mandal: velugodu Dist:Kurnool Ph.No:919985758013	Innovation
150.	Remote operation device using cellphone for irrigation motors for the farmers.	Tejawat Rambabu Bommanapalli Billudi Tanda Mandal.Tekulapalli Dist.Khammam	Innovation
151.	Kodisa (cleistanthus against rice hispa collinus) is a toxic plant	Payam Seetharamiah Chinnarlagudem Small tribal hamlet in the Bhadrachalam forests of A.P	Innovation

152.	Water turbine powered by flowing canal water	K.MallikarajunaRao Khammam Dist.	Innovation
153.	Non-Pesticide Management (NPM)	VenuMadhav Khammam Dist.	Innovation
154.	Efficient and low-cost pumps which can be operated manually.	Mr.Ganeswara Rao Bhadrachalam Khammam Dist.	Innovation
155.	Paddy Harvestor	Y.Venkateshwarlu Tiruvur (V), Dist Khammam	Re-invention
156.	Recorded highest yield in paddy	G.China Narayana Edulla Bayyaram(V), Pinapaka (M) Dist Khammam	Innovation
157.	Organic farming in oilpalm cultivation	Shri. C.Ravindranath Gokavaram(V), East Godavari Dist	Re-invention
158.	Innovative method of onion harvesting	D.Shailesh Babu Enkuru Dist Khammam	Innovation
159.	Hanging hatchery in the back yard poultry	Mulla Annapurna Marrivada(V) Rampachodavram(M) East Godavari district	Innovation
160.	Using Shevri (*Sesbania egyptifolia*) as border crop in banana	Mopuri venkateshu Panyam (V) (M) Kurnool district Ph No. 9866308431	Innovation
161.	Adopted wider spacing in teak plantation	D. Chandra shekar Kothapalli (V) Dornipadu (M) Kurnool district	Re-invention
162.	Irrigation motors are fixed with pH value checking machines	D. Chandra shekar Kothapalli (V) Dornipadu (M) Kurnool district	Innovation
163.	Regrowthing of the extinict species	D. Chandra shekar Kothapalli (V)	Innovation

		Dornipadu (M) Kurnool district	
164.	Solar Cotton harvester	M.Satyanarayana Janampeta (V) Pinapaka (M) Khammam Dist. Ph.No.9000250692	Innovation
Wetland faring situation (Non Sample Area)			
165.	Bicycle pump	Mr.Vikram Rathod Narsapur (M) Utnoor Adilabad Dist	Innovation
166.	Vitamin A rich (1,242 IU) Rice.	C.Venkat Reddy Hyderabad Ph.No.98480-40103	Innovation
167.	Roller marker for SRI method of rice cultivation	K.Lakshmana Reddy, Ramavaram, East Godavari	Innovation
168.	Three tier harnessing system of energy of the chulha	Mrs.Jyothi Borra (V) in Araku valley Titinvalsa Vishkhapatnam	Innovation
169.	Modified paddy drum seeder	L. Rama Kota Reddy Karedu (V) Ulavapadu (M) Prakasam district Ph.No. 9908775545	Re-invention
170.	Modified the conoweeder for better weed management and smooth functioning.	Sri. GAV RamaRaju Thettangi (V) , Gurla (M), Vizinagaram Dist, Ph No. 96665 47266	Re-invention
171.	Designed a marker	M.Ramesh Anguru (V) Sarvakota mandal Srikakulam district	Re-invention
172.	SRI marker with locally available material i.e bamboo sticks	Sri. Thoika Bangarraju Gorada village	Re-invention

		Gummalakshmipuram Vizianagaram dist	
173.	Roller marker – innovative adaptation of rangoli maker	Mr. Sapay Sriramamurthy Pallamkurru (V) Katrenikona (M) East Godavari Dist.	Re-invention
174.	Drum seeder modified with six drums	Sri. Kolli Ramu Pulla (V), Bhimadolu (M) West Godavari district Ph.No: 9492513274	Re-invention
175.	New Bio pesticide formulation for insect pest management in Rice	Bachu Veera Reddy Karimnagar Dt.,	Innovation
176.	Semi SRI	Mr.Veerapaneni Veerabhadra Rao Vaanapamula (V) Peddaparupudi (M) Krishna Dt.	Re-invention
177.	Organic farming	Shri. Karra Shashikala District Nalgonda,	Innovation
178.	Organic farming	Shri. G. Satish Babu Seetampet (V) Denduluru (M) West GodavariDistrict	Innovation
179.	Hyacinth cutter	Godasu Narasimha Pochampally (V) Nalgonda district Ph.No.919492558698	Innovation
180.	Recorded high benefit cost ratio with organic farming	Shri. S. Suresh Uppal Hyderabad	Innovation
181.	Organic farming	A. Seeta Naga Malleswari Nuthakki Guntur district.	Innovation

182.	Cell phone operated pump	G.V.Krupakar reddy Bajjora (V) Bheemgal (M) Nizamabad Ph.No: 9849333644	Innovation
183.	Water turbine irrigation for small farmers	Dabbeta Rajalingaiah Karimnagar dist. Ph No: 9396518078	Innovation
Dryland faring situation (Non Sample Area)			
184.	Pesticide sprayer	Mr.Uppuvella Krishna Ananthavaram (M) Yaddanapudi Prakasam Dist.	Innovation
185.	Sustainable, cheap and locally available herbicide	Sri.K.Rajamallu Gorlaveedu (V) Bhopalpath (M) Warangal Dist.	Innovation
186.	Zero tillage maize in cotton follows	Sri.K.S.Ramakishan Mujigi (V) Nirmal(M) Adilabad Ph:9848162234	Re-invention
187.	Contraption which looks like a sprayer	Sayyed Subhani NagabiruvariPalem(V) Pedananidpadu (M) Guntur Dist.	Innovation
188.	Sowing of redgram in polythene covers followed planting in the main field at 40 days age	Sri V.Satyanarayana Thimmayapalli (V) Doma (M) Rangareddy district	Innovation
189.	Wild boar scaring	Srirampuram Padma Sirpoor (V) Nizamabad (M) Nizamabad District	Innovation
190.	Motor bike operated plough	V.Thirupati reddy Sri puram (V) Nagarkurnool (M)	Re-invention

		Mahaboobnagar dist.	
191.	Innovative hatchery	Batulu Narsayya, Nalgonda District	Re-invention
192.	Automatic Sprinkler System	P.Vijay Kumar Visakhapatnam	Re-invention
193.	Calotropis to Fight Red Hairy Caterpillar in Groundnut	Mrs. Prasanthi Chittoor	Re-invention
194.	Cycle and motor cycle intercultivator	Sri.Jitta Bal Reddy Ramakishtapuram Bhongir Nalgonda Ph.No.9912199326	Re-invention
195.	Village Level Fodder Bank	K. Madhava Reddy Gundlakattamanchi(V) Bangarupalyam (M) Chittoor Dt. Ph.No.09866090081	Innovation
196.	Ploughing technique for high yield in ragi	Manchala Paaramma Thanukuvalasa(V), VijayanagaramDistrict	Re-invention
197.	Mini Tractor	Shri. Mastan Vali Ponnakallu (V) Tadegudem (M) Guntur Dist	Innovation
198.	Semi Automatic cultivator	Shri. Mahipal Chary Peddaragipeta (V) Tharkal (M) Warangal Dist Ph.No.986692168	Innovation
199.	Tractor Mounted Boom Sprayer	Shri. Syed Subhani NagabiruvariPalem(V) Pedananidpadu (M) Guntur Dist. Ph.No+9848613687	Innovation
200.	Seed Dispenser and Herbi sprayer	Shri. T.Guraviah Gupenaguntla (V) Naggerakallu (M)	Innovation

		Guntur Dist. Ph.No.919989087931	
201.	Modified cultivator	B.V. Ramana Reddy Kamalapur(V) Manaal. Naripet(M) Nizambad Dist.	Re-invention
202.	Auto engine to supply irrigation to field	Shri. Hakeem Khan G.Hukrana (V) Narayankhade(M) Medak Dist	Innovation
203.	Replenishing old soil with new soil	C.Venkat Reddy, Hyderabad Ph.No.98480-40103	Innovation
Gardenland faring situation (Non Sample Area)			
204.	Mulching with sesamum stubbles in turmeric	Sri.K.Jayaramudu Kesalingayapalli(V) Mydukur (M) YSR district Ph No.:9963121404	Re-invention
205.	Innovative multiple cropping in rainfed alfisols	D.Yesu Gangaiah Tokapalli (V) Peddaraveedu (M) Prakasham dist Ph.No.9581880862	Re-invention
206.	Fermented Rice to control flower drop in Solanaceous vegetables	Mrs Parijatamma, Putturu Chittoor Dist.	Re-invention
207.	Alternate method of tissue cultured banana technology	S Venkatesh, S Lingamayya, & S Bhaskar, Chandragiri (V) YSR Dist	Re-invention
208.	Crop Diversification with Oil Palm	Shri P. Subba Rao Remalle (V) Bapala Padu (M), Krishna Dist,	Re-invention

		Ph.No.9848509326,	
209.	Bio pesticides in brinjal cultivation	Shri. P.MuniRatnam Kasturikandriga (V) Thirupati Rural(M) Dist. Chittoor	Innovation
210.	Organic farming	Mrs. V.Malleswari Musalireddygaripalli YSR Kadapa district.	Innovation
211.	Organic cultivation	Mrs. Savita Jeevan Khanapur , Adilabad district	Innovation
212.	Improving soil fertility without chemical fertilisers	C.Venkat Reddy, Hyderabad Ph.No.98480-40103	Innovation
213.	Pounded chilli sorter	Mr.NazeerAhmed Gadwal (V) Mahbubnagar Dist. Ph.No.919885541400	Innovation
214.	Using only soil as manure in pomegranate	K.Prabhakar Reddy & K.Sudhakar Reddy, Chandanvelli (V) Shabad (M) Rangareddy Dist.	Innovation
215.	Innovative intercropping of leaf vegetable cultivation in mango orchards	V.Krishna Murthy Bollapalli (V) Marturu (M) Prakasam Dist. Ph.No. 9490023986	Innovation
216.	Integrated farming	Shri. Uppala Prasad Ghantasalapalem (V) Ghantasala (M) Krishna Dist.	Re-invention

Table 2. Classification of farmer innovations and re-inventions based on sample area and non sample area

N=216

S.No.	Category	Frequency	Percentage
1	Sample area	164	75.92

2	Non sample area	52	24.08
	TOTAL	**216**	**100.00**

Table 3. Classification of farmer innovations and re-inventions according to farming situations

N=216

S.No.	Category	Frequency	Percentage
1.	Wetland farming situation	67	31.02
2.	Dryland farming situation	66	30.55
3.	Gardenland farming situation	64	29.63
4.	Hillarea farming situation	19	8.80
	Total	**216**	**100.00**

Table 4. Classification of farmer innovations and re-inventions according to farmer innovations and re-inventions N=216

S.No.	Category	Frequency	Percentage
1.	Farmer innovations	160	74.07
2.	Farmer re-inventions	56	25.93
	Total	**216**	**100.00**

Table 5. Classification of farmer innovations and re-inventions based on discipline

N=216

S.No.	Category	Frequency	Percentage
1.	Agronomy	63	29.17
2.	Plant protection	38	17.60
3.	Horticulture	47	21.76
4.	Agricultural engineering	57	26.38
5.	Veterinary	6	2.78
6.	Agroforestry	5	2.31
	Total	**216**	**100.00**

Table 6. Classification of farmer innovations and re-inventions according to nature of practice

N=216

S.No.	Category	Frequency	Percentage
1.	Informal trials or introduction of new crops or varieties	5	2.31
2.	Testing and modification of seed rate, sowing, irrigation technique, planting distance and cropping pattern	28	12.98
3.	Botanical pesticides	6	2.77
4.	New formulations of animal feed	4	1.85
5.	Developing and using new farming tools	52	24.07
6.	New methods of compost preparation	9	4.16
7.	Organic farming	16	7.40
8.	Rain water harvesting	1	0.46
9.	Pest and disease management	34	15.75
10.	Crop production practices like land preparation, nursery raising, intercultivation, bund formation etc.	19	8.80
11.	Soil fertility enhancement and mulching practices	27	12.50
12.	Shifting cultivation	3	1.40
13.	Farmers turned enterpreneurs	1	0.46

14.	Organic seed treatment	2	0.92
15.	Animal husbandary	3	1.40
16.	Vermicompost technology	6	2.77
	Total	**216**	**100.00**

Table 7. Classification of farmer innovations and re-inventions based on crop economic botanical classification

N=216

S. No.	Crop economic family	Frequency	Percentage
1.	Cereals	77	35.64
2.	Millets	3	1.40
3.	Pulses	10	4.63
4.	Oilseeds	5	2.31
5.	Vegetables	27	12.50
6.	Spices and condiments	3	1.38
7.	Fruits crops	33	15.27
8.	Fibre crop (mesta)	1	0.46
9.	General Agriculture	21	9.73
10.	Commercial crops	14	6.48
11.	Fodders	3	1.40
12.	Forestry crops	6	2.78
13.	Vermicompost technology	6	2.78
14.	Animal husbandary	7	3.24
	Total	**216**	**100.00**

Table 8. Classification of farmer innovations and re-inventions in different farming situation related to different crops

N=216

S.No.	Crop	Frequency	Percentage
1.	Paddy	67	31.02
2.	Maize	9	4.16
3.	Wheat	1	0.46
4.	Sorghum	2	0.92
5.	Ragi	1	0.46

6.	Black gram and green gram	5	2.31
7.	Red gram	1	0.46
8.	Bengalgram	4	1.86
9.	Groundnut	4	1.86
10.	Castor	1	0.46
11.	Vegetables	20	9.27
12.	Chillies	4	1.86
13.	Onion	2	0.92
14.	Cucurbits	1	0.46
15.	Turmeric	3	1.40
16.	Banana	6	2.78
17.	Pomegranate	2	0.92
18.	Mango	7	3.24
19.	Grapes	2	0.92
20.	Cotton	9	4.16
21.	Sugarcane	5	2.31
22.	Coconut	9	4.16
23.	Oil palm	7	3.24
24.	Jute	1	0.46
25.	Fodders	3	1.40
26.	Forestry crops	6	2.78
27.	General agriculture	21	9.73
28.	Vermicompost technology	6	2.78
29.	Animal husbandary	7	3.24
	Total	216	100.00

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Effective production and post-production activities in agriculture through use of Information Technology (IT) based tools

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Abstract

'IT based tools' can be broadly termed as Information and Communication Technology (ICT), enveloping all IT based tools including networks, devices, mobiles, services and application. ICT interventions are constantly being developed and tested around the world aiming to improve the livelihood through increased agricultural productivity, income and reduction in risks. Agricultural production including crop and livestock production can be effectively monitored through appropriate application of GIS (Geographical Information System) and remote sensing. These technologies are useful for tackling challenges like crop stress, soil problems and natural disasters. IT tools must be used for monitoring of demand and supply of agricultural inputs integrating various information on availability of improved varieties, seeds, fertilizers and pesticides in different locations. Using laser technology for optimizing the use of various inputs such as water, seeds, fertilizers etc. may be encouraged. Livestock individual database and analysis system must be developed. Dairy cattle individual information database and individual recognition system should also be developed. Use of satellite imaging data analysis should be adopted for forecasting agriculture related information like rainfall, area under different crops, soil properties and yield estimation. Post-production activities in agriculture mainly incorporate tasks to prepare crops for market, including shelling, storage, cleaning, grading, grinding and packaging agricultural products. A crop guide information system should be developed containing reliable and authentic information on important varieties, cultivation techniques, ideal fertilizer doses, pest/disease control measures, harvesting methods and post-harvest practices including primary processing at the farmer's field. Information of export procedures, rules and regulations should be made available to the producer so as to promote exports. Data pertaining to various aspects of agricultural marketing is important for policy formulation, infrastructure planning and research. State level informative website of agricultural market needs to be developed, which would provide information of each commodity, major areas of production, its movement and storage and major consumption centres. This will facilitate both the public and private sectors in development of proper marketing strategy in agricultural sector.

Key words: ICT, agricultural productivity, storage, marketing

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Introduction

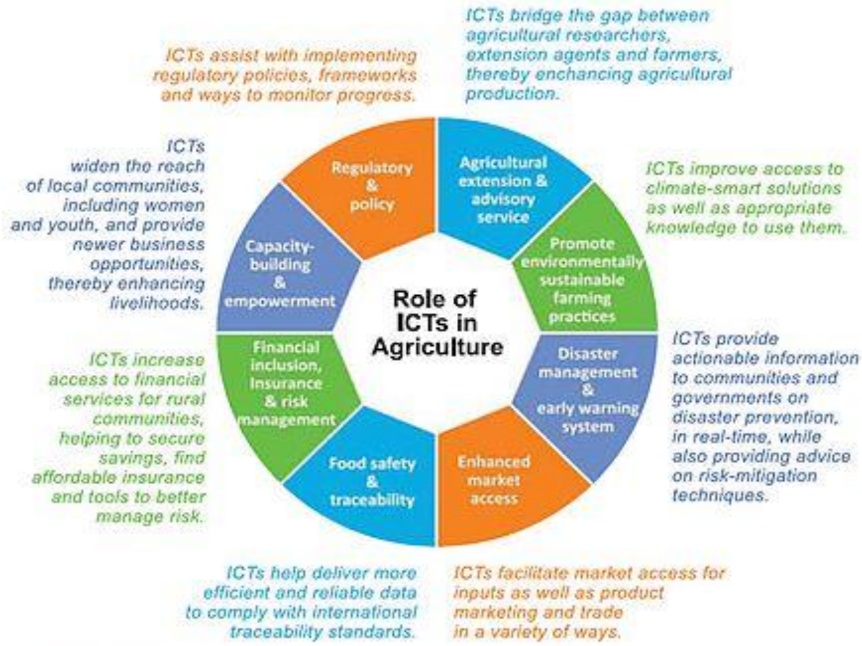
Agriculture has become main source of livelihood of approximately 70% of the people in India. In most of the developing countries, agriculture contributes lion share in national economy. Since last few decades, agriculture has been associated with production of essential food crops and fodder for domestic animals. Dairy animals provide people with milk which is a form of protective food. In addition, livestock also meets people's food requirements. Now-a-days, agriculture above and beyond farming includes forestry, dairy, fruit cultivation, poultry, bee keeping, mushroom, arbitrary, etc. Recently, processing, marketing and distribution of crops and livestock products etc. are all acknowledged as part of current agriculture. Agricultural products like sugar, tea, rice, spices, tobacco, coffee etc. constitute the major items of exports of countries that rely on agriculture. Thus, agriculture could be referred to as the production, processing, promotion and distribution agricultural products. Thus, agriculture has become vital for the survival of human beings and animals in the modern era. The produce from agriculture regulates trade from one country to another, fetches income for farmers, makes productive use of land, and brings food on the table. Considering the population growth and urbanization, there is severe disparity between production/supply and demand of food items from the existing land.

Information technology (IT) has transformed many aspects in human endeavour like transportation, communication, national security, health systems, marketing etc. to meet out the wide range of social needs. The IT has connected the world globally and is now changing our life style and social consciousness dynamically. However, information, and its automated technological embodiment, has not impacted agriculture to the same level in the past times. Now, with the advancement of civilization and availability of IT, the effect is becoming more and more visible in society and also in the field of agriculture. It refers to how we use the information, how we compute the information, and how we communicate the information to the people for their benefits. Information technology in agriculture has great potential for improving decision making, better planning, community involvement, agricultural breakthroughs, management processes and success in agri-business. Broadly, the potentiality of IT can be assessed in two ways- (i) as a tool for direct contribution to agricultural productivity, and (ii) as an indirect tool for empowering farmers to get informed and quality decisions which will have positive impact on agriculture and allied activities are conducted.

Concept of E-agriculture

The information and communication technology (ICT) in agriculture is known as E-agriculture. The technology relating to the field of agriculture is continuously improving for providing better services. It offers a wide range of solutions to many agricultural challenges through improved information and communication processes. The ICT acts as an umbrella which encompasses all information and communication technologies including devices, networks, mobiles, services and applications; these range from innovative Internet-era technologies and sensors to other pre-existing aids such as fixed telephones, televisions, radios and satellites. E-agriculture continues to evolve in scope as new ICT applications continue to be harnessed in the agriculture sector. More specifically, e-agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use ICTs in the rural domain, with a primary focus on agriculture. Provisions of standards, norms, methodologies, and tools as well as development of individual and institutional capacities, and policy support are all key components of e-agriculture. The Food and Agriculture Organization (FAO) of the United Nations has also given due emphasis to ICT applications on E-agriculture. Its application helps agriculturists to improve their livelihoods through increased agricultural productivity and incomes and reduction in risks.

The FAO-ITU E-agriculture strategy guide, developed by the FAO and the International Telecommunication Union (ITU) with support from partners including the Technical Centre for Agricultural and Rural Cooperation (CTA) as a framework for countries in developing their national e-agriculture strategy/ master plan, has been shown as under.



Source: FAO, ITU

The various advantages of E-agriculture include- timely availability of information and weather forecasts and calamities, better awareness, improved networking and communication, development of on-line trading, ready-made availability of recent farming practices of agriculture, better marketing and pricing opportunities, increase production and income, decrease agricultural risk and better representation at various forums/ platforms.

Information Technology (IT) based tools

Mobile phones, GPS systems, barcode scanners, RFID readers and smart card readers are all examples of technologies that can be used to capture, read and store data. However, further components, such as the internet, communication networks and regulatory systems for providing data security and standard systems for codes are essential to complement the input and output devices. The ICT can help agriculture farming life cycle in three stages- a) pre-cultivation which includes crop selection, land selection, calendar definition, access to credit etc. b) crop cultivation and harvesting which includes land preparation and sowing, input management, water management and fertilization, pest management etc., and c) post-harvest which includes marketing, transportation, packaging, food processing etc. Recently, mobile phones, tablets, applications and software are being used to collect basic data, monitoring and evaluation of different project from even remote rural communities along with their feedback. Farmers' friendly apps on various aspects are being developed and used to access the information within the shortest possible time.

Secondary agriculture/ Post-harvest technology

Secondary agriculture basically refers to the processing of products of primary agriculture or value addition to the primary agriculture. Sometimes, this also involves the tertiary processing where by-products from livestock and fisheries and crops residues or even the main crop is used for extraction of high value bio-active compounds e.g. use of livestock processing waste and fish processing waste, use of natural fibres for bio plastics and bio composites, culled potato and tapioca for bio plastics, extraction of pectin from peels of fruits, production of bio ethanol, exaction of vitamins and dietary fibre from vegetable waste and use of spent material as animal feed. Secondary agriculture has potential and can generate additional value to the farm produce in addition to income and employment generation and nutritional status for the farming community. Most of the farmers use to sell their agricultural produce immediately after harvest leaving a part for own consumption and seed purposes. However, post-harvest technology has the capability to meet out the food requirement of growing population through reducing losses making more nutritive food items after processing and fortification from various agricultural commodities. In this light, agro-processing industry viz. fruit and vegetable processing, grain processing, milk processing, meat processing, fish processing, packaged food, alcoholic beverages etc. in our country is continuously putting efforts to develop various innovative products. Generally, food items are marketed in different forms as raw, primary processed, secondary processed and tertiary processed. Primary processing refers purification of raw materials by removing foreign matter, immature grain and then making the raw material eligible for processing by grading in different lots or conversion of raw material into the form suitable for secondary processing. Secondary processing means processing of primary processed raw material into product which is suitable for food uses or consumption after cooking, roasting, frying etc. whereas, tertiary processing is nothing but the conversion of secondary processed material into ready to eat form.

Secondary agriculture can create agriculture based small industries at rural level which can balance the growth, economy and standard living between rural and urban sector. To make post-harvest industry a successful venture, focus should be given on maximum use of agriculture produce with minimum handling, eco-friendly processing and handling of waste materials, maintaining hygiene and quality of products, creating market demand etc.

Integration of IT based tools in agriculture

Since long back, data relating to agriculture is being collected in the traditional way particularly under field condition with the help of pen and paper for monitoring and evaluation of any developmental project. Although the process is time consuming and susceptible to human error that may affect productivity and accuracy, it is used due to easy accessibility and availability of very limited alternate options. But, information and communication technologies are now being used widely with remarkable positive results to perform these tasks in agricultural development projects. The information technology-based tools supports precision agriculture like computerized farm machinery, electronic sensor based feeding and identification of animals, online marketing and many others. It has been possible because of drastic change towards communication and internet facility at national and international level. Another such communication tool is the website which simply replaces the conventional media like newspaper, leaflets etc.

Agricultural production encompasses two large subsectors- crop production and livestock production. To effectively monitor agricultural performance, GIS (Geographical Information System) application and remote sensing can be utilized. These technologies are useful for tackling challenges like crop stress, soil problems and natural disasters. It tools must be used for monitoring of demand and supply of agricultural inputs. Various information on availability of seeds, fertilizers and pesticides in different location must be at fingertips of the farmers. Agricultural universities and other National Institutions are regularly releasing improved varieties of various crops. The importance of these varieties like its performance, disease resistance and adoptability should be made known to farmers through websites. For prompt identification and effective pest/disease control, audio-visual clips of the affected/diseased plant part/livestock with its prevention should be displayed on the website.

The ICT intervention directly or indirectly facilitates to improve the livelihood of rural agricultural farm families through enhancing agricultural production, proper marketing and adopting post-harvest activities. It also encourages accountability at each level, transparency and good governance. The best practices are now being adopted and expanded along with introduction of further refinements. Science-based tools are used for designing and setting up of different policy decisions to provide operational platform for agricultural modernization and rural development. The use of transparent, evidence-based, and innovative tools and approaches have been developed and tested by the agriculture sector including the vulnerability and suitability assessment (VSA), expanded VSA (e-VSA), value chain analysis (VCA) tools, rapid market assessments and use of geo-tagging with geo-mapping. Agro-industrial based enterprise development is one of the key contributory components for agricultural development and toward achieving targeted growth, job creation and increased farm productivity and income.

Online learning e.g. open online courses and their combination with scientific and educational content enables an increased flow of new information and learning to smallholder farmers. Online learning also makes it possible to monitor the capacity of institutions and communities to use this information effectively. The farming community can get benefit from agricultural advancements and can live sustainable lives by improving the production, harvest methods, and distribution of agricultural goods. All of these effects and more are possible through the successful merge of IT and agriculture which is why farmers are getting more and more encouraged to take part in this positive change. The use of some IT based tools is mentioned as under.

- Laser technology is used to plough a land which helps in optimizing various inputs like water, seed, fertilizer, labour etc.
- Crop production, livestock production and soil status can be monitored through GIS and remote sensing.
- Demand and supply of seeds, fertilizers, water, pesticides, feeds, fodders etc. in different places can be monitored using IT tools.
- Livestock and fishery related data base can be monitored through IT tools.
- Forecasting in agriculture can be possible using satellite imaging data analysis.
- Post production activities can be regulated through use of IT tools.
- Disease outbreak can be predicted by using IT tools Marketing strategy can be developed. Based upon the available data source the future policy can be formulated.

Future thrust

To meet out the future challenges in successful agri-business the planners must consider the following points for judicious use of information technology tools towards the benefit of farmers' fraternity and the society as a whole.

- Developing coordination between R&D institutes and agro-industries.
- Establishing controlled flow of agricultural produces from one place to another place.
- Developing strong market linkage.
- Availability of agri-venture capital in the country.
- Development of infrastructure i.e. road, transport, electricity, internet facility, storage facility, processing unit etc.
- Basic education of agriculture at school level.
- Developing farmers' friendly apps relating to agriculture in local languages.
- Developing alternate means power source.
- Implementation of comprehensive, integrated and long-term E-agriculture involving all stakeholders, and political and executive commitment with sufficient budgetary allocation.

Conclusion

Knowledge management through information technology based tools can play a pivotal role in enhancing agricultural productivity and addressing the problem of food insecurity in our country. Planned and systemic use of these tools in agriculture production system can definitely minimize the risk and uncertainty of all categories of farmers from the stage of production to successful marketing of agriculture produces. Adequate mechanisms are to be developed at different level for generating, capturing and disseminating knowledge and information through using IT tools which can be used for the benefit of agriculture development in the country. Side by side, there should be the scope for getting feedback of using different sophisticated information tools from the end users and the way of improvement for future use. User-friendly apps relating to agriculture with local languages may encourage the farmers. A better quality of life can be provided through developing rural decision making capabilities by supplying quality information inputs. However, special thrust to meet the international standards may be accorded to this sector. For penetration of the information Technology at the grass root level it is essential that the extension staff and the farmers are computer literate. Internet, cable TV and community radio should be used in integrated manner, to reach the unreached and include the excluded in information, knowledge and skill empowerment. State level informative website of agricultural market needs to be developed, which would provide information of each commodity, major areas of production, its movement and storage and major consumption centres. This will facilitate both the public and private sectors in development of proper marketing strategy in agricultural sector. A national coordinating agency with an advisory role can act as a catalyst in empowering e-agriculture. It should advice different organizations/agricultural sectors to gather information necessary for creating informative databases, websites and mobile applications. On the other hand, precaution must be taken to check the misuse of IT tools by the other countries through proper security measures.

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Extent of empowerment of women entrepreneurs on risk orientation and awareness creation

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ABSTRACT

Risk-taking is a major component of entrepreneurial activity and this is the reason entrepreneurs bear substantial risk. Women have been involved in entrepreneurship since time immemorial, learning the traditional family trades and services. Stiff competition in the market and lack of mobility of the women make the dependence of the women entrepreneurs on middleman indispensible. Many women entrepreneurs find it difficult to capture the market and make their product popular. They are not fully aware of the changing market conditions and hence can effectively utilize the resources. Hence the present paper focused on analyzing the risk orientation and awareness creation of women entrepreneurs. Majority of the women entrepreneurs had high risk orientation and medium awareness creation.

Key words: Risk orientation, awareness creation, empowerment and women entrepreneurs

INTRODUCTION

Entrepreneurship itself has been recently recognized as full-fledged profession and women entrepreneurship is an even newer phenomenon. The assertion and analysis of the concept of women entrepreneurship is essential to understand how they can be empowered much to take up entrepreneurial activities more on scientific manner. Many dimensions shall contribute for the empowerment of women entrepreneurs in general whereas the risk orientation and awareness creation would influence significantly in empowering the women to take up entrepreneurial activities. A few research studies focused their attention to understand the role and influence of these factors on empowering the women entrepreneurs. Keeping this in view the present paper focused on analyzing the extent of empowerment of women entrepreneurs on risk orientation and awareness creation

Material and Methods

Ex- post facto research design was followed for carrying out the study. The State of Andhra Pradesh and telangana region were selected purposively for the study as the investigator hails from the state. Out of 10 districts of the region, Medak district was selected purposively for the study.

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1. Ph.D scholar
2. Professor
3. Professor

Out of 46 mandals of the district, five mandals were selected randomly. The selected mandals were Siddipet, Thoguta, Chinnakodur, Nanganoor, Dubbak, Sangareddy. From each mandal two villages were selected at randomly. The selected villages were- Hensanpally and Bandarupally from Siddipet mandal; Thukkapur and Ghanpur from Thoguta; Ramancha and Lingareddypally from Chnnakodur; Nanganoor, and Akkannapally from Nanganoor; Dubbak and Cheekode from Dubbak, where as Pothireddy pally and Malkapur from Sangreddy mandal. Ten respondents were selected randomly from each village thus making a total of 120 respondents. Extent of empowerment was selected as variable for the study and Risk orientation and Awareness creation were the dimensions selected in it. An interview schedule was developed to collect the data from the respondents.

Results and Discussion

It could be indicated from the Table-1 that majority of the respondents (50.83%) had high risk orientation, followed by low (25.83%) and medium risk orientation (25.34%).

Table-1 Distribution of respondents according to their risk orientation

n=120

S.No.	Category	Class interval	Frequency	Percentage
1.	Low	23-29	31	25.83
2.	Medium	29-35	28	25.34
3.	High	35-41	61	50.83

The Table-2 indicates the rank ordering of the statements of risk orientation of the women entrepreneurs. The ranks assigned to each item on extent of risk orientation sensed that better use government policies reduce the financial burden in running enterprise ranked first followed by better to procure raw materials by avoiding middle men (rank II), high productivity levels dissolve high cost of operation (rank III), Periodical training updates the knowledge of entrepreneurs (rank IV), Ownership is always better than partnership (rank V), Chance must be taken in making big profits than to be satisfied with smaller one (rank VI), Location of the enterprise near to market will reduce the transport cost (rank VII), Timely repayment of loans and taxes provide financial stability to the enterprise (rank VIII) and Social participation and extensive market information avoids the difficulties in marketing (rank VIII), better to cease some of the activities due to price fluctuations (rank IX), Occasional reshuffling of the

responsibilities will pull down the problems associated with labour (rank X), Observation of the competitors will help in betterment of the quality of the product (rank XI), Cordial treatment and fulfilment of needs will considerably reduce the labour problems (rank XII), Maintenance of records on financial transactions will eliminate the problems in partnership (rank XIII) and Tie ups with the government will help in getting better price to the product (rank XIV).

The women entrepreneurs of the study across all the selected enterprises had high risk orientation followed by near to equal per cent of low and medium level of risk orientation. Young age, minimum level of formal schooling, high level of commitment aspirations, medium to high confidence and ability to coordinate might have triggered for high risk orientation.

The rank ordering of the statements of risk orientation further indicate that they were agreed on the issues of lessening financial burden due to availing government policies, procuring raw materials by avoiding middle men, dissolving high costs through high productivity levels for enhancing the risk taking ability of the women entrepreneur. Maintenance of records, tie-ups with the Govt. for better price and cordial treatment of workers and labour are the issues not much appreciated by the entrepreneurs to increase the level of risk taking. In this connection more institutional finance should be given to encourage women entrepreneurs to start new enterprises and strengthen existing enterprise. A mechanism may be designed to provide raw materials directly to the entrepreneurs and evolve steps to increase the productivity. These measures may contribute to enhance their risk taking ability. Much attention may also be given to imbibe the spirit of maintaining records and entering into the agreements with various Govt./ private /non govt. organisations which may facilitate enhanced risk orientation. The results are in accordance with the findings of Anitha (2003).

It is found from the Table-3 that majority of the respondents (38.33%) had medium awareness creation, followed by high (34.17%) and low awareness creation (27.50%).

Table 2. Rank ordering of the statements of risk orientation of women entrepreneurs n =120

S.No.	Statement	Agree		Undecided		Dis-Agree		T.S	M.S	Rank
		f	%	f	%	f	%			
1.	Better use of government policies will reduce the financial burden in starting and running the enterprise	67	55.83	42	35.00	11	9.17	308	2.56	I
2.	High productivity levels dissolve high cost of operation	63	52.20	44	36.67	13	10.83	290	2.41	III
3.	Periodical training updates the knowledge of entrepreneurs	63	52.50	41	34.17	16	13.33	287	2.39	IV
4.	Occasional reshuffling of the responsibilities will pull down the problems associated with labour	53	44.16	41	34.17	26	21.67	267	2.22	X
5.	It is better to procure raw materials by avoiding middle men	66	55	40	33.33	14	11.67	292	2.43	II
6.	Social participation and extensive market information avoids the difficulties in marketing	56	46.67	44	36.67	20	16.66	276	2.3	VIII
7.	Observation of the competitors will help in betterment of the quality of the product	53	44.17	39	32.50	28	23.33	265	2.2	XI
8.	Tie ups with the government will help in getting better price to the product	46	38.34	38	31.66	36	30	250	2.08	XIV
[illegible]	of other needs will considerably reduce the labour problems	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10.	Timely repayment of loans and taxes provide financial stability to the enterprise	63	52.20	44	36.67	13	10.83	276	2.3	VIII
11.	Location of the enterprise near to market will reduce the transport cost.	58	48.33	45	37.50	17	14.17	281	2.34	VII

Table 2 (contd.....)

S.No.	Statement	Agree		Undecided		Dis-Agree		T.S	M.S	Rank
		f	%	f	%	f	%			
12.	It is better to cease some of the activities due to price fluctuations.	56	46.67	42	35.00	22	10.33	274	2.28	IX
13.	Chance must be taken in making big profits than to be satisfied with smaller one	61	50.84	42	35	17	14.16	284	2.36	VI
14.	Ownership is always better than partnership	59	49.17	48	40.00	13	10.83	286	2.38	V
15.	Maintenance of records on financial transactions will eliminate the problems in partnership	42	35	48	40	30	25	252	2.1	XIII

Table-3 Distribution of respondents according to their awareness creation

n=120

S.No.	Category	Class interval	Frequency	Percentage
1.	Low	18 - 21	33	27.50
2.	Medium	21 - 24	46	38.33
3.	High	24 - 27	41	34.17

The Table-4 indicates the rank ordering of the statements of wareness creation of the women entrepreneurs. The ranks assigned to each item on extent of awareness creation highlights that majority of the respondents inclined towards entrepreneurship by the information provided by friends and neighbours (rank I) followed by the sources created awareness on entrepreneurship are Lack of availability of similar product in the market (rank II), Ancestral involvement in the enterprise and Previous experience or employment in the enterprise (rank III), Nearness to the market (rank IV) and Spouse involvement in the enterprise (rank IV), Easy availability of raw materials (rank V), High market demand of products (rank VI), Unemployment (rank VII), Success stories of other women entrepreneurs (rank VIII), Subsidies on machinery and equipment (rank IX), Government policies and incentives (rank X), Extended credit by various financial institutions (rank XI), Various entrepreneurial training programmes (rank XII), Background knowledge of management courses and Individual creativity is forced to find out the alternatives to exploit the potentialities (rank XIII).

It was noted from the results that medium level of awareness creation was prevailed among the women entrepreneurs as the entrepreneurs not undergone much training, poor socio-political participation, low in information source utilisation and not much access to formal channels of communication resulted in present trend of medium awareness creation.

More awareness is created among the respondents on enterprises through friends and neighbours followed by lack of similar products in the market, previous enterprise in the enterprise and proximity of market. It is easy for an individual to get aware of any innovation through friends and neighbours, the absence of products compatible to the products of intended enterprise, piled up practice acquired through experience in some activity and closureness of

Table 4. Rank ordering of the statements of Awareness creation of women entrepreneurs n=120

S.No	Statement	Yes		Yes		T.S	M.S	Rank
		f	%	f	%			
1.	Information provided by friends and neighbours created curiosity in you towards entrepreneurship	82	68.33	38	31.67	202	1.68	I
2.	Spouse involvement in the enterprise generated awareness towards enterprise	56	46.67	64	53.33	176	1.46	IV
3.	Ancestral involvement in the enterprise generated awareness towards enterprise	62	51.67	58	48.33	182	1.51	III
4.	Success stories of other women entrepreneurs in newspapers and magazines generated awareness about the entrepreneurial activity	36	30	84	70	156	1.3	VIII
5.	Government policies and incentive created awareness about enterprise	34	28.33	86	71.67	154	1.28	X
6.	Extended credit by various financial institutions have created awareness about enterprise	26	21.67	94	78.33	146	1.21	XI
7.	Various entrepreneurial training programmes organised by different institutions have created awareness	21	17.50	99	82.50	141	1.17	XII
8.	Background knowledge of management courses has enlightened the overall picture of the enterprise	20	16.67	100	83.33	140	1.16	XIII
9.	Previous experience or employment in the enterprise created awareness	62	51.67	58	48.33	182	1.51	III
10.	Easy availability of raw materials forced to know about the enterprise	48	40.00	72	60.00	168	1.4	V
11.	Subsidies on machinery and equipment under various government policies to empower women encouraged you to find about the suitable enterprise	35	29.17	85	70.83	155	1.29	IX

Table 4. contd….

Table 4. Rank ordering of the statements of Awareness creation of women entrepreneurs n=120

S.No	Statement	Yes		Yes		T.S	M.S	Rank
		f	%	f	%			
12.	Nearness to the market has generated awareness	56	46.67	64	53.33	176	1.46	IV
13.	Lack of availability of similar product in the market forced you to know about the enterprise	72	60.00	48	40.00	192	1.6	II
14.	Unemployment has created the situation to know about various employment generating activities	41	34.17	79	65.83	161	1.34	VII
15.	Individual creativity is forced to find out the alternatives to exploit the potentialities	20	16.67	100	83.33	140	1.16	XIII
16.	High market demand of products forced to start the enterprise	45	37.50	75	62.50	165	1.37	VI

selling places to the enterprise are the driving factors for getting awareness on any new enterprise. Creativity always cannot act as a propelling force to search for alternative ways. The respondents do not possess higher education, their poor attendance to the training programmes and low level of knowledge on credit offered by various financial institutions are the reasons for scoring less on some of the items of awareness creation. It strongly highlights that there is a need to inculcate the spirit of creativity and positive thinking, making to undergo higher education especially in management courses and facilitating to participate in various training programmes

Conclusion

The women entrepreneurs of the study across all the selected enterprises had high risk orientation and medium level of awareness creation. The respondents preferred to use the government policies better to reduce financial burden and to procure raw materials by avoiding middle men. More awareness is created among the respondents on enterprises through friends and neighbours followed by lack of similar products in the market.

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Family Farming and Small Scale Farming Systems: Challenges and Opportunities for Agricultural Extension

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The largest number of farm families in India is constituted by small farmers. The number of these families is bound to increase in the coming decades in view of divisions and fragmentations of land holdings. These holdings are becoming uneconomical which is further aggravated due to fragmentation of holdings and majority of these families are located in rainfed areas. Small farmers are generally facing the problems of low financial resources, do not own pair of draught animals to take care of timely land preparation, sowing and other farm operations. They are low risk bearing farmers in view of low confidence and limited knowledge. Due to aforesaid background great majority of them did not adopt the improved technology along with big farmers. Many studies have pointed out that either they have gone for delayed adoption or no adoption and in some cases partial adoption. In the process the gap between the rich farmers and poor farmers has widened. This was very much evident particularly after the 'Green Revolution' in India. In order to narrow the gap between resource rich farmers and resource poor farmers, many client based programmes were introduced for small farmers development during 1970's. The most important ones are:

1. Small Farmer's Development Agency, 1970-71
2. Marginal Farmer's and Agricultural Labourer's Programme, 1970-71
3. Integrated Rural Development Programme-1978
4. Lab to Land Programme Sponsored by ICAR, 1979
5. District Rural Development Agency / Society, 1980
6. Some states have also started specialized programmes like 'Anthyodaya' by then Rajasthan government to improve the socioeconomic conditions of these families.

Most of these programmes were implemented in selected parts of the country, they were time bound, poor linkages and more emphasis on physical changes than behavioural changes without addressing end to end issues, particularly marketing. As a result the improvement brought about due to these programmes did not sustain in the long run.

In the recent years, the dependency on external inputs and support has increased to all types of farmers, more so for farm power with the introduction of tractorization while in the yester years, the dependency was minimal and villages were self contained to a greater extent. The draught animals were owned by almost all the families in the yester years gradually declined particularly among small farmers. The conditions of small farmers in the recent years particularly after the commercialization and globalisation of a agriculture has become very weak both on resources and the confidence to continue in farming. Most majorities of big farmers have shifted to high value crops and gone for commercialisation of agriculture. The standard of living of big farmers has improved considerably while the small farmers living conditions remained to be same or further declined. The dependency of small farmers on large farmers has increased on timely farm operations besides certain critical inputs, non formal sources of loan and certain socio phychological factors in the social system. Both State and Central Governments have launched several programmes after 1990's including Institution Village linkage programme (IVLP) by ICAR, but they did not address wholistic development as well as end to end issues. There is absolutely need for a more comprehensive but also a sustainable programme to address the alround development of less resource farmers. Keeping all these developments, UAS, Bangalore took initiative to bring in sustainable development of farmers in general, small farmers in particular through the implementation of Rural Bio resource Complex project.

Rural Bioresource Complex Project (RBRC)

The RBRC project funded by Department of Biotechnology, Government of India was implemented by the University of Agricultural Sciences, Bangalore from April 2005 to March 2010 for a period of five years in Tubagere Hobli of Doddaballapura Taluk, Bangalore Rural district, Karnataka state with a budget outlay of 4.36 crores. The major objective was to bring improved standard of living of farmers including landless families and ensure farming as a profitable venture on a sustainable basis. Baseline survey was conducted to know the status and new opportunities for the development of these families. There were 8340 families spread over in 75 villages which included eight percent big farmers, 66 percent small farmers and 26 percent land less families. The other agricultural profile of every family and common infrastructure facilities were also studied including the extent of adoption of improved farming technology, constraints in adoption and problems.

Further analysis on the distribution of farm families in the project area revealed interesting information that 89.12 percentage of total farm families were small farmers. The development of small farmers cannot be addressed in isolation without giving due attention to other category of farmers in view of negative attitude they are likely to invite from other category of farmers in a social system. Therefore it was felt necessary in the initial debates and discussions by a team of Scientists to include even the agricultural labourers and rural artisans besides school going children in the main stream of development.

Interventions:

The project was implemented initially with five interventions namely:

a) Twenty two capsule of technologies which includes vermi compost, bee keeping, value addition and processing.
b) Providing timely information and training including linking of Village Resource Centres to Expert Centre established in collaboration with ISRO.
c) Ensuring required critical inputs for full scale adoption of improved technology including farm machinery on custom hire services.
d) Effective functional linkages to enlist synergy among related institutions.
e) Market intelligence to help the farmers to derive the best price for their produce.

Two pronged strategy namely; Integrated farming and addressing end to end issues were given due attention throughout the implementation of the project.

These interventions were implemented with the active involvement of 32 scientists coordinated by a Project Coordinator and assisted by a Associate Project Coordinator. A team of eight young scientists (Research Associates) representing different subject matter areas were appointed to work with one thousand families each. The activities were implemented under the close guidance and supervision of the senior project team. Although four interventions were effectively implemented, the intervention related to market intelligence was partially covered. The feedback analysis revealed that market intelligence was availed mainly by big farmers who generally produce large quantity at a time and it is economical for them to transport in a truckload at one go. In case of small farmers, the salable farm produces are marginal in quantities, it was found uneconomical for them to hire a truck to transport, difficulty in transporting through public transport and addressing the market dynamics individually is a big challenge.

Further, most majority of them are nucleus families, if husband goes for marketing, wife will have a problem to look after the entire family responsibility and vice-versa also. A strong debate and discussions were initiated for a period of six months with project staff, collaborating institutions and farmers to address this problem in the beginning of second year of the project. Thereafter, weighing all possible options, it was thought appropriate to promote Producers Associations to address the marketing problem.

Start of Producers Association:

Efforts were made by the project team with the active involvement of farmers during the middle of 2006 to start selected need based Producers Associations. This was the important milestone in the project work which was not conceived initially when the project was formulated.

Ten associations were started for the produces where the problem of marketing was more and they are;

- Rural Biofuel Growers Association
- Jack Growers Association
- Fruits & Vegetables Growers Association
- Organic Farming Farmers Association
- Flower Growers Association
- Corn Growers Association
- Federation of Women SHGs
- Fish Farmers Association
- Agro Processors Association
- Chawki Rearing Centres

Although the association was started with the objective of enabling realisation of best price for the produce, transport through organised group and bargaining for the fair price, later it was realised that it could be productively used to address majority of the backward and forward linkages. More specifically, promoting producers association was useful to manage critical inputs, technology, exchange of innovative experiences, farm machinery, credit, insurance, availing the facilities from government, storage facility, transport, sharing labour, value addition and processing, joint study tour and so on to develop farm families' particularly small farmers on a sustainable basis.

Outcome of the project:

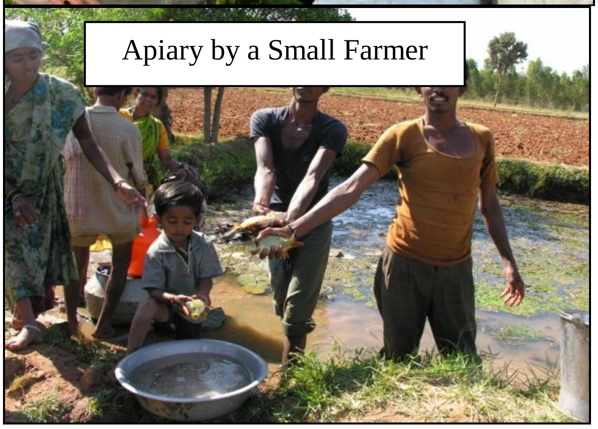
The project outcome reveals 11 percent growth rate in agriculture, more than two fold increase in net income for all the farm families including small farmers with 2.52 lakh man days of additional employment generation annually. The agricultural labourers got increased employment opportunities besides engaging in value addition and processing, sheep rearing, poultry, catching fishes in tanks and marketing so on.

The analysis revealed that the outcome was due to timely empowerment and providing critical inputs free of cost, timely farm operations particularly for small farmers because farm machinery was provided on custom hire basis resulting in full scale adoption of improved technology besides additional support system and knowhow from all the related institutions which were effectively synergised. In fact the benefit from these collaborating institutions was more than two folds compared to the project cost of 4.36 crores. The number of enterprises for each families was increased generally from two to five which supplemented and complemented the existing enterprises. More specifically apiary, Vermicompost, diary, Sheep, Poultry, Fishery, Sericulture, Baby corn, Sweet corn, small scale floriculture, nutritional gardening, value addition and processing, direct marketing responsibility by small holders and so on have together contributed for added net income and additional employment opportunities particularly for small farmers.

Low Vermicompost established by Youth

Chawki Rearing Centre established by Youth

Apiary by a Small Farmer



Farm Youth in Fish Harvesting

More income and employment generation were realised due to the start of 10 Producers Associations. The Rural Biofuel Growers Association was started in the project area with 42 rounds of meeting, visits and experience sharing which took nearly 18 months for commissioning the processing plant. The farmers who were getting Rs 5 per kg during 2006 were paid Rs.15 per kg and procured through Milk Producer's Cooperative Society from the respective service area with five percent overhead charges. Five unemployed semi skilled youth were given employment, payment was made timely and weighnent being transparent.

Dr. S. Ayyappan, DG, ICAR and Secretary DARE visiting a small Farmer's feild adopted Integrated

Many of the family owning biofuel trees were hesitant to harvest the produce before the formation of Association, now every family members are actively involved in harvesting, old age people are engaged in dehusking and cleaning while school going children are involved in planting the biofuel seedlings.

In case of Jackfruit, Jack Growers Association farmers were able to realise more than three fold added income for their produce. Many small farmers entered direct marketing of Jackfruit through Jackfruit melas in Lalbaugh and other places. These small farmers have realised four to five fold more income compared to bench mark year. Interestingly, many High School and College going students from these families have taken up direct marketing by selling bulbs since the Jack harvesting season generally coincides with summer vacation.

School Children involved in Biofuel momentum

Youth involved in Jack Fruit Nursery

Marketing of Jack Fruit through packing

The start of Fish Farmers Association was quite a good experience. Out of 321 water bodies, less than 20 were used for rearing the fishes during Pre Project Period. As a project intervention in the first three years, fingerlings were supplied free of cost to all the farmers owning individual water bodies including community tanks where group of youth were guided to manage. Further timely training inspired all of them to take up rearing fishes. The procurement of fingerlings from Hebbal/Hessaraghatta was done through common transport arrangement and also distribution by the project staff with the help of volunteers from each panchayat. The marketing was done at Doddabalalpur (near by town) on every Wednesday and Sunday in a specified place and time by the association representatives. The payment to the fish farmers was done in the same day/next day in relation to the quantity supplied and rate realised which use to be nearly two folds compared to the bench mark year. The consumption of fishes has increased several folds more so by small farmers. The activity also provided additional employment to the fish farmers and agricultural labourers. The Fish Farmers Association was started during fourth year of the project and thereafter, they managed enterprise independently.

Similarly, women federation for value addition and processing, marketing of fruits and Vegetables, sheep producers association and chalky rearing centre have made varying impact on the income and employment generation. Interestingly all these associations are continuing in the same wavelength despite the project was withdrawn during March 2010. The follow-up work and needed guidance is provided by the scientists of KVK established in the project area by the ICAR during quarters.

Training of Farm Women on Preparation of Value Added Products

As a result of increased income among the farm families, it was observed improved nutritional status particularly among children and women, increase in material possession such as mobile, motorcycles, household utensils and furnitures, construction of new house, renovation of existing house, behavioural changes such as communication skills, leadership qualities, change in social status such as recognition through awards, using them as resource persons in the KVK training programmes and other ongoing extension programmes. Some of the office bearers and awardees were invited in the adjoining districts, outside states, colleges and Universities to share their valuable experiences by paying respectable honorarium. These awardees were extremely happy about their recognitions and opportunities created expressing that they hardly dreamt. The overall standard of living of these families was improved significantly compared to baseline report fulfilling the objective with which the project was started. These findings were the outcome of two M.Sc. (Agri) and three Ph.D. studies besides the final completion report.

Summary:

The resources of small farmers are less compared to big farmers thereby they are unable to realise the full production potential. Marketing is the biggest challenge they find it difficult to address individually besides many social as well as psychological problems. In the Indian social system, it is difficult to isolate small farmers and extend development support.

There are many ongoing programmes launched by both the respective state and central governments exclusively meant for small farmers which could be dovetailed for their development. In the project work, effective linkages were ensured by actively involving all the development departments,, financial, marketing and research organisations.Hence there is need for addressing them together with other farmers for their overall development in the Indian context.

Hon'ble Former Prime Minster of India, Sri. H. D. Deve Gowda visited the project area during February 2013 spending nearly six hours and said at the end of the day that this is the model, India wants for sustainable development of farmers.

Sri. H. D. Deve Gowda, Former Prime Minister and MP observing Value Added Products displayed and interacting with SHGS

In view of the comprehensiveness of the model, by promoting integrated farming, ensures independency for the farmers to stand on their own and improving their confidence level, particularly through producers associations, more employment generation, emphasis on eco friendly technologies and above all respectable price for their produce, the model has relevance. Therefore, there is absolute need for replicating this cost effective model with suitable refinement to suit different agro climatic regions and socio cultural mileau to bring about sustainable development of small farmers in India.

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Future Agricultural Extension: A Prophesy to Innovations in Extension Approaches

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Agricultural extension started as delivery arms of research, in developed and developing countries. The system was basically designed and integrated with much applied research works, along with trials and studies, as well as outreach efforts. The modus operandi of this special branch of agricultural social science is different in various nations like public, private, partnership based, Information Communication Technology based etc. with the ultimate aim to serve the farming community. Realizing the crucial need of speedy transfer of technology to accelerate technology dissemination and adoption, the extension system in independent India started different methods and models devoted for extension education, technology assessment and refinement and its transfer. Extension system and services in India have traditionally been funded and delivered by the Government and hence it has been considered as a public good. In the era of globalization farmer's needs are diversified which added so many challenges to the extension system to innovate good models to carter time specific demand. Even though it has been blamed as most collapsed system, extension science in our nation attained its momentum in recent years and presently considered an object of reform, while continuing to be an increasingly important engine for knowledge, innovation and development. In the present paper, an attempt has been made to analyse the past and present extension modalities and to give a road map for the future directions in extension system which allows flexibility to visualize or foresee the emerging situation in farming community and respond locally.

Key words:

The agriculture which has a history of 10,000 years, no longer is a life supporting art. It changed the face from simply growing crops for consumption to an enterprise. Ever changing nature of the human demands, consumer preferences and natures adaptation to different unforeseen natural phenomena crated much pressure on the divine age old practices in crop cultivation and it assumed to a new player as a business endeavour in this current era of human development. These changes made many transformations in the scientific and social aspects of the culture which prevailed in the agriculture. Agricultural extension originated as educational aid to carter the information needs of the farmers near to their homes, rapidly changed its function as delivery arms of research in the Indian agricultural scenario. Agricultural Extension is the main responsible authorized discipline for the diffusion and utilization of knowledge and information which is created, stored and captured in research and innovation system of the agricultural science. Extension enjoyed a long and illustrious history of promoting meaningful and beneficial development in the communities it serves in the initial stages of its development as a discipline (Peters 2001). Ever coming changes in the preference of farming community, changing environment in which Extension is being operated propagate changes (McDowell, 2004) in the status of the extension discipline among the other disciplines of the agriculture. But the discipline which once enjoyed the status of excellence in field work in 1960 to 1980s is now blamed by others as most collapsed system in the country. Many practitioners and academicians who had sympathy and concern to the science in the extension contributed a lot to change the culpability of the agricultural extension in the field of technology dissemination and information sharing for the betterment of livelihood of the poor farmers. In order to give a future road map of innovations in extension approaches, there is a need to look through the attainment and failure of the extension models which arise time to time to meet the demand of the clients.

Glimpse of past experience and present status of Indian agricultural extension system

Realizing the crucial need of speedy transfer of technology to accelerate technology dissemination and adoption, the national agricultural research system of India has started different units solely devoted for extension education, technology assessment and refinement and its transfer. The extension models conceptualized and implemented to reduce the gap between Lab and Land which ultimately catalysed rapid advances in productivity and production in the independent India. National Demonstrations (1965), a series of demonstration being conducted by the extension scientists themselves in the farmers' field all over the country was one among this and it helped the research system to observe how the new technologies was behaving in farmers' field. Minikit Trials (1972), Operational Research Projects(1974), Lab to Land programme (1979) and High Yielding Varity programme (1966) etc. are also added feather to the crown of the national extension system. The training and visit system (1984) designed for building a lined professional extension service that is capable of guiding the farmers in agricultural production and raising their income by providing appropriate plans for country development supported by the World Bank made the status of the extension services as an indispensable part of field life and farming. But after the withdrawal of the financial support by funding agencies for the extension activities changed the fate of agricultural extension system in India. India has witnesses the glorified past and tragedian present of the extension system due to the public good status of the extension services. Extension system and services in India have traditionally been funded and delivered by the Government and hence it has been considered as a public good. But present situation made changes in the status of agricultural extension and extension is no longer a public good. In Indian condition Agricultural extension persons can reach only 6.8 per cent of the farmers in India (GFRAS 2012) due to the less manpower availability. We may have the financial means to increase the coverage but we do not have the technical and institutional capacity to carter the changing need of the ever-increasing population. The extension worker to farmer ratio is very wide in India, i.e. 1 : 3000-5000 and with a total of about 60 thousand extension workers at present (Davis et al. 2010; Kaur et al. 2014; Mukherjee and Aniruddha 2015). From the past experiences, it is evident that lack of access to the technologies among the farmers due to limited capability of public extension system was the major constraint to augment the production and productivity.

In the era of globalization farmer's needs are diversified. More emphasis is on market oriented and beyond production information rather than mere production information. These add again so many challenges to the extension system. Considering all these challenges extension renovated the approaches which leads to more focus on the demand side of the services. In this way Krishi Vigyan Kentras (KVK) (1974) and Agricultural Technology Management Agency (ATMA) (2000) has started working. Present day they are the working hand of extension system in the field level. Further, for promoting private sector to effectively supplement, complement and wherever possible to substitute public extension Agri Clinic and Agri Business Centers (ACABC) scheme and Diploma in Agricultural Extension Services for Input Dealers (DAESI) was initiated. For meeting information needs of farmers related to agriculture and allied sectors many extension strategies were undertaken like Agriculture Technology information Centres (ATIC) for single window delivery system; Kissan Call Centers (KCC) for immediate and cheap information; mKRISHI as mobile based services; IARI post office linkage (Krishi Dak) model as an innovative extension approach to reach the unreached; Farmers' Portal as one stop shop; DD Kisan a dedicated 24X7 agriculture channel; community radio etc.

In spite of the all efforts made in our country, there is a mismatch between what farmers need and what we actually provide them and this stems from the fact that most of our extension services are supply led rather than demand driven. There is a need felt to introspect and reorganise the extension approach by innovative effort with a shifting towards new, location specific, demand driven and pluralistic for reducing the workload of conventional system (Babu and Joshi, 2015).

Future Agricultural Extension: A paradigm Change

Futuring or giving a road map is a rigorous process of thinking about the future in order to form well considered expectations which could able to bring a better tomorrow or future rather than waiting to to see what fate brings and analysing it to find out the falling points to suggest some strategies (Graham Cochran etal.2014). About 50 years ago, agricultural extension was introduced to the concept of developing logic models which graphically depicted how our activities translated into desired outcomes by making the behavioural change among our clients i.e. farmers. But future of extension should not be built in the concept of making changes in our client behaviour, but it should be stand on the concept on changes and innovations in the extension strategies itself for adapting with the demands arising among the client population from time to time.

1. **Market oriented extension work:** Extension has moved from the status of just providing messages to farmers, to involving market access, food safety and trade issues. There is a need of innovative ways so that the extension workers are equipped to deal with these emerging issues. Extension professionals must need to adopt marketing strategies to be competitive in the information marketplace (Maddy and Kealy 1998). Preferred approach to extension is through farmer groups. It is an approach where one offers not only agriculture solutions and advice, but one try to answer as many farmers' needs as possible, from marketing and access to credit, to the right seeds and planting material. In this one should try to involve as many young people as possible for the perpetuation and sustainability of the model adopted.

2. **Innovations in extension delivery system**: Today's rapidly changing social and economic environments oblige Extension to re-conceive the future through creative thinking and innovative action to reduce barriers to success. It is mainly by not to try to fix the problems in the past but instead use wisdom to become smarter at what we do and how we do it in extension activities. (Argabright et al. 2012). We need to stop viewing the farmer as someone who does not know anything. The farmer has knowledge and one want to work with the farmer to identify his problem and identify the solutions. That is an attitude change on behalf of the researchers and the disseminators. Then the attitude change on the part of the farmer is also to be more proactive in seeking solutions and taking up opportunities. There is no proper mechanism at the field level to understand farmer priorities, analyse field problems, provide feedback to researchers,

provide problem solving support, engage in technology adaptation, promote fodder cultivation or educate about preventive health care of animals etc.

3. **ICT leveraged extension model:** According to predictive reports, technology experts agree that by the year 2025 technology will have progressed to mobile and wearable devices embedded computing will be tied together in the Internet of things, allowing people and their surroundings to tap into artificial intelligence-enhanced cloud-based information storage and sharing in all aspects (Anderson & Rainie, 2014). Since, agriculture and allied sector also showing an increasing trend in this direction, there is any future for extension unless it uses ICTs. No country will ever have the money for one extensionist to serve five hundred farmers again. If we look on a worldwide scale, communication is impossible without ICTs. ICT is a wonderful tool for extension. Where person to person contact is not feasible, ICT can take over and perhaps that can help in reaching out large number of farmers with information on agriculture and allied sectors. Through ICTs farmers can access market, crop husbandry, animal husbandry and disease related information by just sending a text to a designated number from their mobile phones. But still there is much local knowledge around that is only transmitted orally, and this is equally as important as ICTs. However one should note that interpretation of ICT messages and translating those messages into specific action relevant for farmers often need human networks (eg; could be farmer organisations, e-choupal or farmer field school). Merely putting information on the website or sending SMS alone is not enough especially when you are dealing with complex problems. Government of India is also investing heavily on use of ICTs in agriculture. M-kisan portal, Kisan Call Centres and the much recent Kisan television channel (DD-Kisan) are all initiatives that focus on use of ICTs.

4. **Making a pluralistic system of extension work:** It is now widely accepted that no single actor or agency is best placed to offer the wide ranges of advisory services required. This means that a plurality of service providers is needed to meet the needs of producers and the rural poor. In many countries, NGOs, private companies and farmers' organisations are delivering extension services to producers using a range of modalities. The role of governments must be that of ensuring quality. There is should be a good understanding of what the comparative advantages of each type of provider are and in what kind of context.

Efforts really need to be made for a synergetic effort, one where the actors do not perceive themselves as competitors, so that they complement each other. The future lies in public-private sector partnership, remembering that farmers are part of the private sector. One cannot expect the government to do everything, but at the same time the government needs to create an enabling environment for these things to happen. Every effort should be made to coordinate the activities of the educational institutions, government departments, international development agencies and the non-government organizations in providing an effective extension service to the farmers. The extension systems have to be pluralistic and the participation of the private sector in the provision of extension services should be more for the reform process as the extension systems in our countries become more demand-driven (Babu and Joshi, 2015).

5. **Beyond production extension:** Orientation of the extension system in India is still largely centred on the production technology-related knowledge sharing. Yet there is great need for a holistic approach to sustainably develop the food systems that goes beyond production technologies. Since the productivity and capacity of the land reached its fullest potential, farmers could not able to make profit only because of production. The primary focus of agricultural extension today is no longer on increasing production but rather on enhancing rural incomes through market-orientation and responding to farmer demand. For decades, agriculture has been associated with production of essential food crops. At present, agriculture above and beyond farming includes forestry, dairy, fruit cultivation, poultry, bee keeping, mushroom, etc. Today, processing, marketing and distribution of crops and livestock products etc. are well acknowledged as part of agriculture. Agriculture sector needs streamlined supply chain in the form of well functioning marketing infrastructure to make “farm to fork” model as reality. There is need to strengthen the capacity building of extension functionaries as well as farmers through organizing farmers field schools in this regard.
6. **Reorienting the extension policies and education approaches:** There is a need for a relook at the multiple schemes implemented by various line departments and to integrate them in a way to provide one-stop solution to farmers challenges at the village level. Without a comprehensive agricultural extension policy, agricultural extension is unlikely to get the priority and attention it deserves.

Therefore formulation and implementation of an extension policy should be the first priority for improving extension delivery. Though there are different methods of extension, say for instance, demonstrations, trainings, exposure visits, farmer field schools, farmer group approach, mobilising farmers into producer companies, farmer to farmer extension, use of farmer volunteers, local service providers, different ICTs etc, there is no academic input that guide extension personnel to select the appropriate approach that suit the specific local context. In regions, where farmers are facing a lot of distress (where there are large number of farmer suicides) you might need an altogether different approach. Extension personnel should have the knowledge of the merits of these different approaches, what it costs and the ability to choose from several different options. We can’t simply load everything to ATMA or the KVKs. There is need to have flexibility in the present extension setting to visualize or foresee the emerging situation and respond locally. There is no academic support to guide extension professionals on these aspects and here comes the role of research in extension and proper application of the findings.

7. **Attracting rural youth in farming**: India is world's youngest nation. Out of 132 crore total population, there are 356 million youth in the country at present. Around 41 percent of India's population is below the age of 20 years. By 2020 the average age of Indian population will be 29 years. It will be the strong area for the country if one could able to tap the potentials (The Economic Times, 2016). It can go otherwise also if the challenges are not addressed properly.The rural youth may be encouraged, trained and supported for undertaking innovative farming and associated ventures like agri-tourism to supplement income. There are several challenges in promoting innovative ideas and innovation which attract and retain the rural youth in agriculture. Lack of knowledge among farmers, lack of training opportunities to learn about new innovation and implementation of these innovations and absence of policies and infrastructure support that can support their initiatives are some of the major challenges. Extension can play major role in overcoming these knowledge and training barriers. Sufficient resources should be invested to improve not only technical skill training, and entrepreneurship development but also a range of other skills and competencies, particularly those ‘soft’ skills such as communication, leadership and business skills. This can be achieved effectively,

if youth are mobilized through youth clubs, financially supported under extension reforms.

Conclusion

The future of extension can be viewed with optimism. Extension workers have been planners, developers, and agents of change in the past in many countries. In order to turn this optimism into action, will require properly trained, competent, and future-oriented extension workers and changed strategies of work. There is an urgent need to foster the policies and culture that encourages open minded, positive attitudes and thinking related to innovations, futuring and increasing capacity for change. Without an innovative approach toward creating Extension's future, troubles will fester, and morale of the extension worker will continue to decline. Extension's priorities must transform to meet the needs of the people, the way they need to be met, doing things in ways that have never been done before. Then only extension can leverage knowledge, release constraints on talent, destroy existing barriers, and discover its full potential.

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Gender based Extension Strategy to Strengthen Household Food and Nutritional Security in India

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I. Malnutrition scenario

Nutrition security of all human beings continues to be an important item in the development agenda of the global community. This is clearly reflected in the Sustainable Development Goals (SDGs) of the UNO to be achieved by 2030. Out of 17 SDGs, the first three, i.e. No Poverty, Zero Hunger, Good Health and Wellbeing are directly related to nutrition. The fifth one, i.e. Gender equality has significant implications for creating a nutrition secured society-a target that is still elusive despite the collective efforts of countries and organizations across the globe. Globally, 795 million people, 10.9% were chronically undernourished during 2014-16. Out of 780 million undernourished people in developing countries, 194.6 million people in India, constituting 15.2% of its population, were malnourished during the said period. Only 9.6% of total children (aged 6-23 months) receive adequate diet in India. About 38.4% of the children (under 5 years) in India are stunted, 21% are wasted and 35.7% are underweight. About 56.4% women have Body Mass Index (BMI) in normal (18.5 - 25 kg/m^2) range where 61.2% men have BMI in normal range. About 58.4% children (6-59 months) are anemic, 53% women and 22.7% men (15-49 years) are anemic (NFHS, 2016). Thus, incidence of malnutrition is relatively more among women and children.

Women who suffer malnutrition are less likely to have healthy babies. Consequently, new born infants are unable to get adequate amount of nutrition from their mothers. Deficiencies in nutrition inflict long-term damage to both individuals and society. Compared with their better-fed peers, nutrition-deficient individuals are more likely to have infectious diseases such as pneumonia and tuberculosis, which lead to a higher mortality rate. In addition, nutrition-deficient individuals are less productive at work. Low productivity not only gives them low pay that traps them in a vicious circle of under-nutrition, but also brings inefficiency to the society, especially in India where labour is a major input factor for economic production.

II. Present extension system and farmwomen

In India, about 65% of women workers are engaged in agriculture and a high proportion of women workers are involved in pulse production, vegetable production, dairying and many other activities that are directly or indirectly related to food and nutrition security of the population of country. But what is really worrisome is poor access of these women to quality inputs, new knowledge, technology and other agri-services which continues to be the most important factor for low productivity of women in agriculture and poor performance of agriculture sector. Such a state of affairs can be attributed partly to the fact that agricultural extension services and research are generally governed by the existing socio-cultural climate and gender relations in the farming communities. As a result, farm women are often less reached by extension systems. Women typically access fewer rural advisory services than men (Manfre *et al.* 2013). Globally, only 5% of women have access to extension services. Extension services worldwide remain dominated by men. It is estimated that globally only 15% of extension agents are women (World Bank, FAO and IFAD 2009). Therefore, it is important to understand gender equity issues in the existing extension services of India and their implications for agricultural growth and development. In the light of above, priority areas should be identified and interventions should be reoriented from women's perspective keeping in view the personnel, time and location accessible to both farm women and men.

Case Study-1: Krishi & Pasu Sakhi Model: An innovation for resource poor farm women in Rajasthan *(Ponnusamy et al., 2017)*

Mahila Kisan Sashaktikaran Pariyojana in Rajasthan is largely implemented through Krishi & Pasu Sakhi Model. For Agriculture activity, 900 Krishi Sakhi and for Livestock activity, 150 Pasu Sakhi have been developed. These Sakhis are supported by field coordinators, Subject Matter Specialists and Agriculture & Livestock Assistants. An innovative extension model has been developed where villagers can access the agriculture & livestock related information and inputs in a decentralised technology transfer system called Krishi & Pasu Sakhi model. Krishi & Pasu Sakhis are a farm women who are practising agriculture & livestock as their livelihood source, providing extension and input delivery to 25 to 30 families in the same village. Farming and animal rearing related groups were formed by Pasu Sakhies. Number of technologies are demonstrated in their own plot/house in order to see their results by fellow group members. Pasu Sakhi is also engaged in deworming, vaccination, organising animal health camps, wheat straw urea treatment, *azolla* pit installation, mineral brick preparation, input sale to animal rearers so that they can buy and feed their animals.

Case Study 2: Women Extension Volunteer (WEV) model in Ghana

(Miriam and Brent, 2013)

It developed by Voluntary Service Overseas (VSO) and Ministry of Food and Agriculture (MoFA), Ghana to address female farmers' constraints and needs. The WEV model is a peer-to-peer extension approach that uses community-based female volunteers to increase agricultural information dissemination in rural northern Ghana. The WEV model have main objective of improving women's access to extension services and providing a model for sustainable community based extension systems. WEVs are female farmers who volunteer to offer basic extension services in the communities in which they live. Specifically, they work with farmer groups, offer on-demand extension services, and liaise between local farmer groups, MoFA and Non Governmental Organizations (NGOs). The approach is designed to increase the reach and coverage of extension services at a low cost, with a focus on serving female farmers. The WEV model was established to supplement and complement the services of public sector extension agents.

III. Gender friendly extension system

While looking at extension system as an institutional mechanism for delivery of inputs and services, due attention should be given to include female extension workers in the team so as to reach out to women clientele and facilitate both women and men for adoption of new technologies leading to higher agricultural production.

There are two approaches mainly used to address gender issues in agriculture (Njuki *et al.* 2013; Farnworth & Colverson, 2015). First, gender accommodative approach accepts existing gender inequalities while suggesting gender sensitive interventions. It doesn't address the root cause of gender inequalities and designed to facilitate deprived gender (e.g. providing tubular maize sheller to reduce women's drudgery in maize shelling). Second, gender transformative approach seeks to transform gender inequalities by addressing their root causes (e.g. Enhancing women's access to and control over resources such as land, credit, extension services, etc.). Transforming gender relations at individual, social and institutional levels help to address gender issues in agriculture more effectively and efficiently. While designing extension strategy, both these approaches may be simultaneously tried. Presence of women extension agents in the system makes the system gender sensitive and in a way lessen the dominance of male extension workers in the system which is very often cited as a reason for the persisting gap between extension system and farmwomen. Further, orientation of extension personnel on gender issues through sensitization and training would make them gender sensitive. During past years such steps have been taken by the governments and other agencies. A number of states have already made the provision of allotting one-third of agri-extension positions to women. Similarly at programme level, explicit provision has been made to spend at least one-third of the budget on women through gender budgeting. Despite these pro-women measures, a large segment of women in agriculture and allied sectors is unreached and quality extension services still elude them. Hence, the question is, how can the present extension system be innovated upon to bridge the extension gap?

Now-a-days, communication technologies are playing a big role in disseminating information and connecting the source with the end users. Ultimately, it is the distance between the source of information and the user, ease of interfacing, quality of information available and cost of accessing the information that determine the effectiveness of innovations. Though these innovations in information & communication technology are quite common today in research and development sectors, agriculture is still lagging way behind. This may be due to the characteristics of users, technology developers, information generators and attributes of the technologies demanded. Rural women, who are involved in multifarious activities both at home and outside are low in human development face many socio-cultural restrictions. In such a situation, high-tech means of communication and dissemination of agri-information among farmers and farmwomen has not been effective. Moreover, the complexities of problems related to agriculture, food and nutrition warrant information capsules which are difficult to prepare and deliver through ICT. Therefore, creating a mechanism to strengthen village level extension whereby women can discuss their problems directly with extension agents as and when required, and get those addressed could prove an effective extension strategy. In this context, the Gender Sensitive Village Level Para Extension Worker (VPEW) Model developed and tested by ICAR-CIWA (Sadangi *et al.,* 2011) is quite promising. Under this model two para-extension workers comprising one man and one woman from a locality are selected for the job of acting as a conduit between villagers and government extension officials. They are suitably trained in agriculture and exposed to the functioning of extension systems and various activities. Being present at grass root level, they have immediate access to farmwomen and vice-versa. Thus the interface between para-extension workers and rural women become more frequent and flow of information takes place in both ways. Real problems get identified and diagnosed. Success of the model depends on how promptly these para-extension workers facilitate address solving of the problems. As discussed above, since rural women are involved in multifarious activities, both productive and reproductive, the problems encountered by them are many. Therefore the para-extension workers should be trained and educated in a number of subjects covering critical areas related to crop production, livestock management, nutrition, government welfare schemes & initiatives, etc. so that they may be able to facilitate rural women in getting right idea, right inputs and right information for agricultural production and family resource management. The para-extension workers can be given area specific like livestock rearing, crop production, homestead nutrition gardening, women friendly tools and technologies, health & sanitation, etc. training under skill India programme for scaling up their potentials and sustainable extension services.

IV. Holistic intervention involving women

There are a number of pathways to address the issue of nutrition insecurity. The overall approach depends on what are the reasons for malnutrition. There are many causes for the prevalence of under-nutrition in India. One is inadequate access to balanced food and lack of exposure to nutrition education. Long term food security demands production technology of non-cereal food as well as technology access to the small producers especially women farmers should be promoted. The informed decision making by women farmers can reduce the burden of malnutrition to a great extent. Many traditional vegetables and underutilized legume crops are an essential source of energy, vitamins, micronutrients and protein and, thus, a valuable component to attain nutritional security. Some of the interventions that may be targeted involving rural women are given below.

(a) **Enhancing pulse production:** While the availability of cereals in India has gone up, it is a matter of concern that per capita availability of pulse is grossly inadequate; important reason being dwindling area and production of pulses. As data suggest, pulse production has declined from 18.2 million tons in 2010-11 to 17.15 million tons in 2014-15. This has resulted in declining and per capita availability of pulses which is just around 40g/day as against the RDA of 80g/day. Pulses, being an important source of protein, different essential amino acids, vitamins and minerals, do form an inalienable component of human diet and under-consumption of pulses is therefore the most likely cause of malnutrition. One of the pathways to increase production of pulses could be to strengthen women's role in pulse production through science and technology interventions supported by farmer friendly policies to make pulse production remunerative. Additionally, available fallow lands around village may be brought under pulse cultivation with involvement of women groups. Despite having a host of programmes like NFSM, ISOPOM and developing pulse villages under RKVY in India, pulse production during first four years of XII Plan has been far from satisfactory, though the pulse production is estimated to touch 22 million tonnes in 2016-17.Considering the fact that women are both the producers and consumers of pulses, and at the same time, they play an important role in household food & nutrition management, involving and empowering women groups in pulse production through targeted interventions such as transferring improved pulse production technologies, seed production technologies, imparting training and regular advocacy at different stages of crop cycle, organized marketing, price incentives would create a positive impact on pulse production and household nutrition in the country. Towards this end, village level Para extension workers can play a pivotal role in learning the technologies and demonstrating the same in fields.

(b) **Nutrition garden**: Though production of fruits and vegetable have increased manifold, many of the rural families do not have adequate access to these food groups both in terms of quantity and quality. Apart from timely availability, prices are some of the factors that constrain the access of rural people to these foods. Therefore, development of nutritional gardens in the homesteads where family members including women can contribute their labour is a convenient and effective way to improve consumption of fruits and vegetables. What is required is scientific planning of the nutritional gardens and orienting women on the technology.

The diversification of farming systems through integrated farming systems or mixed farming models offers more scope of nutritional security at household level by integrating scientifically all the basic four food groups (carbohydrates, proteins, fats, minerals & vitamins). The focus on these components is require but the relationships created among them by the way we integrate them in the homestead garden is relatively more important. In this case also Village level Para Extension workers can play an important role for promotion of nutrition gardens by making available quality seeds and package of practices to women.

(c) **Livestock and poultry rearing:** Though rearing of milch animals and poultry birds are common in rural areas; low yield from these sources is one of the reasons of poor access to animal based products. Therefore, scientific management of such resources is critical to augment availability of foods like milk and egg at household level. Interventions could be at household or community level. There are many government programmes that women can take advantage of. In this case also village level para extension workers can facilitate timely flow of information both ways benefiting rural women.

(d) **Nutrition education**: Lack of proper awareness and education among a large section of rural women on nutrition requirements, nutrition sources and benefits and nutrition related problems is an important factor of malnutrition. Often availability of different food sources fail to ensure nutrition security due to ignorance of women about what is required and what is to be taken. Lack of knowledge about food value of different food sources make it difficult for taking consumption related decisions at family level which affects nutrition of family members. Further, there are many practices related to cleanliness and hygiene of children that contribute to malnutrition. Therefore, it is imperative to promote nutrition education among rural women where in village level para extension workers can play pivotal role by disseminating nutrition related information brochures.

V. Conclusion

The gender balanced extension service delivery mechanism could enhance extension personnel's reaching to both men and women farmers. The available location specific technologies and extension services should be tailored according to the food & nutritional needs of farm families. The formation of women farmer groups and introduction of the concept of women farmer friend will be the good start under ATMA model in India. The training of village-based representative women farmers on food and nutritional aspects is an effective way to sustain the household nutritional security. Ultimately, the effectiveness of extension agents whether women or men in reaching and assisting women farmers will probably depend on the features of the extension system. Hence, there is need to formulate gender sensitive national extension policies involving all stakeholders engaged in agricultural extension, research and development for building gender transformative agricultural extension facilitation system (Ambra 2010, Babu *et al.* 2013).

In conclusion, there are a number of pathways to address the issue of nutrition insecurity at household level. Long term food security demands production technology of non-cereal food as well as technology access to the small producers especially women farmers should be promoted. Many traditional vegetables and underutilized legume crops are an essential source of energy, vitamins, micronutrients and protein and, thus, a valuable component to attain nutritional security. The informed decision making by women farmers can reduce the burden of malnutrition to a great extent. Extension systems need to facilitate both men and women to become an active change agent for gender sensitive decision making at household level. Therefore, it is worthwhile to capture, integrate and scale out best bet practices to build gender transformative agricultural extension system for strengthening household food and nutrition security in India.

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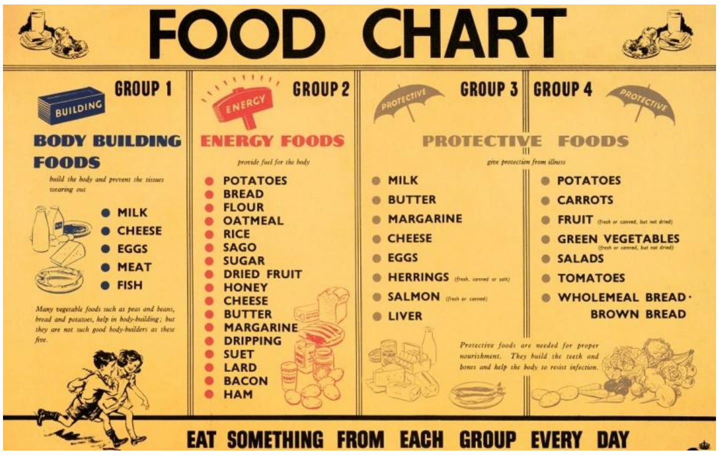

INTERACTIVE INFORMATION DISSEMINATION SYSTEM (IIDS) – AN ALTERNATIVE ICT MODEL TO MEET THE INFORMATION NEEDS OF INDIAN FARMERS

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Abstract

'Interactive Information Dissemination System (IIDS)' has been designed after rigorous field study of 26 ICT initiatives in agriculture in India and information needs assessment of farmers across 12 states of India. This study was undertaken in a project awarded by Indian Council of Agricultural Research under National Agricultural Innovation Project (NAIP).The IIDS is now being up scaled in three states. The benefits realized by the farmers are they are being provided personalized advices on Agriculture, Horticulture, Animal Husbandry and Fisheries. Farmer can record their queries 24x7 through Toll Free Number. Farmers are provided with Text & Voice messages in local language (Telugu).Farmers are provided emergency messages and alerts on their mobile. The impact of IIDS is seen on shift in the Source of Information and was found that the farmers who were earlier dependent for agriculture information on their friends & neighbors and Input dealers are now calling on Scientists on toll free number. The IIDS has got vast scope to cover in all State Agricultural Universities in India to enhance outreach.

Key Words: *IIDS, information needs, ICT, State Agricultural Universities*

1. Introduction

The Indian Council of Agricultural Research (ICAR), Government of India, New Delhi has awarded the project under National Agricultural Innovation Project (NAIP) to Media Lab Asia, as a Consortium Leader with Acharya N.G. Ranga Agricultural University (ANGRAU), National Institute of Rural Development (NIRD), Hyderabad and Mudra Institute of Communication, Ahmedabad (MICA) as the partners, to develop an alternative ICT model to meet the information needs of Indian farmers. As part of that, Interactive Information Dissemination System (IIDS) was developed and successfully pilot tested in Telangana and Andhra Pradesh states of India.

The IIDS has been launched by the Secretary Government of India, Department of Electronics and Information Technology, Ministry of Communications and Information Technology (MCIT) in 2013 in Telangana and Andhra Pradesh states through Krishi Vigyan Kendra. After successful implementation of the IIDS model in Telangana and Andhra Pradesh states, the same model was implemented in Central Agricultural University, Imphal as m4agriNEI.

2. Literature Review

Gidda Reddy et al., (2011) reported that, quality inputs availability, pest and disease management, updated weather and market information, farm mechanization, and government schemes were the major information needs of farmers

Gidda Reddy et al., (2011) stated that, the ICT initiatives are moderately useful for farmers for obtaining agriculture and related information for their farms. Though, the queries of farmers were addressed as required, the expectations of the farmers are high and hence the utility and performance of the ICT initiatives need to be improved.

Gidda Reddy et al., (2011) reported that, by becoming member of the ICT initiatives, majority of the beneficiaries are being respected by the villagers and consulted them for the agricultural information.

Anurag et al., (2014) concluded that, the concept of IIDS is very relevant to the agricultural extension functionaries. The information dissemination through multimedia (Text, Voice, Image and Video) is very appreciable; if one mode of dissemination is failed other can reach the farmers. IIDS will be a better alternative ICT model to the farmers because; from field itself he/she can interact directly with the scientists.

3. Methodology

A comprehensive need assessment study was carried out to develop an understanding of the agriculture related ICT needs and problems of the farmers in using ICT, with a special focus on the small and marginal farmers in using ICT in various agro and socio-economic situations by doing primary survey using structured schedules / questioners, focused group discussion and Participatory Rural Appraisal. Total of 26 ICT initiatives in agriculture were studied covering 1381 Farmers in 57 selected sample villages in 12 states of India to elicit the felt need of the farmers, prioritize their perceptions and bring out the reality of the issues involved in development of ideal ICT applications for agriculture.

4. Results and Discussion

4.1 Situation analysis

Mobile is the most popular ICT gadget among the farming community; the study shows that 72 per cent of the farmers possess mobile phones, followed by TV (61%) and Radio (42%). Radio is mostly popular in the area where the power availability is very poor. Farmer needs information mainly on Pest and Disease (45%), Field Preparation (44.9%), Nutrient Management (41%), Input Availability (39.5%), Market Information (32%) and Weather Information (22%). Most of the farmers believed in the information provided by their Friends and Neighbors (61.5%) followed by ICT provider (53%) and Local Input Dealer (46.4%).

Major Gaps / Limitations & Way Forward:

Gaps Identified	Way Forward
Mobile Based Initiatives	
Text SMS	
Generic Information Delivered	Requirement for farmer's specific information
Language / Literacy Barrier	Requirement for voice & Image based information Exchange
Limited records of the farmers & their farming details	Requirement for Updated info

No direct interaction with expert (for push based services)	Requirement for personalized advisory
Voice Calls	
Largely Push based services and information delivery at undesired time	Requirement of right information at right time as time desired by farmer
No direct interaction with the with expert (for push based services)	Requirement for personalized advisory
Call Centre / IVRS	
Information provided (at both ends) on voice alone is not always complete	Requirement for other modes of information exchange for better understanding
Service available only at prescribed time (i.e office hours)	Service timing required as convenient to farmers
Limited records / database of the farmers	Requirement for complete & updated database - Farm & Farmers
No / very limited follow up of services	Requirement for Experts field Visit and other feedback mechanisms
Web Based Initiatives	
Accessibility & Adaptability is low	Requirement for User Friendly Interfaces
Abundant / Generic information is provided	Requirement for region & farmer Specific filtered Information
Mass Media Initiatives – Community Radio Station	
One way communication	Requirement for 2 way communication medium
Largely push based information	Requirement for personalized information

4.2 Way Forward

The major findings of this study are crucial for choosing and designing the future strategy and system to provide ***'Information to the farmers as and when they require'.*** There is a requirement for an integrated approach which should cater the problems of farmers in using ICT applications in agriculture such as accessibility, acceptability, simplicity, timely & useful information (right from the choice of inputs in the farming system to marketing of the farm products) in location specific manner.

In view of the above, the following approach is envisaged in an ICT based holistic extension system:

- There is a need for aggregation & cater the farmer queries in multimedia mode i.e voice mode (i.e. in local language) along text, image and video.
- Requirement of farmer friendly and simple interfaces to access information and advisory services in effective manner preferably through smart phones
- Need is to develop a combination of push and pull based interactive system (essentially pull based) so that the communication can be possible in both ways, i.e from farmers to expert and vice versa.
- Requirement for interlinking of location specific information from various service providers to cater the specific needs of the farmers
- Requirement for interlinking of location specific information from various service providers to cater the specific needs of the farmers
- Requirement of maintaining farmer's database with their farming details, so by referring to it an expert can provide appropriate solution to concerned farmer's query.
- Requirement of expert support system which has user friendly interfaces and reference content (e.g SAU's Knowledge repository, farmer's details, FAQs from the farmers query, etc) for fast and proactive delivery of advices. The system should also facilitate an expert to be virtually available by giving him any time anywhere access.

4.3 Interactive Information Dissemination System (IIDS)

This is an integrated model based on the study and analysis of 26 major ICT Initiatives in agriculture in India. This model is largely integration of Toll free IVRS, Smart Phone Application and Web based agricultural advisory system. The major limitation in current information dissemination system i.e call center, IVRS system and mobile services are lack of database of farmers, such as location of the farmer, type of field, crops grown, status of the farmer, need of the farmer and other demographic and agriculture profile. Thus, in the proposed system each farmer have to register himself by providing certain details which would be stored in the database and a profile and requirement (need) of each farmer would be recorded. The agricultural expert would provide the personalized solution based on the inputs provided by the farmers and his available profile. Also this system would allow farmers to send images / videos of the field along with their queries by using a smart phone. This system would be helpful in addressing farmers' information need on important aspects including agriculture technology, crops / plant protection, weather information, market prices, government schemes etc in location specific manner.

USP of IIDS System

- Personalized ‘Agro Advisory’ Based on ‘Farm and Farmer Profile’.
- ’Personal Assistance’ to raise ‘Multimedia Query’
- Live Interaction with Scientists
- Facility to ‘Refer Critical Problems’ to relevant ‘Crop Specialist’ available virtually
- ’Round the Clock Query Registration Facility’ through IVRS & Smart Phones
- ’Anywhere Anytime Access’ on Past Advisories
- Facility to ‘Push Emergency Message’ to Farmers based on Location and Crops
- ’Network Independent’ – Accessible from All Networks

Fig 1: IIDS Framework

IIDS Applications & its Features

It is an integrated system with a combination of Web, IVRS and Mobile Technologies for dissemination of farm and farmer specific advises/information at user desired mode and time. The major applications are - Mobile based application, Web based application and IVRS based application. The major features are as follows:

(i) Mobile application for smart phones

- Standalone Application
- Offline query aggregation capabilities.
- Data Synchronization at hot spots / areas of data connectivity (store and forward).
- Offline capability of display of last synchronized data.
- Coordinator information system (profile page, visit scheduling, list of registered farmers).
- Farmer registration and profile.

(ii) Web based application (www.akps.in)

- Colour coded iconic based logins for various type of users
- Expert support system linked with authentic content / information service providers.
- Information dissemination and aggregation system (multimodal).
- Centralized common database for web, mobile & IVRS applications.
- Reports and analytics.

(iii) IVRS based application (Toll free number: 1800 425 3141)

- Call incoming facility on expert's computer.
- Call forwarding and recording facility in case if the experts are not available.
- Intelligent enough to route the call to the relevant experts.
- 24x7 query registration facility for farmers

Benefits to the farmers through IIDS:

- Farmers are being provided personalized advice on Agriculture, Horticulture, Animal Husbandry and Fisheries from their Krishi Vigyan Kendra (KVK)/ District Agricultural Advisory and Transfer of Technology Centre (DAATTC) on Toll Free number (1800-425-3141).
- Farmer can record their queries 24x7 through Toll Free Number.
- Farmers are provided with Text & Voice messages in local language (Telugu).
- Farmers are provided emergency messages and alerts on their mobile from Krishi Vigyan Kendra (KVK)/District Agricultural Advisory and Transfer of Technology Centre (DAATTC).

As a joint initiative of PJTSAU and Media Lab Asia, the IIDS is being up scaled in 9 districts (old) of Telanagana KVKs/DAATTCs. 13,000 plus registered farmers are being served with this IIDS.

The IIDS model is useful in enhancing the extension outreach through KVKs and DAATTCs. The implementation of IIDS has elevated the image of the Professor Jayashankar Telangana State Agricultural University (PJTSAU) extension in terms of increased direct interaction of farmers with scientists over toll free number, dissemination of farm information through mobiles (text and voice messages in telugu) and Annapurna information corners, functional linkages among the Department of Agriculture, Animal Husbandry and Fisheries and Indian Council of Agricultural Research (ICAR) institutes.

Farmer's feedback:

- Farmers are able to talk to the Scientists directly over a mobile phone.
- Farmers are receiving the messages in local language.
- Farmers are receiving text as well as voice messages on their mobiles.
- Farmers are using the text messages as Reference and showing to the input dealers to get the right pesticide from the shop.
- Timely information helped in reducing no. of sprays/application of excessive use of fertilizers etc.
- Illiterate farmers are also comfortable in receiving messages, since information is given through voice messages.
- Messages related to production, protection, post harvest and weather are sent to the mobiles of farmers.
- The weather forecasts helped the farmers, to avoid the unnecessary irrigations before rains, postponing of crop harvests etc.
- Short films are loaded in the mobiles of project farmers thereby farmers are accessible to the information with multimedia experience.
- Reduced production cost
- Increased awareness about use of ICTs in agriculture

4.4 Impact analysis

While interviewing the respondents regarding the perception of IIDS, 98.0 per cent of the respondents agreed that IIDS service is giving clear information on the subjects they required 91.7 per cent of the respondents agreed that IIDS service is providing the farmers with timely information and 98.3 per cent of the respondents agreed that information provided by IIDS service is easily understandable.

- The effect of Scientist-Farmer interaction programme was appreciated by 66.2 per cent of the respondents.
- Only 46.4 per cent respondents agreed Field diagnostic visit is useful. Since they didn’t get much exposure on the same.
- The interaction between the innovative farmers and other farmers has been accepted as a useful system by 69.3 per cent of the respondents.
- Majority of the respondents informed that usage of chemical fertilizer (88.8 per cent respondent) and pesticides (91 per cent respondent) has been reduced due to the fertilizer and pesticide management information provided by the IIDS model.
- The shift in the ‘Source of Information is found among the IIDS farmers and it was noted that 92 per cent farmers who were earlier dependent for agricultural information on their friends & neighbor is reduced to 56 per cent and 68.7 per cent farmers who were dependent on Input dealers is reduced to 35 per cent due

to the provision given to the farmers to direct interact with the KVK/DAATTC Scientists on Toll Free number.

Table 1: Perception about the IIDS Model:

Sl. No.	Statements	Agree	Undecided	Disagree
1	IIDS service is giving the clear information	98.00	0.6	1.4
2	IIDS service providing the farmers timely information	91.7	0.00	8.3
3	Information provided by IIDS service is complete	90.5	1	7.3
4	The information provided by IIDS service is easily understandable	98.3		1.7
5	The information provided is practicable / adaptable in the field conditions	97.9	0.4	1.3
6	Annapurna Library is useful to get information	9.00	69.3	21.7
7	Scientist – Farmer interaction Programmes is useful	66.2	30.2	3.6
8	Field Diagnostic Visits is useful	46.4	50.5	3.1
9	Innovative Farmer to other farmers interaction programme is useful	69.3	31.2	9.5

Table 2: Progress in Agriculture due to the IIDS services:

S. No.	Item	Increased	Decreased	No Change
1	Use of chemical Fertilizers	1.7	88.8	9.5
2	Use of chemical Pesticides	2.2	91.2	6.6
3	Marketing information	90.4	7.1	2.5

4	Cost of cultivation for crops	4.5	87.0	8.5

Table 3: Source of Farm Information before & after the initiation of the IIDS service:

S. No.	Sources	Before	After
1	IIDS service		97.5
2	Friends and neighbors	92.5	56
3	Local input dealers	68.7	35.0
4	Daily News Papers	32.0	17.0
5	Monthly Farm Magazines	21.0	18.0
6	Television	21.7	15.0

CASE STUDIES

1. V. Husya Naik, Turuputhanda Village, Damarcherla Mandal, Nalgonda district

ID: 76208990, Mobile number: 9642450240, No. of calls made: 41

He has registered in IIDS through Krishi Vigyan Kendra (KVK), Kampasagar, Nalgonda district. He got the advisories on pest & disease management, fertilizer management, seed treatment chemicals, weather information etc. He has used the text messages as reference to buy the pesticide from dealers shop.

He could reduced the cost of cultivation by Rs. 3,500/- per acre of Rice and got an increased yield of 6 bags per acre, and the net benefit obtained by him was Rs.8,000/- per acre.

2. P. Kashanna, Kummera Village, Thadur Mandal, Mahabubnagar district

ID: 24336565, Mobile number: 9440166676, no. of calls made: 31

He has registered in IIDS through Krishi Vigyan Kendra (KVK), Palem, Mahabubnagar district. He got the advisories on pest & disease management, fertilizer management, varieties etc. He has used the text messages as reference to buy the pesticide from dealers shop. Voice and text messages are helpful to protect the crop time to time. He has reduced the no. of sprayings (from 6 to 3), saved an amount of Rs. 6,000/- due to reduced no. of sprayings and also got the yield advantage of 5 quintols per acre in Rice crop by adopting the experts advices got through toll free number.

5. Conclusions and Recommendations

The concept of IIDS is very relevant to the agricultural extension functionaries. The information dissemination through Multimedia (Text, Voice, Image and Video) is very appreciable. IIDS is can be a better alternative ICT model to the farmers because; from field itself farmer can interact directly with the scientists. As the farmer get the solutions on their mobile itself in local language, even though he/she is illiterate, if he/she can't remember also, he/she can show the text message to the input dealers to get right inputs from the shops. The personalized advisories to the farmers are more appreciable in this model as the scientist can refer the farm profile and history before providing the solution. It will be a good monitoring tool to the scientists of KVKs/DAATTCs to monitor the farmer's field and it will be a good knowledge management system for knowledge providers and policy makers. During the natural calamities, the text & voice message facility in IIDS is very useful to the farmers for regular information dissemination.

At present, the IIDS is being up scaled in 9 districts (old) of Telanagana KVKs/DAATTCs. 13,000 plus registered farmers are being served with this IIDS through Krishi Vigyan Kendras (KVKs) and District Agricultural Advisory and Transfer of Technology Centres (DAATTCs). In view of the vast scope of IIDS services, it is recommended to be replicated in other states of India especially by the state agricultural universities and departments of agriculture.

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Issues and challenges in Livestock Extension

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SUMMARY

The contribution of livestock sector to the national economy in terms of Gross Domestic Product is 4.1% at current prices during 2012-13(GOI, 2014). The livestock sector including dairying has been identified as one of the most promising sectors having potential to boost Indian economy further and a potential contributor for doubling the farmers' income by 2022. The demand for milk is set to touch 200-210 million ton by 2020-21. The livestock production especially dairying in India is run largely by millions of landless agricultural labourers, marginal and small farmers having no formal qualifications and training in livestock production. A sizeable proportion (80 per cent) of India's milk production is contributed by small and marginal farmers, who maintain mostly one or two milch animals of low genetic potential for milk production. These animals are primarily fed on crop residues and by-products, and reared with the help of under-employed family members, mostly female workers. Nearly 80 per cent of the Indian dairy industry is still unorganized. Indian Dairy sector employs about 8.47 million people on yearly basis out of which 71% are women (ASCI, 2015).

Livestock farming in India would not turn out to be a profitable business until and unless livestock farming is carried out on a commercial lines and due attention is given to bringing the smallholders in the organized marketing fold. Development of value added products industry would increase marketing avenues and contribute to increased production through better utilization of surplus products. About 40% of total milk produced is handled as liquid milk. Establishing small-scale ventures for the production of value-added products would go a long way in improving the economics of livestock production and meeting consumer demand.

Livestock producers benefit from institutional innovations that link them with markets, like promotion of agribusiness, market reforms, organisation of back end and front end and good pricing. There is a need to explore the feasibility of alternate market avenues in the form of forward contract and pool marketing and encouraging the states for contract farming under which the buyer can provide the farmer access to modern technology, quality inputs, other support and a guaranteed price.

There are 800 dairy plants in the country, but only 18% milk is handled by organized sector. Processing, including manufacturing of different dairy products, engages

only 1.2% of dairy workers in both the formal and traditional informal sectors. A little over 6% of workers in the dairy sub-sector are engaged in selling of milk and milk products, including both wholesaling as well as retailing. Higher proportions of workers in the dairy sector in rural areas are engaged in production-related activities (95%) and less than 1% in processing. Dearth of trained human capital with adequate qualifications remains a major concern in the unorganized dairy sector. Even in organised sector, National Skill Development Council has pointed out several skill gaps and requirements, many of them pertain to extension based soft skills (NSDC, 2009). Moreover, even in organised dairy sector, only the bigger dairy companies have skilled manpower to perform dairy operations. The presence of unskilled professionals along value chain with inadequate knowledge in dairying is one of the serious constraints with respect to dairy development (ASCI, 2015). Moreover, rural producers are currently unable to adopt good dairy husbandry practices due to variety of constraints. These workers often have least opportunities to institutional sources of information. Extension and advisory services in livestock sector are woefully lacking. Lack of information has been cited as most important factor for dairy product quality vis-a-vis prescribed standards in India (Jagadish, 2013). Farmers have not been able to harness the full potential of their animals because they lack required information on feeding, housing and other managemental practices which could enhance productivity and product quality. This paper, thus, discusses various needs of livestock and dairy farmers on good practices in the areas of production, health management, housing, feeding, and processing etc which can be catered by strengthening informal education mechanisms including an enhanced use of ICT enabled communication tools.

Introduction

The contribution of livestock sector to the national economy in terms of Gross Domestic Product is 4.1% at current prices during 2012-13(GOI, 2014). The livestock sector including dairying has been identified as one of the most promising sectors having potential to boost Indian economy further. The demand for milk is set to touch 200-210 million ton by 2020-21... The dairying in India is run mostly by millions of landless agricultural labourers, marginal and small farmers having no formal training in dairying, who maintain mostly one or two milch animals of low genetic potential for milk production. These animals are primarily fed on crop residues and by-products, and reared with the help of under-employed family members, mostly female workers. Nearly 80 per cent of the Indian dairy industry is still unorganized (Jagadish, 2013).A sizeable proportion (80 per cent) of India's milk production is contributed by small and marginal farmers. Indian Dairy sector employs about 8.47 million people on yearly basis out of which 71% are women (ASCI, 2015). There are 800 dairy plants in the country, but only 18% milk is handled at organized sector. Processing, including manufacturing of different dairy products, engages only 1.2% of dairy workers in both the formal and traditional informal sectors. A little over 6% of workers in the dairy sub-sector are engaged in selling of milk and milk products, including both wholesaling as well as retailing. Higher proportions of workers in the dairy sector in rural areas are engaged in production-related activities (95%)

and less than 1% in processing. In urban areas, about 31% of the dairy workers are engaged in selling of milk and milk products (Staal et. al., 2008). Dearth of trained human capital with adequate qualifications remains a major concern in the unorganized dairy sector. Even in organised sector, National Skill Development Council has pointed out several skill gaps and requirements, many of them pertain to extension based soft skills (NSDC, 2009). Part of the reason is that even in organised dairy sector, only the bigger dairy companies have skilled manpower to perform dairy operations. The presence of unskilled professionals with inadequate knowledge in dairying is one of the serious constraints with respect to dairy development (ASCI, 2015). Moreover, rural producers are currently unable to adopt good dairy husbandry practices due to variety of constraints. These workers often have least opportunities to institutional sources of information. Extension activities in dairy management are woefully lacking. Lack of information has been cited as most important factor for dairy product quality vis-a-vis prescribed standards in India (Jagadish, 2013). Farmers have not been able to take advantage of the potential of their animals because they lack information on feeding and management practices.

With intensification of crop/ livestock production systems and increased market demand in developing countries, importance of extension information is likely to increase substantially. (Morton and Matthewman, 1996). Extension, especially for women involved in livestock rearing, would enhance dairy production considerably. There is strong social capital and trust in the villages, which can sustain dairy farmer organizations if properly managed (Jagadish , 2013). Henceforth, it is imperative to determine the perceived informal education and information needs for different types of information by dairy farmers in India and the effectiveness with which it is provided and used.

Livestock Extension information need and requirements

Major agencies involved in dairy extension information delivery are State Animal Husbandry Departments, Dairy Co-operatives, KVK, ICAR extension centres, producer groups, paravets and NGO's (Hegde,2012)These agencies use different forms of extension information delivery (individual, group and mass contact methods) to the target clientele. However, livestock information delivery suffers from several limitations and is currently ineffective. The information delivery is skewed towards feeding, breeding and animal health(Ali, 2011). This is understandable given the fact that the thrust of government has been on these major aspects of livestock production. Even the research studies (Subash *et. al.* 2015, Phand *et. al.* 2009)suggest that farmers have also shown preference over information on these aspects.

Areas of Information Needs

According to FAO and IDF (2011),Dairy farmers, as the primary producers in the supply chain, should also be given the opportunity to add value to their product by adopting methods of production that satisfy the demands of processors and customers. They need to adopt Good Dairy Farming Practices in following broad areas:

I. Animal health
II. Milking hygiene
III. Nutrition (feed and water)
IV. Animal welfare
V. Environment
VI. Socio-economic management

These practices ensure that safe, quality milk is produced from healthy animals using management practices that are sustainable from an animal welfare, social, economic and environmental perspective.

Subash *et al.* (2015) prioritized dairy farmers informational needs of Karnal district, Haryana based on the weighted mean score of each subject area. According to them, most wanted information by farmers was in the areas of nutrition and feeding, breeding and reproduction, general management, health care management and fodder production respectively.

Animal nutrition

i. Feeding schedule for milch animals
ii. Information on mineral mixtures
iii. Formulation of ration
iv. Information on calf starter
v. Complete feed block
vi. Complete feed for dairy animals
vii. By pass nutrient technology
viii. Colostrum feeding to new born calf

Dairy Breeding and reproduction

I. Detection of heat
II. Time of service
III. Pregnancy diagnosis
IV. Artificial insemination
V. Selection of milch animals
VI. High yielding breeds of animals
VII. Gestation period
VIII. Breeding heifer
IX. Suitable cross breed to the region
X. Castration of scrub bulls were major areas in order.

General livestock management

I. Clean milk production
II. Care & management of milch animals
III. Housing & sanitation management
IV. Care & management of new born calf
V. Record keeping
VI. Milking methods were regarded as important areas in order.

Livestock Health care management

I. Vaccination schedule
II. Knowledge about diseases
III. Control of external parasite
IV. Deworming practices
V. Disinfection of shed
VI. Disposal of dead animals
VII. Isolation of sick animals
VIII. Fodder Production
IX. Fodder crops and its cultivation
X. Conservation of fodder
XI. Chaffing fodder
XII. Making of urea treat straw were information needs in priority.

Phand *et al*.2009 in a pilot survey in Pune and Ahemadnagar district of Maharashtra assessed that animal health management remained most important area in which farmer needed information. Among animal health, information about symptoms and diseases management was most sought after by farmers. Reason they attributed was high percentage of crossbred cattle, high incidence of mastitis and other diseases in the region.

Also, NSSO report (2005) revealed that in the year 2003, information received by households on animal husbandry were mainly on breeding, feeding, health care etc. and the prominent sources were 'radio', 'input dealer' and 'other progressive farmers. Health care was major concern of interest for households, accessing information on animal husbandry. On the other hand, for the households obtaining information through input dealer, interest was more in feeding.

Although, information delivery in areas of animal health and production is vital, marketing information in today's market-driven, high-value food economy has become even more important. One of the initial information resources required in dairy enterprise is access to information about quality animal source market. Also, the dairy owner needs to know about marketing opportunities to run the enterprise profitably. This was also highlighted by Ali in 2011 who reported that livestock information delivery in Uttar Pradesh was skewed towards feeding, breeding and animal health and nutrition and laid less emphasis on information related to livestock management, processing and marketing.

Raksha (2014) in her study assessed information needs of the women livestock owners of Jharkhand. In her study, it was found that cent per cent farmwomen wanted information on

i. Credit/subsidy schemes.
ii. Milk products and their preparation.
iii. Marketing of milk and milk products.
iv. Marketing of sheep/goat/pig/poultry.

So information on the issues like, production and marketing of the livestock products and its value addition is also a very crucial area where information provision and trainings are required by the women. She also reported that cent per cent women respondents were always utilizing relatives and neighbours as sources of information on livestock matters. Also, cent per cent had never asked any matter related to livestock to any KVK specialist.

Gaps in current livestock extension information delivery

The current livestock extension information delivery remains largely unreached to the masses. NSSO in 2005 reported that percentages of households obtaining information on animal husbandry were very small (less than 6%). This is unfortunate given the fact that India has a relatively large institutional infrastructure for extension delivery. One of the reasons for ineffective extension information delivery seems to be quality of information. In one of the study, Ali 2011 reported that with respect to quality of extension information, livestock owners of Uttar Pradesh gave average rating. Relevancy, accuracy, sufficiency, and timeliness of service delivery for better decision making were kept as criteria for effective information delivery.

In India, the grassroot extension workers have been found to be lacking essential extension skills. According to National Skill Development Council, to participate in organised milk marketing, producer is expected to have certain basic extension skills. These skills involve identifying a loyal consumer locally, or becoming a member of village level cooperative for getting the best prices of the produce. Similarly, basic quality requirements and ways to maintain hygienic conditions, implementing basic value addition in terms of pre-heating, etc. for minimising wastage are also needed. The estimated share of persons who reported to have attended some kind of formal training in agriculture has been found to be very low at 1.1 per cent at all India level. The proportion of female workers receiving any training in agriculture is even lower (NSSO, 2013). In a study, Devaki & Senthilkumar(2013) reported that among the livestock farm women respondents, majority (51.00 per cent) of them had a low perception of information need and the reason might be due to their low level of education and socio-economic status.The information access in dairy farming has been significantly lower among female livestock owners with respect to their male counterparts(Thakur and Chander,2006) Even in the organised sector, extension related skill gaps have been identified. Dairy personals working at procurement level have been found to have poor extension networking skills to maintain good relationship with the farmers and milk producers/village cooperatives. Also, inadequate communication skills, especially in local language because of diverse dialect have also been observed (NSDC, 2009).

Dairy cooperatives have been reported as institutions providing better veterinary services delivery than other institutions. They are engaged in provision of extension and advisory service delivery to its 11 million farmer members. However, access, satisfaction level and willingness to receive extension information have been found to be low even among dairy co-operative members (Chander and Sulaiman, 2014). NGOs too, need to improve the professional competence of animal husbandry information providers

Also, the predominance of production-related information may be largely due to supply side constraints of livestock extension information. (Ali, 2011).Access to market based information can empower poor smallholders, men and women, so that they can provide high-quality, sustainable livestock production (IFAD,2010). Timeliness of information is of critical importance to livestock farmers in the case of market-related information (Ali, 2011). One of the weaknesses of Indian dairy marketing system is the presence of numerous intermediaries, which take advantage of producers' weakness (Rajendran and Mohanty ,2004))

Direct communication between end buyers and producers can be a powerful tool in helping producers to understand the implications of competitiveness in Livestock Markets. IFAD ,2010 reported some of the market related information constraints faced by smallholder farmers in developing countries. These involve limited access to information on prices, value chains, competitors and consumer preferences. Also, lack of business management skills (e.g. production planning) and, in particular, inadequate access to the knowledge and technologies needed to meet rising sanitary standards, makes it extremely difficult for smallholders to gain credible certification of compliance with marketing requirements. India though largest milk producer is unable to compete in export of dairy products due to quality related issues.

Exploration of alternate ways of extension information delivery

Mobile based extension has the ability to provide alternate extension delivery system to the farmers. In the future, moderately skilled farmer through smartphone can pull down expert knowledge and applications from the cloud. Through private sector help, state agricultural universities should also recruit, train and supervise a new group of technology enabled farm extension workers. The universities can also develop expert systems and apps that extension workers can use (Kaka *et al.*, 2014). 'Pashu Poshan' a mobile app has been launched by NDDB in 2015 which advises farmers about balanced diets for dairy cows and buffaloes (PTI,2015). Similarly iCow is an SMS (text message) and voice-based mobile phone application for small-scale dairy farmers in Kenya. It is designed to run on both low-end and high-end mobile phones. It's something of a virtual veterinary midwife, helping farmers track the estrus stages of their cows, while giving them valuable tips on cow breeding, animal nutrition, milk production efficiency and gestation. The app prompts farmers on vital days of cows gestation period; helps farmers find the nearest vet and AI providers; collects and stores farmer milk and breeding records and sends farmers best dairy practices. The text messages and voice prompts are sent to customers within the 365-day cow cycle (Forbes, 2011). Vet Africa a smart-phone based mobile app designed for farmers and vets in Africa has been found to be effective in supporting the diagnosis of cattle diseases in a range of settings in sub-Saharan Africa (CVER, 2015).

Another area of livestock information delivery that needs to be strengthened is farmer to farmer extension delivery .Farmer to Farmer extension is appropriate for a wide range of target groups, including women, youth, and the poor. In the East African Dairy Development Programme in Uganda, about one-third of volunteer farmer-trainers are women, while less than 5% of extension staff were women(Franzel ,2015).In India, quite often farmers who are trained by dairy cooperatives motivate other farmers to adopt better animal husbandry practices and contribute to horizontal dissemination of information and this creates new demands for dairy extension and advisory provision(Chander and Sulaiman ,2014). Farmer to Farmer extension though may be useful in spread of simple dairy innovations. It should however not be used for complex, high-risk, technical enterprises and practices, where cost of an error may be very high e.g. treatment of livestock diseases. If extension staff perceive farmer-trainers as a substitute, rather than a complement, to their own services, conflicts between farmer-trainers and extension staff may occur (Franzel ,2015)

Linking small holder livestock producers to market: Institutional innovations

Livestock farming in India would not turn out to be a profitable business until and unless livestock farming is carried out on a commercial lines and due attention is given to bringing the smallholders in the organized marketing fold. Development of value added products industry would increase marketing avenues and contribute to increased production through better utilization of surplus products. About 40% of total milk produced in India is handled as liquid milk. Establishing small-scale ventures for the production of value-added products would go a long way in improving the economics of livestock production and meeting consumer demand.

Livestock producers benefit from institutional innovations that link them with markets, like promotion of agribusiness, market reforms, organisation of backend and front end and good pricing. There is a need to explore the feasibility of alternate market avenues in the form of forward contract and pool marketing. Encouragements by the States for contract farming under which the buyer can provide the farmer access to modern technology, quality inputs, other support and a guaranteed price can be a good step in right direction.

Three elements that are crucial to scaling up market linkage are:

i. Physical infrastructure (roads, electricity, communication, refrigerated transport, cold chains, etc.) that can facilitate linkages between production and markets. It is essential to reduce transaction cost and post-harvest risks. Poor level of infrastructure results in low level of processing.
ii. Investment in post harvest processing and value addition, cool chain systems for perishables, transport, marketing, commerce and trade.
iii. An enabling regulatory and legal framework

The producer organisations that have strengthened milk production infrastructure, and feed and fodder development must also invest in providing effective dairy extension services to its producer members.This may involve taking advantage of the available professionals in the nearby institutions as well as making use of "progressive" dairy farmers in the milk-shed area in horizontal transfer of technologies and information to other milk producers (Chander and Sulaiman, 2014).

Channels to disseminate information/technology to the farmers

The scope of new models of information delivery - for serving distant and marginal areas - involving village community based worker, NGOs, providing incentives to agricultural graduates in starting their own clinics and locale specific integrated ICT modules need to be explored. Both cost recovery approach and privatization of initiatives towards ICT inclusion of farmers could go hand in hand. Information technology can support disease monitoring and prevention, besides improving farmers' operational and financial management and to effectively connect them with the markets for better price realisation. The real issue in information uptake by farmers could be its accessibility, rather than the price charged, given that the amount charged is reasonable and not beyond the reach of poor. Modules of information dissemination involving various stakeholders could go a long way in bridging the information gap and creating a viable and self-sustainable information dissemination system in the region.

Re-orienting Livestock Services Delivery System

Future growth of livestock sector will depend crucially on availability of services that address the problems of low productivity, disease incidences and quality and hygiene issues associated with livestock and livestock product trade. Public health services, such as zoonotic and food-borne disease control, hygiene, food safety and environmental control remain insignificant and in most regions non-existent. Privatization in Animal health delivery system is being widely advocated on account of public finance rationalization, economic efficiency, equitable social distribution of services and domestic resource mobilization. However, the residual public sector role and interaction between public and private sectors must not be neglected. What is necessary before privatization is that private and public animal health services be clearly identified, veterinary departments should be equipped to make strategic plans and institutions and mechanism be in place to minimize market failure. Animal health services delivery to the poor in remote and marginal areas requires special consideration and there is need for government to explore new models (Community based animal health workers, Members' organizations, SHG's, etc.) of delivery of veterinary services to such regions, while itself assuming the roles of a coordinator and regulator.

Conclusion

Huge opportunities exist for Indian livestock sector for growth and expansion owing to increased domestic and global demand of livestock products. Traditionally livestock farmers in India rely on information that has passed on from generation to generation. While this information may still be relevant, with changing times of commercialization and increased intensification, effective livestock extension information network is the need of the hour. Although, information on all aspects of livestock farming exists in all the farmer-related institutions, but its transfer and uptake by the livestock owners needs radical revision at all levels of information transfer (Sharma, 2014). India needs to invest in mobile based internet to extend the reach of existing workers and make it possible for relatively unskilled workers to deliver farm extension services. Simultaneously, there is need to strengthen farmer to farmer extension in livestock enterprise for informal education needs of women. There is need to reorient the livestock extension information service delivery to meet informal education needs of livestock owners of India.

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Market intelligence and marketing strategies of agricultural producers in eastern India

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Abstract

With the recent enhanced national thrust on BGREI, ensuring the overall agricultural development in eastern Indian states – be it technology-led or market-led – is of utmost importance. Eastern region of India, with its diverse natural resources has been under special focus by Planning Commission for ushering second green revolution of country. This region has plenty of natural resources as well as diverse agro-eco-regions for increasing food production of the country. One of the key impediments of fostering the agricultural growth in this region is the small and marginal production unit of the majority of the farmers.The abundance of technology packages, as inventoried by various research institutions and agricultural universities functioning in the region, calls for developing services for their wide spread adoption and up-scaling. Increasing profitability of the agricultural produces with least or no involvement of middlemen in the value chain management will count for an efficient market intelligence for farmers of the region. Market intelligence is the information relevant to producers' markets, gathered and analysed specifically for the purpose of accurate and confident decision-making in determining strategy in areas such as market opportunity, market penetration strategy and market development.

Agriculture in eastern India is to be an orchestration of the concerted thrust upon the production and productivity in all the crop, livestock and fishery sectors, their effective post-production management and an intelligent and systematic marketing of the produces in coming days. Developing a suitable system of marketing intelligence for the farmers of the region, may be with suitable use of modern IT tools, shall bring more profit by reducing the current level of involvement of the middlemen. Adoption of farming systems for produces based on market demand may be another way to fetch more income by the producers from the limited agricultural land.

Key words: Agricultural marketing; Marketing intelligence; Middlemen; Producer

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Introduction

In the backdrop of the enhanced national thrust on BGREI, ensuring the overall agricultural development in eastern Indian states – be it technology-led or market-led – is of utmost importance. Eastern region of India, with its diverse natural resources has been under special focus by Planning Commission for ushering second green revolution of country. The eastern states of India, comprising of Bihar, Jharkhand, West Bengal and parts of Odisha and Uttar Pradesh, has plenty of natural resources as well as diverse agro-eco-regions for increasing food production of the country. Besides, producing food grains, the region has great potential to produce several high value commodities for augmenting farm income. For example, horticulture, livestock and fisheries sectors have all potential to pull the growth of agriculture sector of this region. One of the key impediments of fostering the agricultural growth in this region is the small and marginal production unit of the majority of the farmers.

The abundance of technology packages, as inventoried by various research institutions and agricultural universities functioning in the region, calls for developing services for their wide spread adoption and up-scaling. Taking a note of the scale and magnitude of multi-functionalities of the KVKs working in these states, it is evident that in near future the agricultural production in terms of crop, livestock and fishes will shoot up urging a systematic agricultural market development in coming days. Increasing profitability of the agricultural produces with least or no involvement of middlemen in the value chain management will count for an efficient market intelligence for farmers of the region. Keeping this in view, here is an attempt to outline the present market scenario and potential of it as well as market intelligence of the farmers.

Market intelligence – Definition and Concept

Market intelligence is the information relevant to a company's markets, gathered and analysed specifically for the purpose of accurate and confident decision-making in determining strategy in areas such as market opportunity, market penetration strategy, and market development. Market intelligence includes the process of gathering data from the company's external environment, whereas the Business intelligence process primarily is based on internal recorded events – such as sales, shipments and purchases. The purpose of incorporating Market Information or intelligence into the Business Intelligence process is to provide decision makers with a more "complete picture" of ongoing corporate performance in a set of given market conditions. Effective market intelligence needs accurate market information that is gathered with right tools and methods. To gather information companies can conduct surveys, interviews, visit and monitor competitors' outlets or gather and buy data from different sources.

Marketing intelligence – Steps for improvement

Marketing intelligence determines the intelligence needed, collects it by searching environment and delivers it to marketing managers who need it. Marketing intelligence software can be deployed using an on-premises or software as a service (SaaS, or cloud-based) model. These systems take data from disparate data sources, like web analytics, business intelligence, call centre and sales data, which often come as separate reports, and put them into a single environment. In order to collect marketing intelligence, marketing managers must be in constant touch with relevant books, newspapers and trade publications. They must talk to various stakeholders like customers, distributors and suppliers. In addition to this they must also monitor social media and carry out online discussions. Marketing managers can design reports that correlate and visualize data coming from a variety of departments and sources (even, in some cases, external data.) This allows them to see current key performance indicators in real time (or as quickly as sources provide data) and analyse trends, rather than wait for analysts to deliver periodic reports.

Marketing intelligence systems are designed to be used by marketing managers and often viewed by employees throughout an organization. They may have user interfaces that closer resemble consumer software than the software around individual data sources, which are designed for use by analysts. Business intelligence for example, can collect highly accurate, timely, granular data, but often requires IT support to build and edit custom reports.

Organizationally, marketing intelligence can be the name of the department that performs both the market intelligence and competitor analysis roles. Business intelligence of any kind may also be their responsibility, in tandem with (or solely performed by) the Finance department, for measuring market share and setting growth targets, the mergers and acquisitions group for exploring acquisition opportunities, the legal department to protect the organization's assets or research and development for cross-company comparison of innovation trends and the discovery of opportunities through innovative differentiation.

Steps to be taken to improve Marketing Intelligence:

(1) *Train and Motivate Sales Force:* The sales force can be an excellent source of information about the current trends in the market. They are the "intelligence gatherers" for the producers. The acquired facts can be regarding the producer’s market offerings, whether any improvements are required or not or is there any opportunity for new products etc. It can also provide credible source to know about competitor activities, consumers, distributors and retailers.

(2) *Motivate distributors, retailers, and other intermediaries to pass along important intelligence:* Specialists are hired by companies to gather marketing intelligence. In order to measure the quality of production, the way the employees are behaving with customers, quality of facilities being provided; retailers and service providers send mystery shoppers. Firms can also assess the quality of customer experience with the shops with the use of mystery shoppers.

(3) *Network Externally:* Every producer must keep a tab on its competitors. Competitive intelligence describes the broader discipline of researching, analysing and formulating data and information from the entire competitive environment of any organization. This can be done by purchasing the competitor's products, checking the advertising campaigns, the press media coverage, reading their published reports etc. Competitive intelligence must be legal and ethical.

(4) *Set up a customer advisory panel:* Producers can set up panels consisting of customers. They can be the producer’s largest customers or representatives of customers or the most outspoken customers. Many business schools set up panels consisting of alumni who provide their knowledge and expertise and help in constituting the course curriculum.

(5) *Optimal usage of Government data resources:* Governments of almost all countries publish reports regarding the population trends, demographic characteristics, agricultural production and a lot of other such data. All this data must be or can be referred to as base data. It can help in planning and formulating policies for the producers.

(6) *Information bought from external suppliers:* Certain agencies sell data that can be useful to other companies. For example, television channels will require information on

the number of viewership, ratings of TV programs, etc. An agency which calculates this information and generates this data will provide it to companies that need it.

(7) *Collect Competitive Intelligence through online customer feedback:* Customer's view about a product is most essential for any producer. Ultimately it's the customer who's buying the product. Hence, customer feedback must be taken. Online platforms like chat rooms, blogs, discussion forums, customer review boards can be used to generate customer feedback. This enables the firm to understand customer experiences and impressions. It becomes easier for companies to apply a structured system to do so as it can then scan out the relevant messages without much of a trouble.

With the above steps being applied, a producer's marketing intelligence system will prove to be beneficial to its effective functioning.

Fig. 1. Diagrammatic representation of market intelligence

Agricultural marketing scenario

The small scale of production unit produces these high value commodities with high production efficiency but is severely constrained with poor marketing efficiency. In the era of market-led growth the volume of trading must be increased to ensure greater share in the consumers' rupee to primary producers. For this establishment of market linkages the functioning of efficient marketing system is utmost important. Currently, the system is operating under a vicious cycle like – large number of small producer - producing low marketable surplus – resulting low bargaining power and – low profit. Then these commodities passes to large number of small traders who are handling these produces in a small scale subjected to high degree of post-harvest losses – ultimately resulting the whole marketing system a non-commercial venture.

After harvesting of crops, the produces are brought in the market by farmers or the village level traders collect the produce and used to bring in the market. First interaction point between farmers and traders occurred at primary market or village level market. Various primary market or *'haat'* operates during specific time of the day or specific day/ days of the week or so on. Farmers sell their produce to the traders called *'fariah'* who are usually the first middlemen functioning in the market (Table 1). They collect the produce from different farmers through direct bargaining from the farmers. However, most commonly the farmers used to bring their produce to the commission agent called *'arhatdar'* in the market and they arrange the auction for selling of the produce. After inspecting quality of produce traders (*fariah*) offer bidding price and based on the maximum bid the produce is sold. Commission agent charges for this function either through cash payment or keeping some quantity of produce which varies from produce to produce and also from market to market. It has been estimated, in terms of value the commission agent charges around 5-7 percent of the total value of the produce sold. Key intermediate functionaries in the marketing include farmers, village traders (*fariah*)/ middlemen – wholesaler – retailer and consumer. Primary grading and standardization is done by farmers and second time the grading, standardization is made by the traders before the produce goes to wholesale market. Functions of various intermediaries are summarized in table below.

Table 1. Major market intermediaries and their key functions

Intermediaries	**Primary Function**
Producer	Primary grading, standardization, bring produce to the market.
Middlemen (*fariah*)	Collection of produce from farmers, grading, packing. Purchase produce either directly from producer or through commission agent (*arahtdar*). Also takes produce to wholesale market.
Commission agent	Arrange interaction between farmers and traders for auction/selling of produce.
Wholesaler	Purchase produce from middlemen and sell the produce to retailer through some persons employed by him
Retailer	Sells produce to consumer.
Contractor	Sometime wholesaler tie up with the contractor to bring the produce from far away/different market or sending the produce to faraway market depending on the demand for the produce in the market

Besides this traditional agri-marketing system, the agricultural marketing environment throughout the country including this region is also undergoing the process of rapid transformation due to large-scale corporate entry into this marketing system. However, so far the share in total volume of retail through such marketing is very less.

Existing market environment and marketing status of agro-products, particularly the un-processed commodities, availability of remunerative/ reasonable prices are very crucial to change the cropping pattern towards high value crops and also crop diversification. Market prices are the key drivers to change the farm economy, but, we all are aware of the high price volatility in agri-marketing sector that adversely affect the up-scaling of these agro-technologies.

Intelligent marketing strategies

Strategies for increasing the profitability of agriculture in eastern Indian states can be evolved through better marketing intelligence by integration of various market related information with respect to agricultural produces like crop/ livestock/ fish to be produced; time of production; season of increased market demand; perishability of the produce; storage and preservation facility available; distance to the market; and marketing frequency of the produce etc. Some significant strategies adopted by the intelligent farmers of the region with the information/ technology support from the KVKs are as follows:-

i) Producing sugarcane by using improved varieties and grading the produce into three categories like Premium, General and Reject helped the farmers in increasing their income by Rs. 20 per quintal.
ii) Processing for oil extraction from Pamaroja, Mentha and Lemon grass can be an attractive enterprise for farmers at small scale as the same brought increased profit in cultivation of these medicinal and aromatic plants. Market was assured by the linking of associated companies.
iii) Quality honey production with assured market support from the companies like Dabur India Ltd. fetched 12% more profit to the beekeepers.
iv) Milk marketing through linking with Magadh Dairy/ Sudha Dairy etc. boosted the dairy farmers' annual income.
v) Scientific production of quail eggs and processing of quail meat resulted in increased profit through innovative marketing by the farmers.
vi) Assured marketing of Gladiolus flower by the growers was effected through linking of local flower markets (both retail and wholesale) of Dinhata and Coochbehar, West Bengal.
vii) Ornamental fish culture and ornamental bird rearing got encouraged by linking the market support by local retail/ wholesale marketing agencies.
viii) West Bengal Livestock Development Corporation Ltd. assured the market for the mutton and chevon produced by the farmers of Sunderbans. This resulted into development small scale enterprises for sheep and goat rearing and their meat processing.

Conclusion

The overall agricultural growth and development in eastern India is to be an orchestration of the concerted thrust upon the production and productivity in all the crop, livestock and fishery sectors, their effective post-production management and an intelligent and systematic marketing of the produces. This can only be possible by developing a suitable system of marketing intelligence for the farmers of the region (may be with suitable use of modern IT tools), which shall bring more profit reducing the current level of involvement of the middlemen. The marketing related information for the region, state and national level bodies shall be useful for integrating the knowledge base on marketing for the farmer-producers. Adoption of farming systems for produces based on market demand may be another way to fetch more income by the producers from the limited agricultural land. Integration of all the market related information and production-consumption system for any agricultural produce should be at hand of the farmers as a ready reckoner which would guide the best marketing of the produce for better income and employment generation through agriculture.

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PROSPECTS OF VALUE CHAIN MANAGEMENT IN INDIAN AGRICULTURE

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Abstract: Indian agriculture supports income and livelihood opportunities to majority of the population. It has undergone rapid transformations from subsistence farming to commercial agriculture. Despite of achieving significant transformations, there are many lacunae existing in the present systems which are unable to fetch a good price for the producer. Value addition and efficient marketing may enable farming as a more profitable business. Value chain refers to "the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and disposal after use". In agriculture, Value chain indicates a set of actors and activities involved in bringing a produce at farm level until it reaches to the final consumer where at each stage value is added. In India, agricultural value chains are often fragmented and difficult to organise and stabilise owing to the existence of small holdings, several middlemen, difficulties in transport and quality assurance mechanisms. Efficient management and organisation of operations along the value-chain framework has been conceived as one of the strategies to bring more efficiency. For this to take place, a better understanding of different stakeholders involved in the value chain in terms of their awareness on other links existing in the chain, level of coordination, communication networks, relationships, knowledge transfer, linkages etc., are necessary. Value chain management approach provides a framework for identifying and examining different actors along a value chain, and the dynamics of roles and operations existing among them which can provide a further insight on strengthening the chain as a whole.

Key words: Value chain, Value chain management.

INTRODUCTION

Indian agriculture supports income and livelihood opportunities to most the population. Since agriculture is the backbone of the country, any development intervention in this sector contributes directly to the economy and aid in the upliftment of rural base. Indian agriculture has undergone rapid transformations from subsistence farming to commercial agriculture. We have achieved self-sufficiency and good degree of stability in food production. Despite of achieving significant transformations, there are many lacunae existing in the present systems which are unable to fetch a good price for the producer. An overview of problems encountered by farmers includelower scale of operation, weak information and communication linkages with markets, exploitation by middlemen, lack of adequate financial support, improper post-harvest management, disorganised value chains or marketing channels etc. In this regard, efforts can be directed towards improving marketing systems and understanding value chain approach in order to make agriculture a more profitable business. Value chain approach basically serves as a tool to understand the dynamics of various operations involved along the chain where at each stage value is added. In agriculture, value chains have always been in existence in the sense that production activities are done at farm level and the final product is reached to consumer with the product being passed through various intermediaries along the chain.

In India, agricultural value chains are often fragmented owing to the existence of several middlemen, absence of information about other links in the chain and inability to improve the performance in almost every part of the chain which further led to inefficiencies and lower incomes especially in the lower end of the chain.Efficient management and organisation of operations along the value-chain framework has been conceived as one of the strategies to bring more efficiency. Value chain management refers to the process of organizing the connected group of activities that create value by producing goods or services from basic raw materials for purchase by a consumer. In other words, value chain management approach is a heuristic, analytical, and strategic tool that provides a framework for identifying and examining different actors along a value chain, the dynamics of roles and operations existing among them, reward and distribution, power-relation structures, linkages, knowledge transfer etc. In this direction, an attempt is made in this paper to understand the concept of value chain management in agriculture, how value chain approach can be used as a tool to analyse various operations involved in the chain and to identify possibilities for future value chain development interventions.

1. CONCEPT OF VALUE CHAIN MANAGEMENT

Understanding value chain

The value chain concepthas been given by Porter (1985) in his book Competitive advantage. A Value chain refers to “the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and disposal after use” (Kaplinsky and Morris, 2002). As opposed to the traditional exclusive focus on production, value chain concept focuses on value adding activities at each stage, thereby viewing production as just one of the several value-adding components in the chain.

The design of value chain can be seen as a system with subsystems each with inputs, transformation process and outputs. Each of these subsystems are linked with one another. The inputs, transformation processes, and outputs involve the acquisition and consumption of resources such as money, labour, materials, equipment, buildings, land, administration and management. How value chain activities are carried out with these resources determine costs and affects profits.

Porter (1985) distinguished between primary activities and secondary activities involved in a value chain (Fig.1).Primary activities are directly concerned with the creation or delivery of a product or service. They can be grouped into five main areas such as inbound logistics, operations, outbound logistics, marketing and sales, and service. Each of these primary activities is linked to support activities which help to improve their effectiveness or efficiency. There are four main areas of support activities such as procurement, technology development (including R&D), human resource management, and infrastructure (systems for planning, finance, quality, information management etc.).

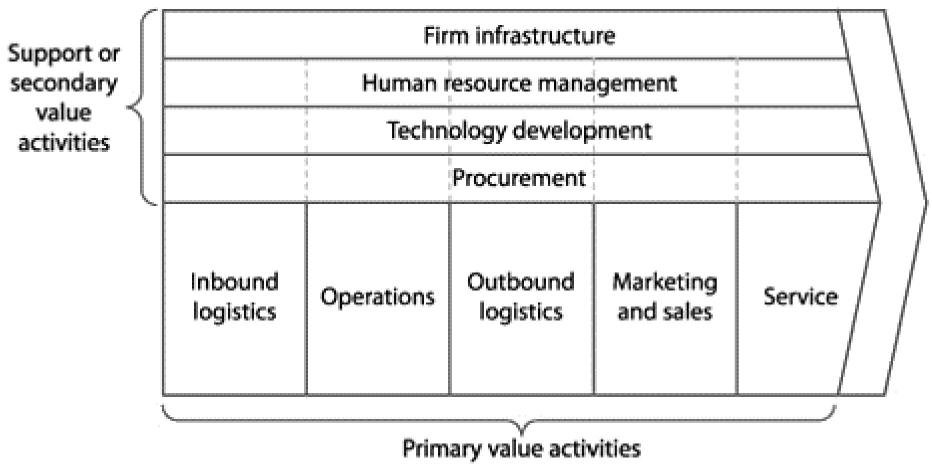

Fig.1. A generic value chain. (Porter, 1985)

In simple terms, value chain involves series of actors (stakeholders) and the activities they do in order to bring a product from its conception stage to the consumable stage where at each stage value addition takes place.

Understanding value chain management

From the above discussion, we can see that “management” is an important component at every stage of the value chain. In other words, every stakeholder in the chain is involved in management of his resources to produce a product which is utilised by other stakeholder of the chain until it reaches to the final consumer. By definition, management is the process of getting things done through people/resources.There is no specific definition of value chain management. An overview of some definitions found or used by certain researchers/authors is presented hereunder.

The public website of business dictionary defines value chain management as the process of organizing the connected group of activities that create value by producing goods or services from basic raw materials for purchase by a consumer. It states that the basic objectives of employing value chain management in a business is to integrate communication and increase cooperation between production chain members in order to decrease delivery times, reduce inventories and increase customer satisfaction.

Koontz and Weihrich (2007) stated that “value chain management involves analysing every step in the process ranging from the handling of raw material to end users, providing them with the greatest value at the lowest cost”.

Kannegiesser (2008) stated that integrated value chain management is the process of integration of demand, supply and value decisions from sales to procurement using strategy, planning and operational processes.

Robbins and DeCenzo (2008) in their book “Fundamentals of Management” stated that value chain management is the process of managing the entire sequence of integrated activities and information about product flows along the value chain.

Gooch and Felfel (2009) Value chain management is a more integrated and cross-functional decision-making approach that sees organizations use their complementary capabilities and knowledge to jointly develop the resources necessary to deliver superior value to consumers.

Wang Aimin and Li Shunxi (2011) stated that value chain management is a coordinating management process in which all of the activities involved in delivering customer value satisfaction are integrated such that customer satisfaction is maximized and the objectives of the stakeholders involved (the suppliers of activities, processes, facilitating services, etc.) are optimized.

It can be observed from these definitions that value chain management is essentially an integrated process of organising different value adding activities at every stage by different stakeholders/actors making up the chain.

Value chain management in Agriculture

A ‘value chain’ in agriculture identifies the set of actors and activities that bring a basic agricultural product from production in the field to final consumption, where at each stage value is added to the product. The dominant actors who make up agricultural value chains in India are farmers, agricultural advisory service providers, aggregators/middlemen, finance providers, agro-processors, retailers and consumers. Agricultural value chain activities may includeinput supply, farmer organization, farm production, post-harvest handling, processing, provision of technologies of production and handling, grading criteria and facilities, cooling and packing technologies, post-harvest local processing, industrial processing, storage, transport, finance, marketing etc. In India, mostly these value chains are fragmented and dominated more by middlemen who exploit producers resulting in lesser profits to the latter who are the most important stakeholders in the chain.

Understanding value chain approach as a tool for any development intervention is of high necessity to improve profit margins at the lower end of the chain. Value chain management approach serves as a holistic, analytical, and strategic tool that provides a framework for identifying and examining different actors along a value chain, the dynamics of roles and operations existing among them, reward and distribution, power-relation structures, linkages, knowledge transfer etc. These will enable to identify inefficiencies existing along the chain and provide measures to improve performance.

Value chain management in agriculture can be defined as the process of organising connected group of activities along the chain that increase value, reduce inventories and improve customer satisfaction. The focus of efficient value chain management calls for improved communication and greater coordination among chain members such that each member gets fair profit.An illustrative model of value chain management in agriculture is depicted in figure 2.

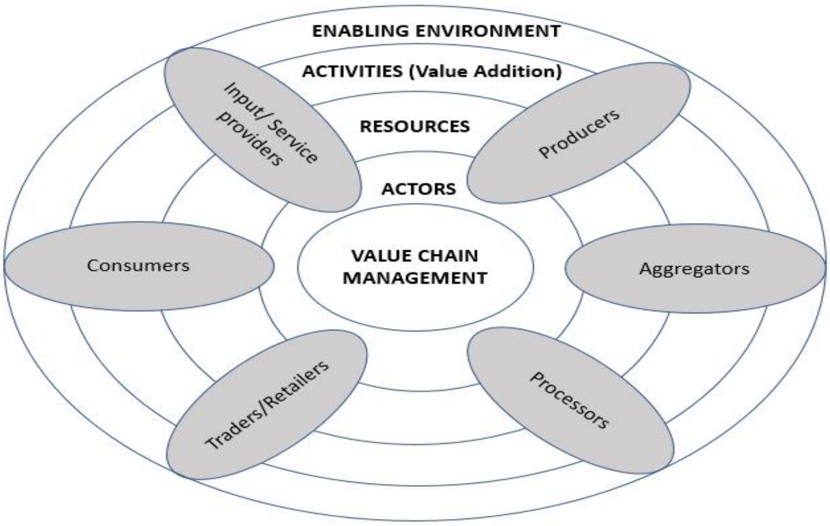

Fig.2. Illustrative model of value chain management.

2. VALUE CHAIN MANAGEMENT APPROACH AS A TOOL

As stated earlier, value chain management can serve as a strategic and analytical tool to identify drivers and disablers existing along the chain. The analysis may include quantitative parameters or qualitative parameters or both and can be applicable to many sectors. There are many theoretical discussions, handbooks and manuals, policy papers,toolkits and guides focussing on value chain approaches as development concepts that can be used to build up or optimise value chains in various fields. A brief review of few publications is presented hereunder.

M4P (2008) Making markets work better for poor (M4P) project of UK Department for International Development has given a tool book for the practitioners of Value chain analysis. The main focus of this tool book is on poverty reduction. This tool book provides a better understanding of how markets can be organised and the role they play as decision makers to facilitate the development of value chain and improve the position of poor within the value chain. The tools are categorised as general, qualitative and quantitative under different dimensions.

Gooch and Felfel (2009) have given the factors that characterise successful management of the value chains. They have also stated some factors which impede the development and management of agri-food and agri-product value chains.

UNIDO (2009) gave a working paper on agro-value chain analysis and development. This paper stresses on organization's approach to agro-value chain analysis, which can be used as a methodological tool in order to gain a full understanding of chain structure and functioning thereby project interventions in agro-industrial development can be made. It has provided various examples of UNIDO's experience in supporting the development of sustainable agro-value chains. Various value chain analysis tools and checklists have been provided in this paper.

Issa Sanogo (2010) gave a detailed account of various tools in his technical guidance sheet "How to Conduct a Food Commodity Value Chain Analysis". The main intention is on how implementation of value chain analysis can better provide a framework for food security analysis especially for World Food Programme country offices.

Weber and Labaste (2011) published a guide on value chain concepts and applications. This guide provides methodological tools and approaches for value chain interventions. In total thirteen value chain implementation tools under six themes have been presented with case studies for each tool. This guide provides good framework for planners, decision makers or other public and private stakeholders in agriculture for creating effective value and supply chain development programmes.

These tools serve as guidelines in building a framework for analysing value chains or assessing the linkages and relationships among value chain actors. The following illustration gives an idea of understanding relationship/ information linkages between value chain partners. (Box 1).

Box 1. Identification of relationships between value chain partners

	Relations with buyer			**Relations with supplier**		
Value chain actor	**Characteristic of relationship**					
	Frequency	Information shared	Trust	Frequency	Information shared	Trust
Farmer						
Aggregator						
Processor						

Note: This illustration is provided as representative purpose (not exhaustive). There may

Our perspectives

- A value chain approach in agricultural development helps identify weak points in the chain thereby providing opportunities to probe into activities that add more value.
- Value chain management approach is social rather than technical, requires innovation and is mostly based on relationships between firms along the chain.
- The focus of value chain approach should not be merely on simple cost analysis. Rather it should include other aspects such as how well the chain is integrated or how easily information flows through it, what are the linkages operating in the chain etc.
- Consideration of environment in which value chain operates is also important for analysis.
- An effective value chain management methodology should include factors which are enabling a chain to perform well and the factors that are hindering to form coalitions among chain partners.

3. POSSIBILITIES OF FUTURE VALUE CHAIN DEVELOPMENT INTERVENTIONS

In a country like India, which is dominated by presence of several small holdings, it is often difficult to organise and stabilize agricultural value chains. Aggregation of several small farms pose challenges in terms of highly dispersed collection of produce, transport arrangements, and quality assurance mechanisms at every level. These not only involves higher costs but also time outlays in the aggregation process. Hence the production efforts can be organized in clusters so that the distances and time are kept within manageable levels. Building the confidence of farmers to move away from subsistence farming to market oriented farming, encouraging them to form into groups, increasing their awareness on application of improved inputs and adoption of higher technology of cultivation are important interventions in creating a sustainable agricultural value chain.

Before actually starting any intervention, we need to answer existing issues in value chain such as whether the inputs provided are of good quality, are threshing techniques, post-harvest drying and storage, grading are done in accordance with the standards, is sufficient training being given for improved post-harvest management etc.

It is also important to know that since extension functionaries are first link in providing agro-advisory services, they even need to be updated well with the concepts of value added agriculture.

Any personnel or agencies involved in value chain development intervention should keep in mind that there are certain factors and capabilities required which can aid in forming a closely aligned value chain. These include shared vision and strategy, mutual respect, leadership, collaboration, commitment, trust and mindsets.

Agri-value chain research or projects requires experts from different disciplines. The pooled efforts have greater chances of improving the value or customer satisfaction and making farming as profitable business to the producers.

CONCLUSIONS

In this paper, an attempt has been made to provide an understanding of concept of value chain and value chain management. Many value chain analysis tool books and manuals have been published by different researchers and authors. But the context in which these manuals were given are different. Although a single tool book cannot serve as a benchmark for all the situations, they can be helpful for practitioners involved in value chain interventions. The possibilities of future value chain development interventions are presented at the end.

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SMS (Short message services) Tool for Diabetes Information Management

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ABSTRACT

Diabetes is a serious, chronic disease that occurs either when the pancreas does not produce enough insulin (a hormone that regulates blood sugar, or glucose), or when the body cannot effectively use the insulin it produces. Diabetes is an important public health problem, one of four priority non communicable diseases (NCDs) targeted for action by world leaders.

Short text and voice message has a potential to provide an important, inexpensive delivery medium for facilitating preventive health care including diabetes care and management. SMS has an added advantage over other media being relatively cheaper mode of communication. SMS is personalized method of interaction, which proves to be more effective because there is a sense of belongingness.Delivery of SMS is a part mobile- based interventions that has bridged an effective communication channel to endeavor behavioral change, enhance disease specific knowledge, skill and attitude and subsequently improve health outcomes. Mobile messages are generally delivered by either short message service (SMS) or voice messages. SMS is available on an estimated 98% of mobile phones, does not require technical expertise to use, and is adaptable to multiple Health purposes. SMS can be accessed at user convenience and

can also be delivered to phones that are turned off or have low batteries. Costs for SMS are lower than other sources of media.

Introduction

Diabetes mellitus is reaching potentially epidemic proportions in India. The level of morbidity and mortality due to diabetes and its potential complications are enormous, and pose significant healthcare burdens on both families and society. Diabetes mellitus is an important public health priority requiring urgent preventive action.

Diabetes education and hence information is cornerstone for effective self-management of the disease thereby reduce the complexity of the diseases. People with diabetes need to be informed about their condition to prevent them from worrying unnecessarily and to allow them to effectively control their condition. They will need a variety of skills and knowledge to enable them to control their condition, sometimes on a day-to-day basis, and modify their approach when circumstances change.

SMS can empower patients to play active role in self-management by enhancing their knowledge, motivation and skills. It can motivate respondents for improved health behaviour, to have improved clinical outcomes, to perceive a better quality of life and to enhance skill. The information can modify the lifestyle of diabetic respondents.

Methodology

An experimental research design was adopted to conduct the present study. The study was conducted in Hyderabad district. A total of 90 diabetic respondents were selected as the sample of the study following proportionate random sampling technique. Data were collected using interview schedule during 2016 to study the information need of the diabetic respondents and the information gap was tried to fill with SMS both text and voice format.

Results and discussion

SMS, a messaging service component of mobile phone communication systems either as text or as voice, to send the information in a short form with less number of words with complete meaning.

The short messaging center to send bulk messages available with www.vigyanasaadhitha.com, the vernacular web portal for dissemination of life style management information through various online services was utilized for the purpose.

Riaz (2014) opined that usage of tailored SMS reminders increases adherence in treatment programs of lifestyle diseases. SMS has allowed an interventional role in self-care management of Diabetes Mellitus.

As all the respondents were educated and english literates, short messages both for text and voice format were developed, in english and in accordance to the information need of the respondents addressing behaviour domain KAS. A total 60 text and 30 voice messages were developed. The text message provides the narration addressing knowledge and skill based needs and voice message had an appeal or direction for action to stimulate attitudinal change.

The developed text and voice messages were delivered to mobile numbers of experimental group. Two text messages and one voice message were sent every day; text messages were sent at 10.00am and 5.00pm and voice message at 8.00pm.

Table1. Perception of the respondents on diabetes after SMS

n1=60, n2=30

Type of information	Perception mean scores of experimental group				Perception mean scores of control group				Mean difference
	K	S	A	Total	K	S	A	Total	
Clinical	2.51	2.56	2.40	7.47	1.81	1.53	1.52	4.86	2.80
Nutrition	2.52	2.62	2.57	7.71	1.64	1.88	2.10	4.62	3.09
Management	-	2.54	2.53	5.07	-	1.89	1.70	3.51	1.56
Total	5.03	7.72	7.50	20.25	3.45	5.30	5.32	12.99	7.45

The perception level of respondents on disseminated messages was measured with a check list on three-point continuum with options strongly agree, agree and disagree for the statements, with a score of 3, 2 and 1 respectively, reflecting the content and respective behavior domains. The check list was administered to the sample i.e. both experimental and control group.

The above table indicates the mean score of the experimental and control group in the areas of clinical, nutrition and management information needs. The mean score of knowledge, skill and attitude in the three information needs area have been studied. The mean score value for the knowledge in clinical information need was found to be 2.51, Skill 2.56 and attitude 2.40 compared to the control group 1.81 in knowledge,1.53 in skill and 1.52 in attitude.

Similarly, mean score values was found to be higher in experimental group compared to the control group in nutrition information need. The experimental group score for knowledge, skill and attitude was calculated 2.52, 2.62 & 2.57 respectively, whereas control group score was lower at 1.64, 1.88 &2.1 in the KSA domains.

In the information needs of management area the experimental group mean score in skill and attitude was 2.54 and 2.53 compared to 1.89 and 1.70 of the control group.

Goodarzi et al. (2012) studied the impact of SMS on improving knowledge, attitude, and practice (KAP) of type 2 diabetes patients. The study was done with experimental and control group. Patients in the experimental group could received messages weekly consisting of information about exercise, diet, diabetic medication, important of self- monitoring blood glucose levels and they could receive the messages at any place where access was possible by mobile phone. There was a significant percentage change in KAP for the experimental group compared to control group.

Table 2. Perception of respondents

n = 90

Groups	Total no of sample	mean	T (cal)	T (tab)
Experimental	60	90.68	10.295*	3.29
Control	30	60.43		

*Significant at 0.01% level of probability

An inference could be drawn from the above table that there was a significant difference in perception level between the experimental and the control group as T values were found significant at 0.01 level of probability.

Bruis *et al*. (2013) indicated that SMS have positive perception and bring positive behaviour change. The respondents in study agreed that messages were clear and easy to understand. Messages had brought behaviour changes related to diet.

Sheikh (2015) studied 236 adult type 2 diabetic patients. All the respondents in the intervention received 90 SMS, based on the principal of behaviour learning theory, once a day for 6 periods. There was reported change in HbA1C levels in the intervention group. The study demonstrated the effectiveness of simple SMS intervention as an addition to standard care for type 2 diabetes in Bangladesh. The intervention is low cost and scalable and therefore could improve diabetes care in Bangladesh and potentially other low-income countries.

Conclusion

Diabetes has reached epidemic state and leads to mortality and morbidity. Diabetes has immense burden. A constant monitoring and care is needed to overcome the complexity of the disease. SMS has significant role in changing the perception of people with diabetes. SMS as a new media was used in satisfying information need in this study because of its relative advantage over other available media. Through, SMS personalized messages are send to the participants. Personalized messages create a sense of belongingness and they feel that the message has been send exclusively for them. There is a feeling that particular messages are according to my need and respondents perceives it important. Besides, this mobile SMS has been used because of increased penetration of mobile phones.

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Revisiting Agriculture Extension Strategies for Sustainable Livelihoods

-Hemnath Rao Hanumankar[*]

Abstract: ***Making progress with the UN Agenda on Sustainable Development for 2030 implies an unwavering attention to the need for securing sustainable livelihoods for the poor, particularly in the rural areas, as the Sustainable Development Goal 8, highlights. The spectre of climate change further compounds the livelihood challenge as the assets and activities that supported livelihoods for the rural poor in the past could come under such stress that new strategies and completely out of box solutions aligned well with the vulnerabilities and resource endowments of rural communities, would be required to cope with the challenge. With its proven contribution to the path breaking green revolution of the 1970s that revolutionized the food security scenario in India, agriculture extension could be a powerful enabler in realizing the SDGs in general and the SDG no.8 in particular.***

This paper elucidates the concept and contours of sustainable livelihoods and identifies opportunities for the time tested agriculture extension system in the country to reorient itself to be able to promote capital formation and climate resilient livelihoods that are both stable and sustainable.Since formation and accumulation of capital- natural, physical, social, human and physical, is the key to securing livelihoods for the rural poor, and agriculture extension specialists and professionals are trained to promote the growth of natural capital, a compelling case exists for deeper involvement of the agriculture extension system in promoting sustainable livelihoods in rural areas. Case lets drawn from a past UNDP supported study of MGNREGA have been used to illustrate how capital formation has benefited poor households who participated in the MGNREGA works and the need to revisit agriculture extension which can potentially contribute more to generating and sustaining farm and non-farm livelihoods.

Sustainable Livelihoods: An Introduction

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The 17 Sustainable Development Goals (SDGs) and the associated 169 targets incorporated in the United Nations (UN) Agenda on Sustainable Development for 2030, provide a comprehensive framework and an historic opportunity for both the developing and the developed countries to approach the challenge of sustainable development in a 'win-win' spirit of holistic partnership, across all the three dimensions- economic, social and environmental. By the same token, individual nations would need to strategise and promote stakeholder networks and partnerships that can potentially tackle the problems of economic marginalisation, social inequity and environmental degradation through well targeted programmes of outreach and service delivery that benefit the 'farthest behind first'. India, with its socio-economic and ecological diversity and concomitant regional typologies of development, faces the twin challenges of both targeting and serving the poorest of the poor and the most vulnerable sections of the society who are concentrated more in rural areas with weak human development indicators and fragile livelihoods.

2. The SDG no. 8, 'Promote sustained inclusive and sustainable economic growth, full and productive employment and decent work for all' pointedly addresses the challenge of providing sustainable livelihoods for both the rural and urban poor but this goal stands out as the pivot around which the progress of the remaining SDGs would revolve. Sustainable livelihoods, as Chambers, R. and Conway, G. (1992) define, "A livelihood comprises the capabilities, assets (resources,stores, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term". This definition around which the British Department of International Development (DFID) has conceptualized its 'Sustainable Livelihoods Framework' (SLF), draws primarily from the work of the United Nations' World Commission on Environment and Development (1987) and is an attempt to break away from traditional ways of thinking that ignore the complexity of the lives and livelihoods of the rural poor people.

3. It can be inferred from the above that a livelihood comprises the full range of assets, activities and strategies that households employ, with due regard to their risks and vulnerabilities at one end and the transforming structures and processes at the other end,

that influence their lives and living environment.The guiding spirit of other models and frameworks of livelihoods such as those advocated by UNDP, Oxfam and CARE are also based on the above assumptions. A simpler working description of livelihoods put forth by the Institute of Livelihoods Research and Training is “the way in which people make their living- getting together basic necessities such as food, shelter and clothing, and meeting longer term needs such as health and education. Livelihood implies working and earning, but it is more than just economic activities as it is always done in a social and cultural context, and thus livelihoods tend to become a way of life”. The Article 39 (a) under Part IV of the Constitution of India which incorporates the ‘Directive Principles of State Policy’ suggests that the state has the responsibility to direct its policy towards securing an adequate means of livelihood for its citizen, men and women, equally. Yet, the poor in the country cannot demand livelihood as a matter of right since the ‘Directive Principles’ are not legally enforceable and hence the need for a multi-stakeholder driven fight against poverty.

Promoting Livelihoods

4.Various approaches to planning and provision of livelihoods have been in vogue but three popular practices widely followed by the livelihood promotion agencies, stand out. These include;

A. The opportunities oriented approach which lays emphasis on the resource endowments available with the rural communities, both in the form of natural resources as well as the traditional skill base. The purpose of the livelihoods intervention here is to conserve, enhance and leverage the resources and skills for better economic returns through superior market linkages. Promoting awareness about sustainable use of such resources like water, soil, forests and animal husbandry as also the traditional skills like weaving and craft making, are at the heart of this approach.

B. Rights and entitlements linked approaches are aimed at raising the awareness of the community about their rights and privileges as members of a gender, caste or social group so that they can access the benefits to which they are entitled. These primarily include the schematic benefits under various programmes implemented by the central, state and local governments, including rights based ones like the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA).

C. Targeted Approaches for the most vulnerable groups involve generating livelihoods for the poorest of the poor, with focus on empowering them with new skills and assets that they could not own through the journey of their lives. This approach often leads to collectivization of the target group and encouraging them to pool their scant resources and hone their market-indifferent skill sets to achieve synergies and scale economies.

5. Recognising the need for a comprehensive intervention that enables communities to expand their capacity to formulate portfolios of livelihoods based on diverse strategies, the Government of India (GoI) has been implementing the National Rural Livelihoods Mission (NRLM) since 2011 with an objective to cover 70 million poor rural households, across 600 districts and 250,000 Gram Panchayats, the latter representing the most primary layer of local self-government for 600,000 villages of the country. An outstanding feature of the NRLM is the growing involvement of self-managed Self Help Groups (SHGs) almost entirely comprising of women at the village level with federated institutions at the block, district and state levels, supporting them for livelihoods generation. Federated institutions and support for livelihoods collectives over a period of 8-10 years is expected to deepen the confidence levels and collective capacity of communities to manage their livelihoods on a sustainable basis. Aided in part through investment support by the World Bank and rechristened in 2015 as DeenDayalAntyodayaYojana (DAY) – NRLM, the Mission aided initially by the DFIDand later supported by the World Bank, aims at:

•Creating efficient and effective institutional platforms of rural poor, enabling them to increase household income through sustainable livelihoods and improved access to financial services.

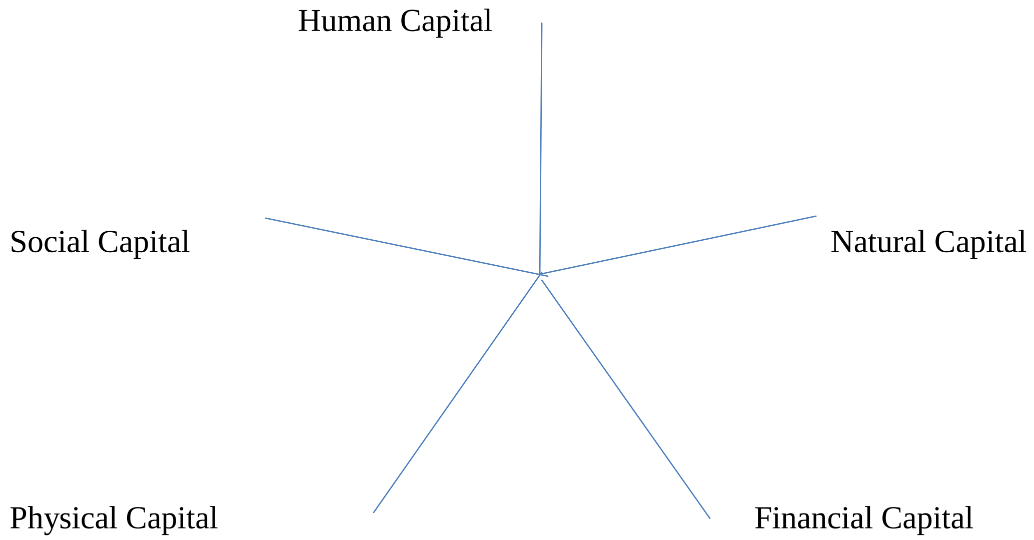
• Facilitating the poor to achieve increased access to rights, entitlements and public services, diversified risk and better social indicators of empowerment.

• Harnessing innate capabilities of the poor and complementing them with capacities (information, knowledge, skills, finance and collectivization) to participate in the nation's growing economy.

Capital Formation and Extension Education

6. Notwithstanding minor differences in the approaches and practices adopted by various agencies that are committed to promoting sustainable livelihoods for the rural poor, livelihood strategies⁄⁄ and outcomes are essentially guided by the form of capital formation that livelihood interventions aim at and achieve. The DFID's SLF has at its core the 'Asset Pentagon'(**Figure 1**) which depicts

Figure 1: The Asset Pentagon



schematically the availability of assets with the community, with the intersection of the lines in the Centre denoting zero capital while the movement of the lines towards the outer perimeter shows increasing access to assets and capital formation. The shape of the pentagon can be varied to reflect the strength of various forms of assets and capital in each community or social groups, through the visual changes in the length of the inner lines inside the pentagon. Each point on the pentagon represents a form of assets or capital which can be accumulated and are interconvertible. The five principal categories of assets or capital that the DFID framework highlights in the Asset Pentagon, are compatible with models put forth by other agencies.

7. Formation and accumulation of any form of capital as a strategy for supporting sustainable livelihoods is predicated o[illegible] quality of extension work that the livelihood promotion agencies like the DF[illegible]ns Development Programme (UNDP) or Oxfam and others enga[illegible]erstand the concept and practice of extension educati[illegible]ent change before seeking to explore its relevan[illegible]inable livelihoods. Though the word ‘Extension’ [illegible]ities of England, Oxford and Cambridge, where the [illegible]as born to deploy peripatetic lecturers to serve the edu[illegible]g urban population, the impact of extending the knowledg[illegible]cts in rural areas was found to be more welcoming. Following the growth of this work in Britain, the land grant colleges in the United States initiated a more formal process of organised extramural lectures on a larger scale for the benefit of farm families (Jones G.E. and Garforth C, 1990). Extension Education, as defined by the legendary Leagans, J.P. (1961) is the process of

teaching rural people how to live better by learning ways to improve their farm, home and community institutions.

8. Available evidence of agriculture related advisory services being provided to the peasant communities dates back to times as early as the 1800 B.C., but the emergence and growth of the modern extension service as practised in most countries of the world, is attributed to the crisis management following the outbreak of potato blight in Ireland between 1845 and 1851. After assuming charge as the British viceroy to Ireland in 1847, Lord Clarendon ordered the appointment of itinerant lecturers who were to travel around the most distressed farming areas to advise small farmers on how to grow nutritious root crops other than potato and bring about overall improvement in the crop husbandry practices (Jones G.E., 1982 as cited in Jones G.E. and Garforth C. 1990). The institution of itinerant farm advisers soon gained popularity in Germany where they were termed as 'wanderlehrer'. When a crisis gripped the vine growers in France due to aphid infestations, a similar system of mobile farm advisers was set up which was later institutionalised as what is considered to be the first case of wholly state funded agriculture extension in the world. By the end of the 19th. Century, agriculture extension systems and institutions became an integral part of the mandate and operating plans of agriculture departments and colleges across United States, Canada, most countries in Europe and Japan thus establishing the relevance of extension services to agriculture development.

9. In the Indian context, after the country became independent in 1947, not only were the memories of the disastrous Bengal famine of 1943 fresh in the minds of the people, but the concerns over food security remained acute as the dependence on imports of American wheat continued. However, the introduction of genetically high yielding varieties of seed coupled with increased cropping intensity and input intensive farming contributed to the Green Revolution of the 1970s which helped achieve a quantum jump in food production. The role of agriculture extension in bringing about the green revolution, is widely recognised. Though the extension programme began with a community development approach in early 1950s, with focus on human and community development, it is in the area of agriculture development that the deepest impact has been recorded. Hence, agriculture extension remains the most organised extension service in the country, serving as a robust facilitator for diffusion of new knowledge, change in attitudes and acquisition of emerging skill sets at all levels of the farm sector.

Application of this knowledge and experience that the agriculture extension system in the country is endowed with could help invigoratestrategies for capital formation to support sustainable livelihoods in rural areas.

Reorienting Agriculture Extension Strategies for Sustainable Livelihoods

10. Since any meaningful initiative in promoting livelihoods must be aligned with the available resources and aspirations of the target communities, a range of assets need to be developed towards creating strategic pathways to different forms of capital- Human Capital; Natural Capital; Financial Capital; Physical Capital; and Social Capital. The profession and practice of agriculture extension has strategically focused on promoting the growth of natural capital which includes soil/ land, livestock forests, water and other resources and the system has delivered effectively in this area, particularly during the years of the green revolution. An attempt is made in this paper to stimulate the interest and strategic orientation of the agriculture extension academics, professionals and practitioners to explore the scope for leveraging their knowledge and experience in supporting the accelerated growth of sustainable livelihoods, even as the impending challenges of climate change, stare at us. A set of caselets are excerpted from a study that the author was associated with for Terminal Evaluation of the UNDP Support Project for Implementation of MGNREGA (2011), illustrating diverse capital formation strategiesin convergence with the MGNREGA works. These case lets are presented below to help the agriculture extension community to reflect on how their expertise could add value and climate resilience to sustainable livelihoods.

A Case of Natural Capital Promotion

11. Natural Capital comprises land, water, livestock, forests and other natural assets that have the potential to generate income streams for the rural poor and is an area where agriculture extension has demonstrated its impact, particularly during the green revolution period. The UNDP, New Delhi and the GoIin the Ministry of Rural Development (MoRD) supported a non-government organisation (NGO) namely the Professional Assistance for Development Action (PRADAN), with a project for capacity building of Gram Panchayats (GPs) in implementing Integrated Natural Resource Management (INRM) practices as part of the MGNREGA works for a six month period from October 2007 to March 2008. The pilot project was aimed at experimenting if INRM could facilitate a transition for MGNREGA from being an unskilled wage-employment programme to a programme for promotion of sustainable

livelihoods for the poor rural households through creation of natural resource based productive assets. Kandhamal was one of the five districts selected across the country for implementation of the pilot project. Ten GPs were identified from three blocks (Balliguda, Dairingabadi and K. Nuagaon) for implementing the pilot project in twenty five villages/ habitations spanning the ten selected GPs in the district.

12. PRADAN's activities were planned to promote INRM based on models and methods that they had developed over the years from its experience of working in different states of India. The INRM practices involve participatory planning among rural communities to enhance land productivity through soil conservation, rainwater harvesting and diversified cropping patterns. Though progress during the pilot project was hindered by law and order problems that cropped up in the district during December 2007, following clashes between the Kandhos (scheduled tribe) and the Panos (scheduled caste), the initial results were encouraging enough for PRADAN to launch a separate pilot project in Gunjagaon GP of Kandhamal district with funding support from Oxfam later in 2008. Based on the progress demonstrated in Gunjagaon in integrating INRM with MGNREGA, the UNDP, Bhubaneswar supported another project in five GPs for enhancing the capacity of village communities to plan and implement MGNREGA works utilising the INRM models developed by PRADAN. This second project was also approved for six month duration, from October 2009 to March 2010.

13. The INRM models demonstrated by PRADAN were integrated with MGNREGA works for developing mango orchards in the upland farm holdings of tribal farmers who were also encouraged to cultivate vegetables as an inter-crop. The mango plantation was taken up in 22 acres by 22 households at the rate of one acre per house hold in Limarpadar hamlet of Mahasingh GPat the planting rate of 160 saplings per acre. Soon, the tribal farmers from other project villages came forward to take up the plantation. The excavation of pits for planting the saplings, fencing against grazing cattle and the mango saplings were all provided under the MGNREGA. Returns from the freshly planted mango orchards had to wait for three years but cauliflower cultivation as an inter-crop or as a second crop in addition to the traditional rainfed paddy began generating additional income for the farmers. This approach to planting fruit trees in uplands, pulses and vegetables in midlands aided by INRM models of water conservation and paddy in low lands following the System of Rice Intensification (SRI)

was very well received by the otherwise jhooming tribal farmers, who could enhance their natural capital and farm income without risking food security.

A Case of Convergent Formation of Human and Physical Capital

14. Human Capital refers to the traditional skills, knowledge base and capabilities of the rural poor while physical capital is formed when new roads, water and sanitation structures, land development, storage and equipment supply facilities are developed. SEWA (Self Employed Women's Association, Ahmedabad) implemented a project from October 2009 to September 2010 for leveraging the MGNREGA to promote human development through skill building in six villages of: Mohanpura, Fatehpura, Anwasa, Swarupura, Doljikakheda and KumharonkaJhopdaofBhilwara district in Rajasthan. The following activities were taken up under the above project:

• Skill building in pouch making, assembly of solar lanterns, paper dish/ cup making, washing powder preparation for generation of non-farm livelihoods.
• Micro-planning for development of natural resources through land leveling and bunding.
• Setting up of Tools and Equipments Depots to be managed and maintained by the KastkarVikasSamitis (KVS) - Farmer SHGs, for timely availability of farm tools
• Setting up of a revolving fund of Rs. 10,000 each in the project GPs for bulk purchase of seeds, fertilisers and other inputs to farmers.
• Preparation of vermin compost and organic fertilisers through KVSs.
• Collaboration with agricultural extension machinery of the Government of Rajasthan (GoR) for farmers' training in progressive agriculture practices through crop demonstrations and exposure visits to research farms etc.

15. Project outcomes from the above interventions by SEWA for sustainable livelihoods, included:

- Six tools and equipment depots with adequate farm tools ploughs, sickles, hoes, solar lanterns, drills, cutters, dusters, sprayers and weeders were organized one each in the villages covered under the project, with an investment of around Rs. 400,000. Any farmer member of the KVS could borrow these equipmentsat a nominal fee. The income from the user fee was parked in a fund for maintenance of the equipment.

- 50 out of the total of 82 farmers who regularly used the facility belonged to the poorest sections of the farming community with little access to agricultural implements. They also benefited from land development adding to their physical capital.
- Almost all the farmers in the project villages have benefited from agricultural extension services like exposure visits, farmer training programmes and bulk purchase of agricultural inputs. The collective bargaining power of the small and marginal farmers has gone up through bulk procurement of agricultural inputs like seeds and fertilisers.
- For Mr. Prem Singh, a 43 year old MGNREGA worker and small farmer from Anwasa village, the tools and equipment facility provided by SEWA has been very helpful. “I was completely dependent on the tractor owners for ploughing my field earlier. The tractor owners charged Rs. 300 per hour. Despite charging such exorbitant rates, availability on time was still a problem. The crop yield and quality are both affected if the farm is not ploughed and sowing is not on time. The tool kits hired out through VKS is a great boon for many farmers like me. We have been able to plough our lands on time and have also been able to save on costs. A good plough can now be hired for just Rs. 20 a day. Other machinery like weeders and sprayers which had to be hired from the neighbouring villages in the past, are now available here at a nominal fee.
- The Pouch Making Group in Mohanpura consisting of 10 people has independently started making pouches, a sign of improved human capital.

A Case of Financial Capital

16. Financial Capital is the ability of rural communities to fund their livelihood activities and besides liquid cash, this includes jewellery and farm surpluses that can be liquidated quickly to generate funds. A project was supported from October 2009 to September 2010 for promoting MGNREGA linked innovations in promoting financial capital among the wage seekers, in partnership with BASIX. The project was planned to cover seven villages namely Rayla, Beran, Jaswantpura, Surajpura, Lambia Kalan, Lotiyas and Alinagar in the Baneda block of Bhilwara district with the following objectives:

i. To promote financial literacy amongst the MGNREGA savings bank account holders

ii. To facilitate access to basic financial services through Business Correspondents.

iii. Integration of the financial services with opportunities for sustainable livelihoods.
Keeping in view the above objectives, a baseline survey was carried out in all the seven project villages with a sample of 541 households actively seeking wage employment under MGNREGA. The survey results pointed to low awareness of financial institutions, with 66 percent of the surveyed households never having visited any financial institution and about 80 percent lacking the knowledge to make basic banking transactions like deposits and drawals.

17. The Indian Grameen Services (IGS), a non-profit affiliate of BASIX Group was designated as the business correspondent for Central Bank of India (CBI) in the project villages for delivery of financial services to MGNREGS workers. The IGS in turn has tied up with Tata Consultancy Services (TCS) for providing biometric technology services to support the project. An intensive financial literacy programme was organised covering more than 4000 MGNREGA wage seekers at the worksites and villages through movies, interpersonal contacts and group discussions. Biometric cards were distributed to 1295 job cardholders. Since most of them had their savings bank accounts in post offices before, BASIX organized opening fresh savings accounts with the CBI, while their biometric data was simultaneously collected and stored in the TCS server. The CBI, after verification of the applications for savings accounts with the entries in the server, permitted the distribution of the biometric cards. BASIX also organised training to orient the mates, Gram RojgarSevaks (MGNREGA- Village Employment Assistant) and members of GPs on the above project. With all banking transactions conducted at their doorstep through the biometric cards, a small growth in savings resulted from the project but their confidence levels to participate in banking transactions was a bigger gain, promising better financial capital formation.

A Case of Convergent Social and Human Capital

18. Social Capital is reflected in the network of social relationships, caste and clan connections and the trust quotient that the rural communities have been able to build among themselves. A project was implemented from December 2009 to November, 2010, in partnership with PRATHAM, an NGO, for promoting functional literacy and agricultural skills among MGNREGA wage seekers, while imparting computer skills to the younger wage seekers with aptitude for the same. The pilot project covered 50 villages across four blocks namely Banera, Hurda, Mandal and Mandalgarh in Bhilwara district. The PRATHAM project co-ordinators identified and trained cluster

coordinators each of whom was expected to mobilise ‘literacy volunteers’ drawn from different sections of the community. Almost 30% of the 5384 adult learners were trained by school children cutting across caste and creed barriers, bringing about an opportunity for closer ties within the community through the good will that the school children could generate.

19. The literacy volunteers were provided free computer learning by the master trainers of PRATHAM and the former were asked to carry out adult literacy work either at work site or in the community for two hours a day. The teaching kit was provided by PRATHAM and each volunteer was assigned responsibility to make five MGNREGA workers, functionally literate. The end line survey results of the pilot project till December 2010 showed impressive outcomes in terms of adult functional literacy as 5384 persons qualified as Adult Literates (ALs). Of these, 647 ALs could read letters only; 1784 ALs could read words only; and 2,930 could read paragraphs. The remaining 23ALs could only put their signatures. More interestingly, the project generated 741 computer literatessix of whom were gainfully employed at PRATHAM. Further, as part of the agricultural skilling component, 1086 persons were trained in soil testing; 241 in drip irrigation techniques; and 600 in promoting vermin culture. PRATHAM has also established one drip irrigation unit in ChhangaKaKheda village in Banera Block for demonstration purposes.

20. From the discussion on livelihood frameworks and caselets above, it seems appropriate to conclude that huge scope exists for the agriculture extension system in the country to strategise and vigorously contribute to both farm and non-farm livelihoods. There are success stories galore where KrishiVigyanKendras (KVKs) and the Agriculture Technology Management Agencies (ATMAs) have promoted farming systems and practices that have significantly enhanced farm incomes. Sustainable livelihoods is not merely about raising economic returns but doing so in the context of vulnerabilities including shocks and seasonality linked stresses while aligning with the governance structures and processes that influence livelihood outcomes, as most contemporary frameworks on sustainable livelihoods, point to. As agriculture extension bears the responsibility to impart climate resilience to the composite farm value chains across Indian agriculture, there is a need to reorient the extension professionals and practitioners to help them embrace the paradigm of sustainable livelihoods. Leveraging their core competence as a trans-disciplinary profession that straddles the knowledge

value chain from its generation to dissemination, agriculture extension specialists could open up a new window of much needed convergence through sustainable rural livelihoods, between agriculture and rural development programmes across the country.

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Strengthening Agricultural Extension System – Road Map

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Centrality of Agriculture in India's Economic Growth: India remains the fastest growing major economies of the world, as per recent report of IMF. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry, is one of the largest contributors to the Gross Domestic Product (GDP). The first advanced estimates of GDP growth for the financial year 2016-2017 (FY17) show a marginal decline from 7.6 per cent last year to 7.1 per cent this year. However, one sector offers a glimmer of hope. Agriculture, and its allied sectors, which registered a jump from 1.2 per cent last year to 4.1 per cent this year while, promising sectors such as Mining, Manufacturing, Trade, Communication and Construction showed a downward trend. Hence, development of

Agriculture continues to remain critical for India's economic growth, poverty reduction and ensuring food security of the country.

Agricultural Extension is central to Agricultural Growth: Green Revolution which brought food sufficiency to the country was due to combination of technologies viz., hybrids and high yielding varieties, fertilizers and improved agronomic practices. It required assured farming areas, better management abilities and for the first time, costly external inputs. Thus, it could benefit mainly irrigated regions and resourceful farmers, bypassing the larger segment of dry farming and resource poor farmers. Now, we are hoping for a Second Green Revolution or Ever Green Revolution which is more inclusive.

However, Indian Agriculture continues to face major challenges such as; Declining land and water resources, decreasing size of farm holding, Competing quality and prices in export & domestic markets, Low profitability of agriculture, drudgery, and poor quality of life in rural areas, Un-interested youth in taking up agriculture, Increasing migration of men from rural areas, Poor access to resources and knowledge to farm Women and Extreme events of Climate change. India is bestowed with large number of Agricultural Research Institutions, Agricultural Universities, Private R&D generating varieties of technologies to face above challenges. However, the real challenge remains to take these technologies which are available to the hands of needy farmers through effective extension. Thus, extension plays the central role in development of Agriculture.

Changing role of Extension in this context, extends beyond transfer of technologies, to perform activities which empower farmers to adopt latest technologies resulting in enhanced production, productivity, profitability, thus, uplifting the living standards of farming families.

Present status of Agricultural Extension: National Mission on Agricultural Extension and Technology (NMAET) launched during 12th Plan period continues to be major extension initiative in public extension. The mission blends technology with extension and services are routed through ATMA at District level. The mission created enough space for convergence and scope for utilization of manpower, infrastructure and funds available with Agriculture and Allied departments, various central and state governments' programmes for Agriculturalextensions. Four Sub-Missions were launched under National Mission viz., Sub-Mission on Agricultural Extension, Sub-Mission on Seed and Planting material, Sub-Mission on Agricultural Mechanization and Sub-Mission on Plant Protection and Plant quarantine. All the extension activities of four Sub-Missions are implemented through ATMA.

Agricultural Technology Management Agency (ATMA) is a platform at district level which bring convergence between Agriculture and Allied departments, public and private extension service providers. Strategic Research Extension Plan (SREP) prepared through bottom up planning process serve as basis for deciding extension priorities and activities in the district. Poor participation of senior officials, lack of convergence with flagship programmes of allied sectors, stereotype meetings with farmers advisory committees, weak public private partnership, non-serious approach in preparation of SREP, delay in release of funds, promotion of weak farmer groups for achieving the targets, weak linkage between ATMA and KVK, lack of involvement of Agripreneurs in ATMA activities, poor understanding and implementation of concept of farm school, target oriented attitude of Extension functionaries, inadequate capacity building of extension functionaries, poor infrastructure for extension are some of the areas which need greater attention while strengthening existing extension system.

Indian Council of Agricultural Research (ICAR) is also carrying out extension activities at district level through KVK, besides promoting technology application through on-farm trials, demonstrations and training.

Progressive farmers, Agripreneurs, Input dealers, Agri-business companies, NGOs, Farmers organizations, Cooperatives, Banks, Mass media also provide private extension services to farmers.

I. Strengthening of Present Agricultural Extension System:

1. **National Mission on Agricultural Extension and Technology (NMAET**) converge three important technologies viz., Seeds and Planting material, Agricultural Mechanization and Plant protection and quarantine with extension. It is equally important to converge with all other technologies in the similar lines at national level.
2. Appropriate institutional mechanism under NMAET may be introduced for ensuring convergence between extension and technologies at delivery point i.e. ATMA.
3. Funds earmarked for extension programmes by central and state governments may be released in time directly to implementing agency ATMA. It may be ensured to release funds well before the agricultural seasons.
4. Inter Departmental Working Group (IDWG) should ensure timely release of funds to ATMAs, SAMETIs, ensure convergence between Agriculture and Allied departments at ATMA level and regularly review the implementation of Extension Programmes. IDWG may focus on Institutional and process reforms and ensure implementation of basic guiding principles of Extension Reforms.
5. A strong monitoring mechanism at national, state and district level may be established. The monitoring system should be adequately supported with necessary manpower, infrastructure and funds.
6. A comprehensive study on the functioning of SAMETI and ATMAs may be instituted to streamline their functioning.
7. Lack of understanding on the philosophy of ATMA has created considerable confusion at implementation level leading to poor performance of ATMA. Hence, orientation on the philosophy of ATMA to all the extension functionaries specially to district heads of agriculture and allied departments may be given top most priority.
8. SREP preparation and revisiting has to be done timely and professionally under the supervision of experts. This process should be undertaken under the direct supervision of Chairman, ATMA i.e. District Collector.
9. The scope of SREP may be extended to include market led extension services and may renamed as Strategic Research Extension Marketing Plan (SREMP)
10. District Credit Plan of NABARD, District Pest Management Plan and District Contingency Plan of Climate change may be integrated with SREMP.
11. Convergence matrix may be made mandatory for implementation of all the schemes of agriculture and allied departments to ensure convergence and implementation on gap filling mode pattern.

12. A scale to measure the performance of ATMA has to be developed and institutionalized for the purpose of measuring the performance of ATMA, comparing the performances for the purpose of recognition.
13. Farm School has to be named after commodity around which activities are carried out. For example Paddy School, Diary School etc.
14. Non-core activities from Extension Workers may be withdrawn to prevent dilution in the delivery of core activities.
15. ATMA has to maintain private extension service providers (PESP) directory and involve them in extension activities. This also includes capacity building of PESP.
16. Farmer Friend positions are not fully filled. The positions may be filled on priority basis and thoroughly oriented on basic agriculture and SREP through induction training. As Farmer Friend is critical extension link at delivery end, center and states may ensure adequate funds for positioning and capacity building of farmer friends.
17. Integrated Agricultural Extension services may be ensured by including credit and inputs besides information in partnership with banks and input dealers.
18. Extension worker shall be retained for a minimum period of three years at their place of posting to ensure stability in extension services to farmers.
19. Agricultural extension has to be strengthened with adequate investment mainly focusing on additional manpower, capacity building, mobility and hand held ICT devices to the extension functionaries.
20. Inadequate manpower is a serious bottleneck in delivering effective extension services. This may be addressed through four pronged strategies namely filling all the existing positions in ATMAs, fullest utilization of manpower available with allied departments under convergence, efficient use of Agripreneurs, Input dealers, agribusiness companies and ICT utilization including Mass Media.
21. Induction training programs at the time of joining service and Regular Refresher programs for extension functionaries may be made mandatory as updated Knowledge is pre-requisite for good extension services.
22. All the extension functionaries may be adequately sensitized about all Agricultural Development programme prior to their launching to ensure proper conceptual clarity and operationalization of the programs.
23. The best talent in the field may be attracted to the positions of trainers in Extension training institutes by providing incentives.
24. Convergence and Coordination between Capacity Building Organizations may be strengthened through Institutional mechanism.
25. MoA&FW online Training Information System (http://www.trg.dac.gov.in/) may be made mandatory for all the training institutions in the country.
26. Training infrastructure, manpower, emphasis on Extension activities, funding support for Animal Husbandry and Fisheries Extension may be given priority, as these two sectors are sunrise sectors and their contribution to GDP is increasing significantly.
27. Training of people representatives, administrators, private sector organizations, women, youth, and farm labourers may be emphasized.
28. Strengthening of Agri-Clinics and Agri-Business Centres (AC&ABC) Scheme implementation - Agripreneurship Development content may be integrated with Agricultural education for undergraduate students. Agricultural Universities may be mandated to organize AC&ABC training with close monitoring on establishment. Screening of candidates may be tightened.

Training programmes may be conducted through experienced Agripreneurs and Stakeholders with experience. Establishment of Agri-ventures may be considered as single criteria for measuring performance of Nodal Training Institutions. Handholding support provided by Nodal Training Institutions may be closely monitored. Agripreneur – ATMA linkage may be strengthened. One branch one Agri-Clinic concept of Govt. of India may be implemented by banks. AC&ABC may be covered by MUDRA.

29. **Strengthening of KVK Led Extension:** KVK has to reorient its focus on acclimatization of technologies to the local situations rather than mainstream extension work. KVK should provide technical back stopping support to public and private extension functionaries of the district. Convergence between Agricultural research and extension, as agreed between Department of Agriculture & Cooperation and Department of Agricultural Research and Education has to be implemented in letter and spirit. ATARIs may be made accountable for ensuring strong linkage between KVK and ATMA.
30. ATMA shall be the platform for convergence and service delivery of all schemes and programmes of agriculture development at the district level and below. ATMA governing structure should be enlarged to provide representation for various organizations and stakeholders involved in CDAP including those from NRM, water resources, power, NREGA, rural livelihood mission, tourism etc.All committees implementing Ministry of Agriculture schemes shall be subsumed in ATMA Governing Board and Management Committee. Mechanism may be designed for redressal of grievances of any sector.

    A convergence matrix may be prepared which will list out scheme and component wise allocations and activities. Every proposal for funding under existing schemes or new schemes should be accompanied by a convergence matrix relating to that department with a detailed explanation about to what extent convergence has been achieved. Every authority scrutinizing and approving the programme must do convergence scrutiny to satisfy himself/ herself that convergence has been brought about. Departments and institutions in the convergence matrix shall co-opt the departments in the related institutions in decision making.
31. One time catch up grant should be provided all training institutions for up-gradationof their training infrastructure.Adequate dedicated quality manpower recruited, trained for capacity building activities, ensuring minimum infrastructure such as Audio – Visual aids, training facility, lodging and boarding for trainees, mobility , library, computer and internet facility, adequate funds have to be ensured for proper functioning of capacity building Agri institutions using the catch-up grants. Accreditation of existing and new HRD and Training Institutions must be made mandatory to enhance effectiveness, accountability and ensure quality training. Appropriate accreditation protocols, procedures and institutionalization may be developed by MANAGE in collaboration with institutions for international excellence. This onetime up-gradation of physical infrastructure of training institutes/ Centres will revive the training institutes to an acceptable level.

II. Proposed Interventions for further strengthening of Agricultural Extension:

1. Group Led Extension: Inadequate manpower, lack of mobility and resources are important bottlenecks in effective extension. Taking the example of AMUL, Mahagrapes, Rubber Producers Companies, Farmers Producers Organizations may be promoted vigorously. This may be prioritized in extension activities. Group approach would also help in providing extension, credit, infrastructure, post-harvest value addition, marketing, storing and branding. The group approach enhances scale of economy, bargaining power of farmers and farmers share in consumer rupee. The present Commodity Interest Groups of ATMA may be established as "Building Blocks of FPOs". Professionally established CIGs may be federated at block and district level for providing storage, processing, value addition, marketing activities. Even though, it was envisaged in ATMA, the same has not been implemented in letter and spirit.
ATMA functionaries may be trained in operationalization of Commodity Interest Groups. Sufficient time may be provided to accommodate natural stages in social mobilization. Roadmap for development of CIG in to Federation and company at different levels may be put in place at the time of formation of CIG itself for which concerned ATMA may be made responsible.

2. Market Led Extension: The current focus of extension is mainly on production and to increase the productivity. However, the extension focus should expand beyond production and to work on reducing the cost of cultivation, aggregating the farm produce, reducing the level of intermediaries, value addition, collective marketing and realizing the better farm gate prices.

In order to implement the extension functionaries have to undertake orientation and sensitization activities, provide information on advantages of the e-NAM platform and encourage farmer participation and utilize this platform for better price recovery of their farm produce.

Market Led Extension should include robust, sustainable e-procurement mechanism, modern storage structures and assured MSP with procurement guarantee, crop insurance and credit will encourage the farmers to choose better and financially viable cropping system, realize better farm price and retain their interest in farming. Massive capacity building of extension functionaries is prerequisite for introduction of Market Led Extension approach.

3. ICT Led Extension: Advancements in Information and Communication Technology have to benefit Agricultural extension in terms of time and cost effectiveness. It also prevents, communication distortion. However, ICT is yet to be utilized for fullest extent for the benefit of farmers by extension. It is important to create farmers and extension workers base who are familiar to ICT tools. Hence, massive national e-Literacy Campaign may be organized to educate farmers and extension workers in usage of ICT tools in extension. Existing ICT facilities such as Telephone, Mobile, Radio, TV, Films, Agriculture magazines, Internet, Social media may be used by extension workers to the fullest extent. ICT tools would be beneficial for providing real-time information to farmers on weather, market prices, pest and disease forecasting, updation of field data etc. It is important to make mandatory to execute several extension activities and transactions on ICT platform so that, extension system slowly acclimatize to utilize ICT tools. Adequate infrastructure such as, LCD Projector/ Pico

Projectors, Tablets, Computers, Internet, Video conferencing facility should be made available for extension in all the levels.

Vast network of television channels, radio and print media may be extensively used to publicize success stories of farmers who have demonstrated profitable agriculture for inspiring and motivating other farmers. The same successful farmers may be extensively used by extension systems in outreach programmes. There is an urgent need for preparing policies with reasonable tax and tariff reduction on ICT in order to effectively utilize the benefits of technological advancement for the benefit of farmers. Agriculture journalism may be developed as an attractive profession through policy support to reach the unreached. Quality manpower may be placed at L1 in Kisan Call Centres to increase the efficiency of Kisan Call Centre (KCC). Teleconferencing services may be added to existing KCC. Updation of mKisan portal and linking to delivery point in extension to farmer friend level need to be ensured. Existing mechanism to provide weekly/ daily personalized information (thru SMS/MMS) to the farmers by the Departments of Agriculture/ Horticulture/ Animal Husbandry/ KVKs/SAUs may be strengthened.

4. Partnership Led Extension: Several important players such as, Progressive farmers, Agripreneurs, Input dealers, Agri-business companies, Farmers organizations, NGOs, Private media, Banks, Donor agencies play important role in Agriculture development. Public extension should make space for partnership with above actors through supportive policy, partnership mechanisms, adequate funds and monitoring process. Liberal access to technologies developed by public institutions should be made freely available to all actors including private sector. Large number of Scientists, extension functionaries and professionals from other organized sectors such as, Agri-business companies, NGOs, Media, ICT sectors are retiring from services every year. An action plan may be developed to make use of this rich resource for the benefit of farmers.
Diploma in Agricultural Extension Services for Input Dealers (DAESI) has evoked huge response among Input dealers. In order to make use of DAESI trained Input dealers in Extension, ATMA has to work very closely with Input dealers through ICT platform, updating information on government programmes, extension alerts, government orders, films, Agriculture magazines for the benefit of farmers through Input dealers.

Develop a policy framework that defines the role of the private sector in the agriculture sector at a macro level for development of state-specific partnership strategies based on local priorities and needs. Standards and regulatory framework for certifying and validating extension activities by all players, including public extension agents should be developed. Innovative and effective extension strategies developed by the private / NGO sector may be identified and up-scaled through funding support. Public and private infrastructure may be opened up of for use in extension. Challenge programmes, competitive grant funds and incentives to promote PPP in Extension should be launched. Special efforts should be made to bring corporate social responsibilities under PPP.

5. Agripreneurship Led Extension: Transformation of Agriculture to Agri-business and farmer to Agripreneur has to be ensured for making farming profitable. Agripreneurship development may be made integral part of curriculum in Agricultural Universities. Agripreneurship may be projected as attractive option for students. Extension should focus more on off-farm and non-farm income generating activities, initiating Agri-startups involving youth, establishment of custom hiring units etc. Rural youth and farm women may be provided with extension education by inculcating technical, managerial, entrepreneurial and personality skills for managing profitable farming. Farm laborers may be trained in specialized skills required for better farming. Focus needed on specialized extension services for Agro and food processing sector at farmer's level.

6. Data bank on Agricultural Extension: There is a need for establishing a data bank of Agricultural Extension containing complete details on manpower available with public and private extension at different levels, status of Agricultural Extension Institutions in public and private sectors covering infrastructure, funding, functions and programmes. This data bank serves as basis for critical analysis of deficiencies in extension system which would help policy makers to channelize the funds for priority sectors.

7. Family loans to farmers: Farmers require finance for Agricultural and personal reasons such as health, education etc. In order to ensure timely activities in his farm, financial freedom and flexibility is required at farmers end. Credit requirement of farmer has to be worked out considering total family credit requirement rather than one crop for one season only. Total family credit requirement including various crops, enterprises, off-farm and non-farm activities, essential expenditure incurred for basic family needs such as health, education etc. Thus, family credit has to be considered andkept at the disposal of farmer for use. However, the implementation has to be designed considering the possibility of diversion of credit from agriculture to non-agriculture and staggered use to onetime consumption defeating the very purpose of family loan.

8. Common Service Centres (CSC) to act as Extension Delivery Points: There are 1.57 lakhs Common Service Centres located at village level providing citizen services to villagers. This is operated by a village level entrepreneur. The CSC possess minimum IT infrastructure to provide IT enabled services to people on payment basis. CSC is great national resource available at village level, managed by entrepreneur which could be used for providing Agricultural Extension services by value addition to the concept. For this transformation, CSC entrepreneur has to be trained in Basic Agriculture and information sources in Agricultural Extension. With this empowerment, CSC can provide Agricultural Extension related services such as, providing weather data, market information, Input stocks availability, information on buyers and exporters, upload visuals about diseases and pests, linking farmers to scientists and extension workers, skype based interaction with scientists, video conferencing, screening of Agricultural films, complaints, etc., on nominal payments by farmers. By virtue of scale, entrepreneur earns additional income which provides financial stability to CSC and easy and affordable information access to farmers. This approach is expected to benefit large number of farmers as government is planning to add another one lakh CSC during the next one year.

9. Post office network to act as Extension Delivery Points: There are 1.55 lakhs Post offices are there in the country out of which 90 per cent are located in rural areas. These post offices have locational advantage besides, possessing basic IT infrastructure and connectivity. Without any additional finance, this facility can be used for reaching farmers on weather data, market prices, new programmes etc.

10. Academics as Extension Channel: There is unanimity that every possible extension channel should be utilized for meeting the country's extension goals. Need for greater role for ICAR Institutions, State Agricultural Universities in direct but focused extension is also being stressed. While there is focus on various channels, academics as an

Extension Channel has not been adequately stressed and its potential is not fully exploited. In all these academic institutions the country has a very large base of academic and scientific manpower which can make a transformational change in Agricultural Extension. This can facilitate quickest increase in farmer's income without additional investment.

11. Agricultural Education Network: Country has a massive Agricultural education system. It has large number of graduates, post graduates, Ph.D. students, diploma and vocational education students. Involvement of these students on a limited scale in extension activities could not only provide hands on experience to students in Agriculture, but also add massive manpower for agricultural extension.

12. Integrating academic functioning with agricultural extension: The large academic resource should be fully leveraged for implementation of flagship programmes of States and Govt. of India. For example, each college could adopt group of villages as per priority fixed by the Government. Extension activities and action research projects may be taken up for developing these villages as model villages under different flagship programmes. Teachers should thus teach and students should learn agriculture by working with the farmers and solving problems of farmers. Such orientation of academic work will also improve academic standards and relevance. This field works shall also serve the objective of education.

13. Student Research: Student Research forms a very important component of research work done in academic institutions. Students should select research projects for specific problems of the area identified by Public extension, Agri-business companies, NGOs and Flagship programmes. Recommendations of every student research project should be put in to practice in the field by public extension.

14. Academic Utility Audit: There should be annual assessment of the performance of academic faculty and students in achieving extension objectives. This assessment should be a major determinant of the eligibility of faculty for recognition and academic performance of students. This should be specially mentioned in the degree/ diploma awarded to the students.

15. Models for Extension: Extension system should be supported through establishing model farms, model farmers, farming system models and model villages as hubs for extension activities.

16. Establishment of Farm Innovation Foundation: The foundation is proposed to test all ITKs, identify farmer innovators, recognize their skills and leverage these for field extension activities. It should capture and monetize farmers' knowledge, monitor its accreditation over the period and further leverage for farmers' incomes and farm growth.

17. Changing Role of Extension: Extension, as a delivery mechanism across agriculture and allied sectors in addition to their conventional knowledge dissemination role, should also play facilitation, intermediation and advocacy roles. These include organizing user/producer groups, facilitating access to production inputs, linking farmers to markets, engaging in research planning, technology selection, feedback, linking various support & service networks, redressal of grievances, enforcement of Farmers' Charters and advocacy of policy implementation issues to support farmers.

18. Project approach in Extension: Extension should follow project approach through projects of suitable sizes to provide full support and facilitation to farmers including backward linkages (production) & forward (marketing) linkages and an integrated farming systems approach through convergence. While doing so, follow projectisation of schemes, programmes and resources of public and private sector and adopting regionally differentiated best partner approach. Resources of PRI institutions need to be fully leveraged and they need to be provided a prominent role in planning and implementation of extension programmes**.** Project proposals should indicate potential income gains and risks and returns to investments to facilitate informed selection of projects.

19. Project Management in Extension: The Project Planning and Management (PPM) capability of SAMETI may be built to(a) formulate projects, access funding, train the staff and stakeholders and support service delivery, assist in project implementation and monitor project implementation; (b) improve PPM skills of ATMA, BTT and other institutions through induction and refresher courses (c) prescribing PPM skills for recruitment; (d) quantification of PPM skills which should be indicated in every project for funding along with efficiency of implementation of previous projects; and (e) leveraging the capabilities of ICT to the fullest extent for formulation and implementation of the Extension Mission.

20. Extension Manual to Guide Extension: The entire range of traditional and modern extension methods should be deployed effectively to extend the outreach and funding provided for the same. Extension Manuals should be compiled and updated in both print and audio visual versions containing detailed guidelines for conducting extension activities includingwide range of strategies, tools and functions that are relevant for their work in different settings.

21. Challenge approach in Extension: For full realization of potential of the proposed decentralized approach, Concept Challenge should be developed to extend the frontiers of possibilities. Challenge programs (say Gold Challenge, Silver Challenge and Bronze Challenge) should be developed for extension staff and extension institutions e.g. SAUs/ICAR institutions, PRIs, ATMAs, KVKs and BTTs with each institution selecting the challenge and prepare plan accordingly. Such Infrastructure supported to fulfill the challenge selected which need to be rewarded and incentivized based on their performance. Standards for various parameters in terms of achievement in increasing yields, incomes, employment etc. should be determined (Gold Challenge - 100% increase, Silver Challenge - 50% increase and Bronze Challenge - 25% increase) in yields and or incomes. National and state awards may be instituted and given on National Extension Day to be designated. Mechanism and methodology may be developed and put into practice for assessing extension impact. Challenge approach may also be extended to private sector through suitable modifications.

22. Agriculture Sub-committee at State and National Level: An Agriculture Sub-Committee of the Cabinet, comprising of all Ministries and Departments, having mandate of promoting agriculture and rural development or building rural and agriculture infrastructure should be created at national and state level for devising and institutionalizing convergent mechanisms and processes for formulation and implementation of programs and giving approval to programs and monitoring implementation. Official inter-departmental committee headed by the Cabinet Secretary/Chief Secretary may be established for giving approval to all programs of these ministries, instead of committees for independent programs, to bring synergy among programmes and also to ensure convergence. Committees may be serviced by a professional group to screen proposals and assist the committees.

The Kharif and Rabi campaigns may be launched at national and state level by Hon'ble Prime Minister and Chief Minister respectively. Campaigns at regional, district, block and sub block levels may similarly be launched by other VIPs ceremonially. Functions may be launched in every institution on a specified day which may be fixed nationally or by each state. Institutions may review work done by them to support agriculture and to release their Farm Agenda for the next year. All these Farm Agendas should be posted on a special website created for this purpose, besides Farmers Portal. In order to reach Farm Agendas to the maximum people, in regional language radio and television Farm Agenda can be broadcasted using regional celebrity/ VIP.

23. Farmers' Charter may be adopted and declared by every organization (public as well as private) providing services to farmers indicating the quantity, quality, price and timings of services. These need to be uploaded in the **"**Farmers Portal" and its implementation has to be closely monitored. Grievance Redressal Officers should be nominated for complaints relating to Farmer's Charter. They should also file complaints with the Consumer Courts. Services amenable for "rights based approach" should be identified and brought under the general law on guarantee of services.

24. Innovations must be prescribed as a key instrument of Extension Mission. Result Framework Documents (RFDs) and Key Result Areas (KRAs) have to be modified to suitably reflect the needs of the Mission as part of Plan.

25. Develop an **HRD Policy for Extension in Agriculture and Allied Sectors** based on a census of extension service providers and supported by Agricultural Extension Human Resource Development Project to build capacities of all extension service providers in agriculture and allied sectors representing the public, private and civil society. Every extension functionary shall be required to undergo minimum 10 days of need based and diagnostic–skill based training every year for being able to perform the task in the field as per a pre-decided career progression plan. Yearly assessment of capacity of institutions at all levels may be made as part of planning process.

26. To give recognition and status to the **farm youth**, they should be trained, tested and certified in farm skills on a modular basis through life time capacity building pattern to enable them to engage in Agri-business activities and to take up employment in various farm related services. Rural Self-Employment Training Institutes (RSETIs) and KVKs may be utilized to train students with agriculture as one of the subjects in their academic programme. As an extension of Right to Education, every youth should have right to vocational training. This should be free and the youth should not be required to pay for the same. There is need for training and skill-building opportunities for young people that can mould them for active participation in decision-making processes. A common platform for rural youth can be developed to discuss opportunities in agricultural development, share experiences and advocate for greater youth engagement and representation in agriculture.

A comprehensive policy on farm youth may be framed**. National Institute for Youth in Agriculture** may be established for research, policy and advocacy support on farm youth with networking across different agro-climatic zones in the country. Policy should support youth for farming and also provide employment in on and off farm services required for agriculture growth.

Budgetary Support may be provided for mobilizing and involving Youth clubs and through Nehru Yuvak Kendras (NYKs) and NSS volunteers in extension activity. They may be linked and networked to organizations including KVKs for providing support.

“YUVAK KISAN SADBHAVANA DIVAS” may be organized at Village, Block, District, State and National level by involving local institutions. Youth with exemplary contribution to agricultural prosperity may be honored on this day.

27.Employment budgeting and employment mapping: Employment generation has to be the responsibility of every sector and organization. Employment budget therefore should accompany every plan and financial budget. Detailed employment mapping covering both formal and informal employment should be a pre-requisite for employment budgeting and employment generation. CDAP should include a separate section on employment generation. Mapping will help in involving youth in the examination of existing policies as well as determining and evaluating potential policy alternatives and also help to identify youth individual interests.

28. Initiate a Fund on Extension Research **(All India Coordinated Research Project on Extension)** at MANAGE and the fund should be made available to all organizations on competitive mode to address the specific problems.

29. Corporate Social Responsibility: The emerging potential of Agri-business companies and other private sector may be harnessed for technology, manpower, funding support to attain the synergy and effective Extension delivery. A special purpose vehicle for promoting CSR activities in Extension may be launched from MANAGE. Extension activities seeking tax exemption may be brought under special purpose vehicle (SPV).

30. Central Agricultural Advisory Services (CAAS) may be created sub-sector wise to provide a decentralized, pluralistic, contract-based agricultural advisory system that would improve farmers’ productivity and livelihoods. Local governments contract Extension activities to CAAS based on needs identified by local farmer groups, organizations, and farmer forums. District governments provide some additional funding for those extension activities and help set priorities. Extension professionals may be hired on contact basis privately. This would also provide opportunity for using the services of retired professionals having rich experience.

CAAS may be encouraged to offer the other key support required for the farmers to prepare business appraisals, develop marketing plans, apply for bank credit, and obtain advice on financial and legal matters. Involvement of private agricultural service providers such as Agripreneurs, Consultancy firm may help the farmers in market oriented production.

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4. Report of the Working Group on Agricultural Extension for Agriculture and Allied Sectors for 12th Plan.

Role ITK and Agricultural Extension Service in Promoting Tribal Farmers Livelihood: A Study in Bijapur District, Chhattisgarh

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ABSTRACT

The present study aims a) to explore strength and limitation of ITK vis-à-vis modern extension services; b) role of ITK and agricultural extension in tribal farmers livelihood. The study was conducted in purposively selected three blocks and 11 villages of Bijapur district of Chhattisgarh. Purposive sampling method has been used to select the farmers, Rural Agriculture Extension Officers (RAEOs), Senior Agriculture Development Officers (SADOs). Data has been collected through semi-structured interview schedule, focused group discussions and observations. The DFID's sustainable livelihood framework was used to analyze the situation in the district and to identify where the strengths of ITK can be fit in the modern extension activities which could benefit farmers in the region. From the study ITK practices were identified under seven heads such as Indigenous crop-cultivation practices, Indigenous post-harvest practices, Indigenous consumption practices, Indigenous animal husbandry practices, Cultural and traditional values, labor chores and availability, and current trends in market access and livelihood diversification. It has been found that most of the indigenous traditional practices are easy to adopt for the locals, and when it comes to reliability of the final produce these practices are more reliable from farmers perspective. Although certain modern agriculture practices are promising a better scenario in terms of improving the agricultural productivity and incomes of farming households, their extension in the context of Bijapur district was limited to a great extent. Main reasons includes: a) lack of interest in farmers in adopting modern methods mainly as the farmers are more self-reliant in carrying out agriculture through indigenous traditional practices, b) difficulty for the extension agents in providing the extension services due to geographical limitations, language barrier, and resource constraints, and c) lack of synergy of modern methods with indigenous traditional practices or knowledge systems which is causing farmers to be very much reliant on the extension agents and hence becoming heavily dependent on them for managing their own agriculture.Further, the study suggests promotion of organic farming and building farmers' collectives in order to include the strengths of traditional knowledge with modern methods of agriculturewould greatly help the farmers of the region in improving their overall livelihood security.

1. Introduction:

The importance of the traditional knowledge for the protection of biodiversity and achievement of sustainable development is slowly being recognized internationally. The

InternationalConvention on Biological Diversity (CBD) in Article 8(j) urges us to *"respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity"*(United Nations, 1992).Recently, the WIPO has recognized the application of traditional knowledge (TK) and the need to acknowledge local systems of innovation and intellectual property (Eyzaguirre, 2001).Warren (1998)highlighted the importance of putting time and effort into understanding, recording and utilizing indigenous knowledge systems (IKS) in agriculture and rural development.Realizing the importance, attention is now shifting to traditional knowledge and technologies developed on the basis of experiences gained and lessons learnt by the farmers, which are generally eco-friendly, socially acceptable, economically feasible and utilize local resources, knowledge and labour. In this regard, Tikai and Kama (2010)recommended proper recording and documentation of indigenous knowledge for agriculture.

Moreover, technological efforts to increase food production through modem technologies have rarely considered the natural environments, indigenous knowledge systems, and resource endowments around which resource-poor farmers normally operate(Chambers, 1989; Fujisaka, 1992; Gupta, 1991; Jodha, 1990; Raman, 1989; Warren *et al.,* 1989).Continuing these food production strategies while neglecting the above-mentioned grass-roots factors may worsen the physical, natural, and human environments of resource-poor farmers.Borthakur and Singh (2012)have highlighted the instant necessity of documenting and preserving indigenous technical knowledge of different communities, many of which are at the brink of extinction. They also highlighted that there is a lack of proper alliance between the practice of indigenous and modern knowledge. An appropriate association between traditional and modern knowledge and technology systems has immense potential to benefit society.

In contrast, development programmes have been emphasizing on the use of modem scientific technologies. The use of costly external inputs, the complex nature of technologies and hidden risk has prevented many farmers from adapting modem technologies. Tribal farmers in India especially in Bijapur district of Chhattisgarh, use traditional wisdom to solve some of their problems. There are several examples of valuable traditional technologies in India, but unfortunately many of these local systems are being abandoned in favour of modem technologies, often causing negative impact to the indigenous farmers' livelihood security. In such scenario the agriculture extension functionaries are playing catalyzing role to disseminate these technologies to farmers. In Bijapur district, agriculture department with its field level staff also aims at creating models of modern extension projects in the region by training selected farmers. In addition, horticulture, veterinary and irrigation departments also playan important role in their respective areas effectively.

It is observed that modern agricultural processes and techniques being promoted through extension services although are helpful to farmers in increasing their production to some extent.However there are many areas where they are unable to tackle the vulnerabilities that the farming households are facing with respect to their livelihoods. One of the reasons for this could benon-integration of the strengths of Indigenous Traditional Knowledge in modern agriculture practices by the extension personnel.Thus the existence of indigenous knowledge is threatened by the development process. In this backdrop the present study was planned to assess the strength and limitation of ITK vis-s-vis modern extension services.

2. Materials and Methods:

2.1 Locale of Study: Being posted as a PMRDF in Bijapur district in Chhattisgarh, researcher has chosen this district as the place of study owing to its characteristics of being tribal dominated, densely forested, remote and conflict affected area.Most part of the district is rather untouched in terms of external mainstream influence, while the rest is partially influenced. One can find very high staff deficit in almost all the sectors of administration. Literacy rate in the district is about 41 per cent(Statistics Bijapur, Chhattisgarh, 2011)and is one amongst the most backward districts in the country in terms of development indicators. Therefore, this necessitates to carefully looking at the needs, aspirations and lifestyle of the people while assessing the compatibility of modern development models. In addition, there is a need to incorporate whatever strengths their traditional knowledge has while extending modern development agenda to these places.

2.2 Sampling: The '*exploratory research design'* was used for the purpose. The convenience sampling method was used to select three blocks (*Usur, Bijapur and Bairamgarh*) out of four blocks in the district by keeping in view the nature of conflict in the district, and influence of mainstream modern agriculture extension practices.From these three blocks nine villages selectedpurposively. Villages such as*Uskapatnam* and *Bencharam* from Bairamgarh block (2), Villages *Nukanpal, Cheramangi, Hirapur,* *Basaguda, Duggaiguda* and *Ilmidi* from Usur block (6), and Village *Borje* from Bijapur (1) have been selected for carrying out focused group discussions with farmers for documenting ITK and capturing strengths of ITK. The Rural Agricultural Extension Officers (RAEOs) of the respective blocks was considered as the Key Informants for the study.Finally, 23 tribal farmers were selected through snow ball sampling technique from nine villages.

3. Result and Discussion:

3.1 Analysis of Strengths and Limitations of ITK vis-à-vis Modern Extension Services through Sustainable Livelihood Framework (SLF)

Table 1 shows that the practices followed by tribal farmers in farming activities with their strength and limitations. The purpose is to create a base for analysis of livelihood assets, structures and processes and various livelihood strategies through sustainable livelihood framework.

Table 1: Indigenous Crop Cultivation Practices (ICCPs)

Type of Practice	Strengths/Limitations	Remarks
Land Preparation		
Use traditional ploughs and/or *Pata*[2]. If the number of weeds in their land is more they cultivate the land more number of times (process is called *Jothai*).	Since most of their lands earlier were uneven, land preparation was a more time taking task for these farmers. [Limitation]	MGNREGA has greatly helped these farmers by helping especially small and marginal farmers with land-leveling.
For Soil Fertility Maintenance: use manure from cow dung (*GobarKhad*) or goat manure (*BakriKhad*). Some of the farmers use *Saja* leaves as manure in their lands.	No additional costs for this. Also despite not using any chemical fertilizers, natural processes of manure deposition from livestock has helped in restoring the soil fertility during fallow periods. [Strength]	Modern Chemical fertilizers might help increase soil fertility in the short term, but excessive usage might also damage the fertility of soil irrevocably at times.
Seed Selection		
Useindigenous varieties for their crops. Traditional ways of seed	In traditional methods, farmers were less reliant	For Seed selection of Hybrid varieties,

[2]Pata is a traditional tool used for cultivation; it is either in the form of a wood log which is used to level the field or sometimes is of the shape of a tiller with tooth made of wood.

selection use to be followed. For example, in the case of rice seed selection was based on selection of rice grains from those plants which are not in *Busa* (upland) region in their farm lands. Those plants in low land areas in their field which gave more number of grains are generally used for seed selection.	on extension agents. They use to collect and store local varieties of seeds for upcoming years in their own traditional ways[3]. [Strength]	farmers generally rely on extension officers and rarely practice any seed storage methods for using in upcoming years.
Sowing techniques		
Most of the farmers use traditional broadcasting methods for sowing which needed less labour.	These indigenous techniques were not labour intensive. [Strength] At the same time, productivity using these traditional methods was low compared to modern methods like SRI, transplanting etc..,. [Limitation]	In Bijapur, *Lehi*[4]method is currently being promoted in most of the areas as it is comparatively less labour intensive than SRI and is more close to broadcasting method, but can give increased yields.
Weed Control		
Most of the farmers use traditional *Pata* with teeth for weeding. They first irrigate the field before weeding. Then running traditional *Pata* with teeth causes the rice and weed grass in the field to get agitated. During the process, since roots of grass are weak they are uprooted completely while roots of rice spread and standup within 2-3 days.	Generally farmers use cows or buffaloes for running *Pata*. They also needed less labour for this traditional method. [Strength]	Mechanized ways of weed control are still in very nascent stage in Bijapur. Most of the farmers still use this traditional method of weeding.
Pest Control		

[3] Seeds are stored in Tukni (Gulla in Gondi). Inside, the Gulla is first coated with cow dung, and then they fill it with seeds, then put layer of dry grass (paira/dry rice straws) over it and again coat a layer of cow dung over this grass. This cow dung helps in protecting seeds from mice and insects.

[4] Lehi method is similar to broadcasting, but here seedlings of 1-2 days age are broadcasted. These short seedlings are prepared by wetting the seeds in a gunny bag.

Most of the farmers use traditional pesticides for avoiding plant diseases. For example to tackle *Banki*[5]disease for rice (also called *SafedBimari*), they use *Odse*leaves, which turns the stagnant water in the field black in color and threatens the insect causing this disease.	Most of the traditional varieties of crops these farmers grow are resistant to pests. And for common plant diseases known to them, they have traditional organic ways to tackle. [Strength]	Modern pest control methods require access to extension services. As hybrid varieties of crops are dependent on pesticides more than the traditional local varieties, it has become important for the farmers to buy pesticides especially for using them for hybrid crops
Indigenous crop varieties		
Indigenous varieties of rice are listed in the table below. In their *Badi* (Kitchen Garden), farmers here generally grow traditional varieties of vegetables like Brinjal, Mirchi, Haldi, Barbatti (long beans), Semi, Louki, Mulga, Karela, Turai, and traditional varieties of fruits like Papita (Papaya), Jam (Guava), Banana, Seethaphal (custard apple) etc..,.	Some traditional varieties of rice are resistant to longer periods of water unavailability (Beedel variety of rice can remain alive even after one month of no water in the field). [Strength] Local varieties of food grains, pulses, vegetables, fruits, etc.., and even poultry are tastier and even healthy compared to hybrid varieties. [Strength]	Modern extension policies sometimes promote hybrid varieties (examples like hybrid maize, papaya, brinjal and tomato) in large scale, which are threatening the indigenous local varieties.

Types of Indigenous Varieties of Rice found in Bijapur District

Rice Varieties	Duration (in days)	Remarks
Safri	110-120	Other varieties of rice like Beedel (long

[5]Banki disease is one of the most common diseases for rice, where stalks turn white in color due to insect attack

Chudi	120-140	duration rice), Midthul (small rice), Sindwail (long, fat but tasty rice) are also grown, but more information has not been obtained about these varieties during the discussion.
Sasanga	80-110	
Ramulaka	130-150	
Kala Mela	120-130	
SalkaBucchi	90-105	Beedel variety of rice is resistant to longer periods of water unavailability (can remain alive even after one month of no water in the field)
Kalenga	90-110	
Korsara	80-110	
Kaabri	80-100	
BhasaBhoga	120-140	
HardiDhaari (Red variety)	130-135	
KadamPhul	110-120	
Motenga	50-60 (Oct. – Nov.)	
Budma (Red variety)	90-100	
Nalavanji (Red variety)	80-90	

3.1.1 Role of Labour in Traditional Knowledge Systems

Community farming used to be traditional way of agriculture in most of the farming households. In a particular community, members of each household generally work in the others fields helping in the process of agriculture. Exchange of goods for goods or services used to be a common thing most of the times within the community.

One example where role of labour and exchange of their services with goods (mainly in amounts of rice) has affected the consumption pattern is with respect to consumption of milk among some communities in the region. Most of the farmers have reduced their consumption of milk as they were unable to manage the livestock grazing due to decline of *Charwaha*(landless laborers who take cattle for grazing) class in the villages. These landless laborers used to graze cattle of community in exchange for some quantity of rice traditionally. But, with advent of assured wage labor schemes like

MGNREGA, food security assured through government structures and processes like Public Distribution Systems (PDS), and importance of cash in sustaining livelihood in the modern times, the relevance of exchange of services for grain is lost to a great extent. Due to this decline of practice of supervised grazing at all times of the year, the local cows and buffaloes now do not give sufficient amount of milk. So they leave this milk mainly for *calves*.

Both men and women equally participate in almost all agricultural activities. But in some of the activities, cultural notions deny women in participating. For example, women are not allowed to be present during threshing activity (*called Mindai/Minjai in local language*) only because of their cultural notions.

Role of labor in traditional systems and modern systems is drastically different. Earlier when community ways of farming was more common, labor was shared between its members and it was their strength in farming. Most of the practices adopted, decision making processes in deciding them, etc.., in farming or agriculture was based on the strength of this community social capital. But, now this has become rather difficult as the nature of farming has become more individualistic. With more modern methods being emphasized on the farmers by extension agents, farmers have become dependent on external factors more and have slowly ignored the strengths of community participation.

3.2 Analysis of Role of ITK and Extension in Farmers' Livelihoods usingSLF

3.2.1 Analysis of Vulnerability Context and Coping Strategies

Following Table 2 indicates the observations from PRA activities in the context of monthly cash flow of a typical farming household.

Table 2: Overview of Monthly cash inflows and outflowsof a typical farming household

Inflows	Outflows
Farm incomes from agriculture, horticulture	Interest Payments
Loans	Basic monthly expenses
Wage Payments through MGNREGA and other means	Festival expenses

Profit made by sale of NTFPs locally (Non timber forest produce)	Sudden outflows for contingency needs
During the activity it was observed that for a typical small/marginal farming household, the livelihood crisis situations are frequent. Farming communities in the villager are mainly prone to shocks such as drought, unpredictable medical exigencies etc..,	
Coping Strategies: - Take more loans from nearby financial institutions (banks). - Reduce monthly recurring general expenditures. - Work for more days in wage labor especially in MGNREGA. - Involve more family members in agriculture to reduce labor costs. - Dropout of adults from schools to pursue wage employment. - Sell Livestock, goats, poultry, etc.., and in worst case even sell land.	

Given below in Table 3 is a comparative analysis of vulnerability context and coping strategies traditionally and in modern times.This analysis is based on data collected during PRAs and FGDs with farmers for understanding livelihood context of farming communities through Sustainable Livelihood Framework.

Table 3: Comparison of vulnerability context and coping strategies in traditional and modern times

Traditional	Modern
Traditional agriculture incurred less input costs; hence the amount of financial capital needed was less compared to current scenario.	Modern agriculture requires more input costs, hence demands farmers to go for more loans and hence increases the risk of a greater liquidity crisis.
Traditional methods of farming utilize community social capital to dissipate risks. This happened mainly as the medium of exchange was either in the form of goods such as grain or vegetables or in the form of labor.	Modern methods of farming are more individualistic, hence the advantages of social capital in dissipating risks is less.
Traditional methods of agriculture use local varieties of crops which are more drought resistant and resilient to pests. Although the importance of irrigation could not be ignored even in the case of traditional practice, the damage during droughts was comparatively less. Cost of Fertilizers and Pesticides used is very	Modern methods of agriculture try to mitigate the effects of drought, and pests by encouraging irrigation facilities, and by using costly pesticides. Most of the farmers even now do not have proper irrigation facilities. So sometimes even after using costly fertilizers and pesticides upon recommendation by experts, the crop may

minimal as soil fertility was managed by organic wastes like Gobar, goat manure etc.., and pest control was carried out using traditional methods which involved very less cost.	fail during drought. In this case traditional crops are more capable of withstanding such shocks.
Food insecurity was high as the productivity was low with no irrigation facilities. But, to some extent this was tackled through community support and use of natural capital (especially forest items like *Kanda* etc.., are used for consumption during times of food shortage).	Food insecurity is less mainly because of PDS reforms.
Most of the produce generated from the village used to be consumed within the village or nearby villages. Community level exchanges of one good for other or goods for services etc.., were more common. This has greatly reduced external shocks such as price fluctuations of commodities etc..,.	Most of the produce from the village is going outside. The impact of price fluctuations of these commodities on other basic goods and services is seriously affecting the farming households as these sudden trends are out of their control most of the times.

3.2.2 Comparative Analysis of Livelihood Assets in Traditional and Modern Times

Following Table 4gives a comparative analysis of livelihood assets of traditional and modern times. This analysis is based on data collected through FGDs and PRAs carried out with farmers during analysis of livelihood context of farming communities using Sustainable Livelihood Framework.

Table 4: Comparative Analysis of Livelihood Assets of Traditional and Modern Times

Traditional	Modern
Human capital (like attitude, skill, knowledge etc..,) especially with regard to agriculture was traditionally acquired. So, it was easy for the farmers to carry out agriculture as the dependency on external resource persons was less.	Human capital with regard to agriculture is dependent on access to information especially coming through extension services.
Social capital is reflected in community	Extension services and existing

based traditional methods. Especially when it comes to agriculture, community social capital greatly helped in sharing labor costs among multiple households. Even the system of exchanges within community helped in reducing their dependency on external factors outside the community's control.	institutional structures have made farmers more individualistic. Scope for community based activities has reduced greatly on account of modern methods in farming. Presence of assured alternate livelihoods like MGNREGA also increased wage costs and thereby reduced the scope of traditional ways of shared labor.
Natural capital in tribal dominated regions is maintained and managed through cultural and traditional values. Economics of Natural capital in traditional ways was limited to smaller geographical extent (may be few villages) hence the risk of vulnerability in terms of returns (may be cash or kind) was less.	Natural capital in tribal dominated regions are still mostly maintained and managed through cultural and traditional values. Economics of Natural capital in current context is dependent on institutional structures present. Since the factors determining it are mostly external, the risk of vulnerability in terms of returns (mostly cash) is greater.
Relatively less needs and aspirations have necessitated comparatively less physical capital. The costs involved in acquiring them were also less as they were met in indigenous ways (like *Kuccha* houses built with wood from forest, grass etc.., at low cost). Since access to Physical capital in those times was not uniform across groups in a village it might have contributed to more inequalities.	Need for physical capital in the current context is more, and is at the same time costly compared to the traditional past. Government Policies are aiming to mitigate the financial burden on the physical capital especially for the poor. Structures and processes of the government in the current context are working towards reducing inequalities within communities by improving access to Physical capital easier especially for the poor.
Financial capital was in the form of cash, tradable assets, livestock, poultry etc..,. Liquidity crisis situations were mainly tackled within the community through exchanges. Access to financial capital (especially cash in the form of bank loans) was very less.	Cash in the current context is most reliable form of financial capital. As the profitability of agriculture in the region has gone down, liquidity crisis situations have become more periodic within farming communities. But, through policy and institutional measures, access to such capital has increased in recent times mainly because of increased focus on financial inclusion measures at national and state level.

Limitations of Structures and Processes in extension

Based on the key informants interviews and field observations, following section tries to categorize the limitations in agriculture extension in the context of the district and explain as follows:

1. **Target oriented approach in implementation:** Monitoring and Evaluation occurs (M&E) in terms of targets, but most of the times the process of M&E ignores the fact that

- ✓ Some targets might not be decided based on field realities, they may be chosen based on a predictive figure obtained from previous year's data.
- ✓ Even if targets are arrived based on assessment of what could happen in the field they may sometimes fail to capture the extent to which farmer can meet them.
- ✓ Limited access to information and too much dependence of extension agents can sometimes bind the farmers to take decisions in favor of meeting targets which might risk their crucial livelihood choices.
- ✓ Delayed realization about the real reasons behind some target failures, especially during sudden shocks like drought situations or dip in market prices for the produce etc..,.

2. **Limited scope for participatory approach during extension:** Many times, agricultural extension activities tend to go in a top down approach like..

- ✓ The kind of techniques to be used during a particular process in agriculture may be directly extended from lab to field, but assessment of its compatibility in the farmer's opinion or situation is rarely taken into account.
- ✓ Loan disbursement targets sometimes get decided at district level and farmers are asked to take loans for availing latest extension services present, but there is very little assessment on how much of them are relevant in the household's livelihood context.
- ✓ Same thing goes about in the kind of varieties of plants recommended and the fertilizer and pesticide usage etc..,.
- ✓ And the very dependence of farmers on extension agents has limited the scope for participatory decision making, and hence the choices of farmers get subjected to the targeted top-down agendas.

3. **Lack of hand-holding support in facilitating farmers' collectives:** Based on the vulnerability context analysis one can see that community social capital can help in dissipating risks of farming households. But, the information regarding the same rarely penetrates at the field in a proper manner like,

- ✓ Farmer Interest Groups (FIG) are formed when there is a need for implementing a scheme for which targets are mandated.
- ✓ But, these FIGs are not organically evolved, as there was no prior hand-holding for making the farmers realize the need for collectivization.
- ✓ Same thing goes with Farmers collectives like farmer cooperatives or farmer producer organizations. In these cases the importance given to register a collective is far greater than the efforts that are put in to evolve such a collective organically.
- ✓ There is a need for incorporating this (hand-holding of farmers to evolve collectives on their own), into current agriculture extension regime in the district.

4. **Tradeoff between localized and generalized approaches**: Many times extension activities ignore the contextual relevance of a particular methodology.

- ✓ Like for example to target yield improvement from agriculture using modern methods like SRI, one has to look into the costs involved in labor and extent of irrigation facilities.
- ✓ As analyzed previously, in the context of a district which is predominantly rain-fed, with farmer's facing the pressure of increased labor costs and in the juncture of modern individualistic farming one cannot adopt SRI so easily.
- ✓ But if targets are decided to make it work, some farmers if not all might be subjected to unpredictable risks which might destroy their confidence on modern extension methods altogether, which might not be desirable.

5. **Missing synergy while planning and executing extension policies:** There is very little synergy between ITK and modern methods while planning extension.

- ✓ Ignorance of the importance of indigenous varieties while promoting large scale agriculture or horticulture projects can in a way lead to diminishing of numerous indigenous varieties.

- ✓ Along with reducing the number of indigenous varieties, they also take away the strengths of indigenous knowledge base which farmers had. This in a way is sometimes responsible for farmers now being too much dependent on extension agents.
- ✓ Hence there is a need for assessment and conservation of indigenous varieties and determining extension policies to protect it.
- ✓ Currently the reason behind large scale promotion of hybrid varieties is to establish markets for their sale. But instead of this, policy can be shaped so that the extent of production of indigenous varieties of that particular species is maintained and this record can be used while determining marketing strategies.
- ✓ In order to establish a synergy between ITK and modern methods and evolve effective extension policies, there is a definite need of maintaining a database of Indigenous knowledge systems within the purview of agricultural extension.

Apart from this, there is lack of synergy between agriculture, horticulture, irrigation and other allied departments which are bound by independent targets of their own. When it comes to formulating plans for farming communities, a holistic bottom-up participatory approach needs to be mandated instead of independent top-down target oriented policies.Okuneye and Ayinde (2004) cited in Anyira (2010) also states that small and marginal farmers stick to their local knowledge and farming practices, because modern technologies can only be successful and sustainable, if indigenous knowledge is taken into consideration.

4. Conclusion:

Inthe modern times, Indigenous Traditional Knowledge and Agriculture Extension are most often being looked at as two different ways of carrying out agriculture. Ignoring the importance of ITK, while planning extension services has yielded undesirable results in the past few decades. Hence the need arises to fill this gap and work towards strengthening extension services for betterment of not only farmers' livelihood but also our natural environment.

Analysis of livelihood context of Bijapur farmers' and role of ITK and modern extension, has not only reaffirmed the importance of ITK in the opinion of farming households but also helped in realizing the vulnerability context and coping strategies of these farming households in traditional and modern times. Using sustainable livelihood framework to analyze the livelihood assets of farming households and compare them in traditional and modern times in addition to previous result has given a direction to look into the structures and processes in extension.

Themes like organic farming and promotion of people's institutions if understood in the lines of SLF and in the current scenario of the district can motivate extension staff and administration to take measures in strengthening necessary structures and processes involved in the system and thereby improve vulnerability context of farming households of the region.

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Futuristic Extension Model for Empowerment and Improvement of Livelihoods of Small Scale Cotton Farmers through Farmer Field Schools, Farmer Life Schools and Supply Chain Linkages*

- A Better Cotton Initiative

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ABSTRACT

A programme on Better Cotton Initiative was launched by Participatory Rural Development Initiative Society (PRDIS), with support from Better Cotton Fast Track Fund (BCFT) and other partners during 2010-2011 in selected villages of Mahabubnagar district of Andhra Pradesh, *involving 2000 small scale cotton farmers. The programme is scaled up serving 23500 farmers in Andhra Pradesh and Telangana States during 2017 with Better Cotton Initiatives Growth and Innovation Fund (BCI GIF).*

The programme aims to empower farmers on Better Cotton production principles and criterias through Farmer Field Schools (FFS) and Decent Work principles through Farmer Life Schools (FLS) as well as supply chain linkages through Farmers Organizations namely groups networks/Federation and Producer Companies. During this process two producer companies were formed and they are immensely benefitted through collective bargaining on inputs and marketing. Besides the information, communications Technologies (ICT) were used for Field monitoring and guidance.

The programme has amply demonstrated as an holistic and futuristic agricultural extension model linking production with markets; The potential of FFS and FLS as an innovative extension methods for empowerment and improvement of livelihood of cotton farmers. In addition to improvement there was increase in human, social and economic capital Majority of farmers were able to get net additional income of about Rs. 10000 to 15000/ acre, 80% reduction in pesticide usage 25% reduction in chemical fertilizers and changes in attitude towards health, hygiene and environment and application of Decent Work principles specially in not using banned pesticides, Child Labour and awareness on farmers rights. Thus the programme has shown the power of changing the lives and livelihoods of cotton farmers through a futuristic extension model.

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Introduction

Globally and domestically, cotton is an important agricultural commodity. In India, Cotton exports are not only a source of vital foreign exchange earnings, but also account for a substantial proportion of their GDP and tax income, leading to significant economic and social development. About 70% of the global cotton production comes from 4 countries, which include China (27%), India (22%), USA(13%) and Pakistan(8%).

India is a major producer of cotton ands is also the 2nd largest exporter after the USA. It accounts for around 59% share in the raw material consumption baskets of the Indian textile industry. Thus cotton plays a major role in sustaining the livelihood of an estimated 5.8 million cotton farmers and about 40-50 million people engaged in related activities, such as cotton processing and trade. India has largest cotton cultivated area, which constitutes about 30% of the global cotton area. India's cotton production has been increasing from 2003 to 2001 as a results of a range of initiatives, such as better technology, seeds, nutrients management, irrigation and governmental initiatives etc.

About 70% of total cotton production is contributed by 3 states: Gujarat (26%), Maharashtra (22%) and Andhra Pradesh (23%), where as 70% of cotton is consumed by spinning mills located in Tamil Nadu, Maharashtra, Gujrat and Punjab. Approximately 65% of India's cotton is produced on rain –fed areas.

Accelerated demand for cotton, globally, has led to more than threefold increase in its production since 1950s. This increase in production has been achieved through intense inputs application, use of which has most often overlooked environmental impacts. Some of these unsustainable production practices include indiscriminate use of pesticides and fertilizers, extensive use of irrigated water , with no regard to water quality and quality, use of application

that contribute to soil erosion, and an unbalanced (quality, time of use) use of resources in some areas.

The environmental impacts associated with cotton production, such as soil and water pollution, are increasingly coming into focus and reiterating the need for sustainable production systems. The united nations defines `sustainable development 'as development that meets the needs of the presents, without compromising the ability of future generations to meet their own needs. The basic premises of this definition are supported by there pillars of sustainable development – economic sustainability, environmental protection and social security.

The Better Cotton Initiative Programme (BCI)

Keeping in view of sustainability of cotton, Better Cotton Initiative is global voluntary initiative formed, supported by a range of stakeholders, such as producers, global retailers, traders and financial institutions. The purpose of BCI is to promote measurable improvements in about 24 countries including the key environmental and social impacts of cotton cultivation, by mainstreaming sustainable production practices through implementing partners and its local partners. The programme is being implemented in India, China, Mosanbique, Pakistan, Brazil, USA, Turkey, Kenya, Mali, Uzbiksthen, Austtralia etc., In India the programme is implemented by 20 implementing partners in 11 States including Andhra Pradesh and Telangana

The Better Cotton Standard System comprises:

1. 'Production Principles and Criteria': providing a global definition of Better Cotton through 6 key principles.
2. 'Capacity Building': supporting and training farmers in growing Better Cotton, through working with experienced partners at field level.
3. 'Assurance Program': regular farm assessment and measurement of results through 8 consistent results indicators, encouraging farmers to continuously improve.
4. 'Chain of Custody': connecting supply and demand in the Better Cotton supply chain.

5. 'Claims framework': spreading the word about Better Cotton by communicating powerful data, information and stories from the field.
6. 'Results and Impact': Monitoring and Evaluation mechanisms to measure progress/change, to ensure that Better Cotton delivers the intended impact.

In other words the purpose of BCI is to promote strong supply chain linkages with measurable improvements in productivity and reduction in cost of cultivation besides environmental concerns.

PRDIS Initiative

As an endorsed BCI implementing partner, solidaridad manages several projects in India in collaboration of local partners. PRDIS is chosen as local Partner (during 2010-2011) based on its successful track record on productivity enhancement programmes over a decade. PRDIS worked with 2000 farmer (1000 farmers each from Boothpur and Bijinepally mandals with eight 8 villages in each mandal) are grouped into 81 learning groups (LGs) with eight (8) villages in each mandal) are groups were empowered through farmer field schools and farmer life schools. The PRDIS later recognized as on Implementing Partner (IP) and worked in Andhra Pradesh, Telangana, Maharastra and Karnataka States with about 12000 farmers. Which were increased to 21000 farmers during 2015 and 23500 during 2017.

a . Farmer Field Schools

It is an approach through which farmers undergo a field oriented, discovery based training that enables them to become field experts, be able to grow a healthy crop and promote better quality of life in a healthy environment. FFS is recognized as an effective extension tool, which can be used for empowering the farming community, development self –confidences of people and improvement in social, economic and human capital. A unit of FFS generally includes 25 farmers. A facilitators assists this groups

in order to builds the capacity of farmers, the facilitators of PRDIS mainly organized Farmer Fields Schools in all villages where in selected members of each LG were enrolled to empower them on knowledge and skills of BCI Production principles and minimum production criteria (include crop protection practices, Water , Health of the soil, Natural habitats, Biodiversity, Quality of the fibre etc). In addition , farmer were also taught the mechanics of groups dynamics. The trained farmer in turn empowered the other member of the members of the groups.

Further this method had good impact on farmers since regular field monitoring with cotton Eco system Analysis (CESA), it was Possible to take rational decisions on resource use management. The trained farmers in turn were intern have motivated and guided other farmers in their LGs for implementation of knowledge and cotton Eco System Analysis, Decision making skills on IPM, INM, ICM, Soil , water, fibre quality , harvesting etc.

Prior to the launch of this programme, a baseline survey was conducted to know the basic information on cotton cultivation practices including land preparation, seed selection, inter cultivation, crop nutrition, pest management , harvest , and marketing , cost-benefit ratio. Identified gaps are the farmers are growing Bt cotton with out refugee crop, boarder crop, inter crop, trap crop and imbalanced fertilization and spray banned and dangerous chemical pesticides for sucking pest management.

b. Farmer Life schools (FLS)

Similarly, the Farmer Life Schools (FLS) an extension of FFS were organized for empowering farmer on decent work Principles such as (farmer associations, forced labour child labor, for hazardous work the minimum age is 18 year, Non-discrimination, Basic treatment and displinary practices, life skills and livelihood skills etc.)

Farmer life school is an open school used for empowerment of farmers to lead a quality, Problem free and happy life with self help, mutual helps and cooperation.

All farmer were taught and given hands on experience on problem analysis, Prioritization, solutions to identified problems and implementation arrangements specially on child labor and other issues

c. ICT Interventions

In addition to the above method ICT tools were used to supplement and compliment them for traceability, monitoring, advise and guidance**.**

d. Cotton Supply Chain in India

The agriculture produce marketing committee (APMC) is the primary market infrastructure in the country through which cotton is marketed. The main function of these markets or mandal is to regulate market practices such as weighing, Process of sale, method of grading, payment process, etc. APMCs also provide facilities for storage, boarding and lodging for buyer , sellers , etc .this committee charges 1% of the goods value as fees from the buyer .the marketing committee , which runs the market and developing the markets yard for and sellers who have the responsibility of maintaining and developing the market yard for its users.

The three Marketing Agencies engaged in cotton trade are

1. Private sector comprising traders, owners of ginneries operating as individual business proprietors, partnership firms and private limited companies.
2. Public sector agencies like the cotton corporation of India (CCI)
3. Co-operative sector

   It has been estimated that approximately 80% of the marketed surplus of kapas and lint is handled by the private marketing channels and the remaining 20% by the institutional marketing channels including co-operative and Cotton Corporation of India (CCI)

   In private setup, farmer sells cotton directly to ginners, primarily in the form of kapas (seed cotton). Recently , aggregators have started to play a major role in collecting raw cotton from farm gate of 10-15 farmers and in selling the consolidated produce to ginner in a radius of 100-150km. sometimes if the prices are attractive the consolidated cotton is dispatched to over 200km from Maharashtra to Gujarat.

e. Organizing Producer Company for connecting Supply with demand as well as Sustainability of the Project

During the year farmers were given knowledge on association of farmer groups to take up marketing linkages with ginners. Efforts are also made with few ginners situated in the district to get cotton directly from farm gate. This year two Producer Companies were formed involving all stakeholders as members to take up activities for sustainable cotton value chain. The cotton value chain has several links starting from monsoon to market such as plant population Bio diversity input utilization, fibre quality storage and supply chain links

f. Supply chain and Traceability

- Cotton from farms is proposed to extract fibre from the seed in a ginning unit and the lint is packed in 170 kgs bales
- These bales are loaded and transported to spinning mills to manufacture yarn
- Yarn is a raw material used by weaving units to manufacture grey fabric.
- Grey fabric is dyed and finished for providing color and property to the cloth in process houses.
- Finally, the dyed and finished cloth is used in the garment manufacturing unit to stitich various clothes
- The Better Cotton can be traceable from level to manufactures by all stakeholders

Monitoring, Capacity Building and Credibility Checks

Periodical monitoring were undertaken by the consultants of PRDIS and BCI india in addition to undertaking capacity building programmes like Training of Trainers, refresher trainings by BCI India. Training of Facilitators by consultants of PRDIS, Training of Farmers by facilitators using Farmer Field Schools approach for production principles and Farmer Life Schools approach for Decent work criteria (Freedom associations, Forced Labour, Child labor, For hazardous work the minimum age is 18 yrs. Non- discrimination, Basic treatment and displinary practices etc). Besides, Self Assessment is done by PU Manger at Producer Unit level to encourage farmers to continuously improve, through measuring results and seasonal learning cycles, followed by 2nd arty credibility check is done by PRDIS as an IP and BCI India on a prescribed sample basis. Finally 3rd party verification id done by an agency appointed by BCI in order to issue a license to farmers in addition to connecting supply with demand through and identifiable bale of 100% Better Cotton linit.

PRDIS was choosen by BCI in India for early impact assessment study in alliance with iseal. Baseline Survey has been successfully completed.

Achievements and Benefits to the Farming Community

Improvement in Human Capacity through various capacity building programme.

Farmers were empowered on knowledge (90%) and skills (80%) concerning IPM practices, banned pesticides (100%), labeled and graded pesticides (100%) water management (90%), soil health management (85%), fibre quality and harvesting as well as post harvest technologies. In addition awareness and attitudinal changes on decent work principles such as use of child labour, discrimination, forced labour, health and safety environment and biodiversity line also emphasized.

Improvement in yield quality and Economics

The analysis of the yield data revealed that was incremental yield of 25-30% derived out of BCI efforts by about 80 percent of farmers. The cost of cultivation was also reduced by about Rs. 4000 / 6000 per acre (reduction use of pesticides 80%) fertilizers 25%). The net additional income gained by BCI farmer compared to control group was Rs.10,900 to 15,000 per acre. The quality of produce was also without contamination and excess moisture. On the other hand, the programme has demonstrated the production potentiality through FFS which has recorded 1.7 quintal / hector. This gap PRDIS will bridge during the coming years. Besides, the cost of cultivation also will be further reduced through soil test based fertilizer application and agro eco system based resource management. This will provide more net income to BCI farmers.

Improvement in Social Capital

The farmers were sensitized about the need for forming the groups and associations (producer company) for collective bargaining, to demand for their rights and directly linking the supply wit demand.

Other benefits

- All the BCI farmers have not used the child labour
- Majority has not used forced labour and children below 18 years for pesticide spray
- There were no discrimination in payment of wages for the same type of work between men and women
- Bio diversity, health, safety, and environmental concerns were taken care off. In fact non pesticide management with use of botanical and bio agents were encouraged.

Leading the change – Conclusion and Lessons

This programme has amply demonstrated (the holistic development) the potential of Farmer Field Schools and Family Life Schools as the innovative extension methods for sustainable holistic development and empowerment of cotton growing farmers. Through the BCI, to farmers human, social and economic capital has considerably improved in terms of knowledge and skills of Better cotton practices and Decent Work. Majority of farmers were also able to get net additional income of about Rs. 10,000 to 15000 per hector, reduced pesticide usage changed attitudes on environment, health and safety concerns as well as awareness on to need to organize producer organization / company for collective bargaining of fair prices of their commodities. Thus the programme has shown the power of changing the lives and livelihood farmers in the project area directly and about equal number of farmers indirectly. This futuristic agricultural extension model can also be extended to different crops and enterprises for improving the livelihoods and sustainable agricultural development of millions of resource poor small scale farmers of India.

Farmer Field School (FFS) is an effective extension tool to kindle the hope and to meet the educational needs of farmers. This powerful tool has a promise and potential for creating a quite revolution in agricultural and rural development thorough empowerment of farmers

- Prof.S.V.Reddy

Innovative Agricultural Extension Approaches and SDGs

Prof. Dr. V. Veerabhadraiah
Former Director of Extension, UAS, Bengaluru

Agricultural Extension is an instrument of change. It enables farmers to seek and adopt desirable changes in farming. Its focus is on technology improvements leading to human resource development. Agriculture normally keeps changing, either slowly or rapidly. The role of agricultural extension is to make this process more purposeful. And, as the agricultural sector changes, the tasks of the agricultural extension will also change, while its basic functions remain essentially the same.

Extension aims to:

- Change production systems and sustain the resource base,
- Increase and improve farmers' productivity basis,
- Attain food security and improve livelihood of farmers,
- Attain higher levels of efficiency in the farm enterprise, and
- Improve well being of farmers.

Major trends shaping the delivery of extension services moving extension far beyond technology transfer

- Dwindling Government budgets for extension, leading to the privatization of public services.
- Emergence of new service providers in the context of privatization.
- Increased differentiation among client groups and issue areas (private demand driven extension for commercial farmers, Public livelihoods focused extension

for poor and subsistence farmers, community management support for environmental and natural resource management challenges).

- User demand for effective and appropriate extension related to higher expectations of rural communities and farm families and their growing capacity to voice demands.
- Globalization and liberalization of agricultural markets.
- Increased presence and agriculture business and commercial farming.
- Environmental imperatives.
- Climate changes.
- Increased use of biotechnologies.
- Access to ICTs – Telephone, Cell phone, e-mail, internet, Whats App in rural areas.

High Expectations of people for Extension

- Efficient, demand driven extension services based on partnerships between Government and private sectors.
- Participation of farmers in extension programme formulations, implementation, monitoring and evaluation ensuring their needs are met.
- Private sector including NGOs and CBOs participating in extension service delivery in response to farmers' demands.

Major challenges facing agricultural extension

1. Realization of untapped potential in hilly, tribal, rainfed and drought prove regions.
2. Diversification of farming situations and promotion of export commercial oriented farming systems and facilitating agro-processing / value addition technology and various categories of farmers with focus on low external input agriculture.
3. Revitalizing, involvement and providing role space for other extension sectors in the process of transfer of technology such as Co-operatives, NGOs, Corporate bodies. Farmers organizations, Panchayat Raj Institutions.
4. Recognizing and encouraging farmer – led activities in research and ToTprogrammes so as to make them demand driven.
5. Strengthening the institutional framework for HRD for farmers and extension workers in improved technology with focus upon gender screening and

conversion of knowledge to skills, education to training and information to technology.

6. Providing strong information management back-up and media use support to extension efforts.
7. Moving away from the uni-directional and top–down information dissemination system to functional multi-directional and multi-focused information communication system.
8. Augmenting linkages with the technology generators at various levels with functional and institutional integration at ground level and networking based on inter dependency within and amongst the system.

Policy outreach in Agricultural Extension for sustainable agricultural development

A good policy is the basis for sustainable development. Hence, the following policy outreach would help to bring about sustainable development.

1. Activating the public extension service to make it more responsive to farming needs/situations.
2. Extension approaches should be designed with the long term perspective, usually 10-15 years.
3. Agricultural scientists must be exposed to the discipline of extension education so as to enable them to design appropriate technological package for the farmers.
4. Extension should serve farmers practicing field crops, fruits and vegetables, trees, livestock, marketing management etc.
5. Extension should serve farmers without depending on subsidies.
6. More stress should be given for maintaining farm – family and environmental relationships.
7. More and more involvement of farm women in extension educational programmes.
8. More emphasis on participating approach in Extension Education.
9. Extension must promote increasing use of indigenous technologies by farmers.
10. Augmenting extension effort in Complex, Diverse of Risk Prone (CDR) environments.
11. Strengthening Research – Extension linkage at various levels.
12. Strengthening training infra-structure and reorientation of training programmes in the state and central sector at various levels.

13. Encouraging the use of NGOs to organize farmers
14. Increased use of information technology
15. Developing appropriate technology for resource-poor farmers.

Current Extension Environment

The agricultural situation in the country is undergoing qualitative change. The combined effect of a relentless population growth, improved family incomes leading to changing life styles, increased export opportunities and expectation of agro – based industries have resulted in striking changes in the demand pattern for agricultural commodities. The circumstances under which the agricultural sector has to meet these demands are also changing substantially. These trends have far reaching following extension implications.

1. Farm holdings are increasing but farm size is shrinking.
2. Still subsistence is the primary goal for many farmers.
3. Stagnating productivity.
4. Technology factor dominates. There are no major breakthrough technologies.
5. Rainfed farming neglected.
6. Support to diversification is lacking. A capacity for promoting appropriate combinations of farm enterprises, in proper proportions, for optimizing farm income, is yet to be built in to the extension system.
7. New farming concerns are emerging Ecological farming, organic farming and low-external input farming are emerging concepts that are becoming dominant considerations in agricultural development.
8. Focusan small and marginal farmers is essential. For a great majority of farmers, farming remains a family enterprise.
9. Farmers are willing to change. Their aspiration levels, their willingness to accept new ideas, their contact with outside world and their information seeking habits have gradually undergone a change.
10. Extension system needs reorientation. There is need for critical review by the current public extension system, presently it is ATMA, all over the country.

Prospective Agricultural Scene

In the contextof “globalization and liberalization, it is possible to identify some specific features of the emerging agricultural situation in the country. The agricultural sector evolves into two distinct segments.

1. **Rapidly emerging commercial segment:** This is a relatively smaller portion of the agricultural sector, essentially made up of venturesome farmers. They are constantly on the lookout for new ideas. Generally, they keep an eye on the profits, in an enterprise based agriculture. They have a better access to credit, information, inputs and markets. They concentrate high value crops and farm enterprises. They make large investments and reap the benefits. They take risks in new ventures and turn out to be superior managers.
2. **Slow moving subsistence segment:** This segment is the largest part of the agricultural sector, consisting mostly. The small, marginal and dry land farmers. Meeting their food and other family needs is their main objective. They also need some cash income. They also undertake some off – farm employment to increase their income. These farmers require a lot of persuasion to adopt new ideas. They have low aspiration levels; they arecomfortable to be more like their fellow farmers. They are resource poor and avoid risk taking. They are well-versed in traditional farm practices which are locally well established. They are often farmers with average competence.

Agricultural Extension Approaches

The basic function of agricultural extension is to relate new knowledge to the needs, problems and opportunities of farmers. The process of relating new knowledge to local needs will have two elements: the technology to be induction and the manner of its induction. The process involves helping farmers to understand the problem, to recognize the technology as a solution and to gain knowledge and skill to adopt it effectively. This, in essence, is educating the farmers.

As seen earlier, the agricultural sector, in the future, will differentiate into two major segments, each with its own priorities, enterprises, technologies and set of farmers. The two extension systems dealing with the commercial and subsistence segments should, therefore, be different in their goals, competence and strategies. Commercial segment farmers has to be served by a specialized Extension Service and the subsistence segment farmers is served by the General Extension Service.

Specialized Extension Service (SES)

The extension service to support the commercial segment, which entails value enterprises, superior technologies, large investments, better management practices etc., must be able to offer high grade technologies, required standards, dynamic approach and firm dependability. The present day public extension system does not measure up to this expectations. The SES can take many forms. Such services may be as follows.

1. **Profession extension groups:** They are made up of former specialists operating individually or in groups, as Extension consultants. They are commonly found in ventures like floriculture, vegetable and fruit production, poultry and dairy enterprises. They offer consultancy service.
2. **Extension service by input agencies:** Firms dealing with inputs like seeds, fertilizers and credit often provide related extension service.
3. **Extension service by farmers organizations:** Farmers organizations like milk producers society, poultry farmers associations, grape growers and mango growers Associations MAHA Grapes, MAHA Mango provide efficient service to their farmers.
4. **Extension service by Trade houses:**Exporters of flowers, grapes, seeds, vegetables and fruits provide very good production facilities to farmers including information, inputs, grading and marketing guidance.
5. **Extension service by agro-processing industries:**the technical service offered in similar to that of the trading houses. There is buy back arrangement here Examples: Gerkins as pickles, ketchups, jam, jelly etc.,

It is necessary to ensure that the SES is able to constantly update its data base and professional competence. It should develop proper information network.

General Extension Service (GES)

Farmers in this segment will depend on agriculture both for food security and for modest cash income. Some of them go for off-farm employment to get additional income. They are mostly localites and are stuck with farmingFarm improvements as guided by the extension service will benefit them.

The task involved here is to enable the large mass of subsistence farmers, in a variety of farming situations, to progressively improve the efficiency in their food crops and other enterprises. GES must work with these low income farmers, farm women and farm youth. Public extension system of the development departments like Agriculture, Horticulture, Animal Husbandry etc., will serve as General Extension System (GES) to such farmers.

Sustainable Development Goals (SDGs) and Agricultural Extension

The Sustainable Development Goals (SDGs) officially known as "Transforming our World": the 2030 Agenda for sustainable development is a set of 17 "Global Goals" with 169 targets between them spearheaded by the United Nations through a deliberation process involving its 194 member countries as well as Global Society.

The SDGs relevant to Agricultural Extension are: 1) Zero Hunger (ZH), 2) Climate Action (CA), 3) Life on Land (LOL)

Agricultural Extension aims at increasing farm production, combating climate change and protect, restore and promote sustainable use of ecosystems, sustainable management of forests, halt and reverse land degradation and halt biodiversity loss.

Innovative Extension Approaches

Both the SES and GES can use some relevant innovative extension approaches to work with the clientele.

1. **Use of ICTs in Agricultural Extension**

ICT tools are extensively used in agricultural extension during the last two decades.Many pilot projects have succeeded in the field. Continuous contact with farmers shall be established to provide knowledge and information, empower and facilitate them to demand and access services through Farmers Portals, KisanCall Centers,Common Service Centers, Agriculture Short Message Services, Community Radio etc., Many approaches have been tried in different states of the country. The success rate differs from one approach to another. The following are some of the innovative approaches tried elsewhere in the country.

1. **Lead farmer centered Extension Advisory and Delivery service in Kerala**

The pilot extension project was initiated during 2010-11. The objective of the project was to utilize the potential of lead farmers for transfer of technology, address field level problems of selected farmers through regular field visits by technical officers, intervene the preparation of monthly technology advice with the support of KVK, Research Stations and development staff. They generate local specific technologies through PTD and technology refined through Front Line Demonstrations and On Farm Trials. The multidisciplinary Team visits the farmers fields on demand. They develop a farm net work of Extension teams: Lead farmers and farmer groups at district level. A preliminary feed back of farmers indicated that they have a positive acceptance of this innovative approach. The farmers are motivated to try new technologies.

2. e-agriculture – An ICT enabled Agricultural Extension Approach

ICT based extension approach called e-velanmai (means e-agriculture) was initiated on a pilot basis in Tamil Nadu. ICT tools such as computer, internet, digital camera and mobile phone were used by farmers / Field coordinators to send images of crop status to researchers to get advice. A majority of small holder farmers participated in e-agriculture and accessed 10797 items of technical advice to practice farming effectively. It was proved that farmers were willing to pay for availing ICT based agricultural extension service from experts based on the size of their farm, which is evident from the membership fee of Rs. 2,83,300.00 paid by them. The turnaround time of dissemination ranged from 1-3 hours in a day. The percentage of adoption of the new technology was 92.65 per cent. The advices helped farmers to improve their farm profit by Rs. 2102.00 / acre (for seasoned crops like Tomato) and Rs. 3101.00/acre for plantation crops like coconut by achieving higher efficiency in the use of inputs. e-agriculture facilitated participatory, cost effective, quality and timely extension service to promote the sustainable farming and develop the livelihood status of farmers in the region. Based on the success achieved in the pilot experimentation, the project has been upscaled in 26 command areas of Tamilnadu.

3. Village – Level e- SAGU: A scalable and location – Specific agro – advisory stem in AndraPrasesh

This is more or less similar to e-agriculture extension approach of Tamilnadu. By developing and implementing the e –SAGU advisory system over several years, since 2004, it was felt that the Indian farmers need e-sagu to identify the timely detection and resolution of crop health problems. By providing the agricultural advice to each farmer at regular intervals from sowing to harvesting, it has been demonstrated that the e-sagu enhance the farm productivity and reduces the input cost and INM practices by early detection of crop health problems.

4. IARI- Post Office Linkage Extension Model

The model was tested in seven rural branch post offices in Uttara Pradesh. Identified Branch Post Masters were sensitized about the rational of Linkage, trainings were organized for capacity building of the post masters and technology information made available to them.These post masters are mostly farmers. Training resulted in 23-50% gain in knowledge.Seeds of improved crop varieties of IARI were sent to the farmers through post – office. More than 90% of the farmers received the seeds of the crops sent though the post office within 4-6 days of despatched. Yield of major cereals, oil seeds and vegetables increased by 11-30%. The capacity building of the post master benefitted farmers in the area. The model was further expended to other states.

5. KrushiMahotsav: An innovative extension approach in Gujarat

The KrushiMahotsav is being held every year since 2005, reaching to farmers with researchers, experts, officers of various development departments and other departments like Irrigation, Land development, Electricity, Input agencies, Financial institutions. These researchers, extension workers credit and input agencies interact with farmers and provide information and counseling on soil and animal health, organic farming and infusing a new spirit of change among farmers and mass mobilization. The purpose of KrushiMahotsav is to encourage the farming community to adopt the scientific approach and to transform the traditional agriculture into modern agriculture. And, also provides services like Agriculture kit, Animal husbandry kit, Soil health card, Kisan credit card, Animal vaccination service etc. KrushiMahotsav is held on the auspicious occasion of *Akshay Tritiya* every year. It is estimated that Gujarat state has achieved and sustained 11 percent agriculture growth. One of the major reasons for this spectacular achievement is the KrushiMahotsav. The farm innovations are taken to the doors of farmers.

6. Integrated farming system approach

It is an approach given importance in recent years. It is integrating field crops, horticultural crops, live stock, agro forestry on the farmers field. It is an intensive educational process to build the capacity of farmers to understand the integration of different enterprises on his farm to maximize the net income. Many KVKs in Karnataka have been using this approach.

7. Multi- Agency Extension Approach

This concept is widely accepted and being practiced in the country. All developing countries including India have public extension services. However, with the changing developing scenario, private, corporate and NGOs have also started playing an important role. The Public Extension, ICAR Extension, NGOs and Farmers Organizations are natural alternatives but uncomfortable partners. But the role of each agency must be specified in this approach. The Watershed Development Programmeis a very good example of Multi-Agency approach.

Conclusion

In recent decades, many innovations in extension methodologies and approaches have been tried in the country by many formal organizations and NGOs.Although some approaches are sporadic in nature, they have yielded good results. But, what is required is how to make ATMA an effective programme in the country since it is in operation in all the districts of the country. Since it is an Extension reform, it is very necessary to incorporate the relevant innovative extension approaches into this reform so that it will deliver the farm innovations required by the farmers.

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Innovative Information Delivery Interventions of ANGRAU in Promotion of Sustainable Farm Practices

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Abstract

The aim of this paper is how the innovative extension methods had impacted the information delivery to reach the unreached farmers. The simple and inexpensive Flag method, Developing Farmer Master Trainers, Innovative Farmers Networking , Annapurna Krishi Prasara Seva – an alternative ICT model, mobile apps (Eruvaka, Greeshma, Krishi Vigyan and Manaverusanaga) and Agritech Hub-Whatsapp group introduced by the Acharya N G Ranga Agricultural University in India, during last six years, have resulted in to advisory services at the field level even in farmers absence, effective utilization of traveling time of scientists, increased awareness of farmers about sustainable farm practices, enhanced contacts between farmers and scientists. The results suggest a change in the approach of field extension for increased outreach and having educational importance for the state agricultural universities in India.

________*Key Words: Innovative extension methods, flag , farmer master, innovative farmers networking, AKPS, mobile apps*

1. Introduction

Effective and efficient Agricultural Extension is the nucleus of Agricultural development process through its agro-advisory and capacity building services. Communication, education and conviction are the major forces used with well supported technologies generated in the University. There is a need to reach the un-reached through networking, interface, virtual interface, ICTs, and partnerships promoting multiplier effects in technology dissemination. Institutional innovations at different levels are the need of the hour as the conventional or imported methods / approaches may not be sufficient to reach more and to cater to the needs of various categories of the farmers and other stakeholders.

The only state agricultural university in Andhra Pradesh, India i.e Acharya N.G. Ranga Agricultural University (ANGRAU) extension services are mainly focused on first-line extension activities like Technology Assessment and Refinement (TAR) through minikit testing / on-farm trials/ on-farm demonstrations / frontline demonstrations; field diagnostic surveys, Capacity building of stakeholders, Dissemination of scientific information through Kisan Melas, Farmer –Scientist-Interactions, publications, mass media such as Press, Radio and TV (public and private) channels for the benefit of farming community and field extension personnel.

All these activities are being carried out through its well established extension centres namely District Agricultural Advisory and Transfer of Technology Centres (DAATTCs), Krishi Vigyan Kendra-Farm Science Centre (KVKs), Agricultural Information and Communication Centre (AI&CC) and Electronic Media Centre .Though the extension outreach is satisfactory, through the limited extension network, still a large number of farmers need to be covered in the State. Keeping this in view, the Directorate of Extension, ANGRAU has initiated Innovative (Flag method, Developing Farmer Master Trainers , Innovative Farmers Network, AKPS and Mobile Apps) extension methods during the period 2010-2016 to enhance outreach and are being used by the all extension centres.

2. Literature Review

The teaching methods employed by the extension worker directly influence the effectiveness of his efforts. This is true whether the extension teacher is a county extension agent or a State subject matter specialist or whether the learner is a farmer ,farm woman, farm youth, or non farm person .An understanding of the capabilities and limitations of the available teaching tools is essential to their intelligent selection and efficient use (Wilson and Gallup,1954).

When the methods of receiving agricultural information are classified as interpersonal and mass media methods, farmers prefer interpersonal methods of receiving information on new or innovative farming practices, eg., on farm demonstrations, tours and field trips), over the mass media methods ,eg. , computer-assisted instruction and home study (Riesenberg,1989)

Agricultural extension, whether public or private, operates in a context or an environment that influences the organization, form, and content of transfer activities (Moris, 1991).

Over the years, particularly with the success of the green revolution, many progressive farmers have started adapting to new technologies once they are convinced of the benefits and easy availability of the inputs required to adopt the technologies. Such farmers, who have adapted to improved agriculture, have been asking for additional information and new technologies from time to time (Hegde,2005) .

If scientific research is to achieve a real impact on farm productivity and livelihoods, new methodologies for dissemination of information have to be developed or adapted. The main direction of reform in agricultural extension is towards a learning rather than teaching paradigm (Madukwe, 2006).

Giddareddy and Punnarao (2011) stated that, the Flag method was found to be the simple, inexpensive and the most useful method in transfer of agricultural technologies particularly educating the farmers about pest, disease and micronutrient disorders. Gurumurthy *et al.,* (2013) reported that the Flag method was found very useful by the farmers and model farmers in correct diagnosis, saving cost of plant protection, reducing the indiscriminate use of pesticides, thereby minimizing the crop losses. Punnarao *et al.,* (2013) in their study on flag method reported that providing immediate solutions to the problems, developed a feeling that someone is really concerned about them and their crops and farmers get advisory services at field level even in their absence are the benefits realized by the farmers.

3.Methodology

In a study on benefits realized by the farmers by the Flag and uses of Flag method in transfer of technology (Punnarao *et al*., 2013) , a sample of 150 farmers in whose fields the flags were placed, 75 farmers each from Vizianagaram and Srikakulam districts of Andhra Pradesh, have been selected randomly for the investigation purpose. The sample consists of farmers growing rice, maize, sugarcane, groundnut and cotton crops. In addition to the practicing farmers, 60 Adarsa Rythus, 30 each from two districts have also been contacted for the purpose. The Adarsa Rythus are model farmers engaged by the Department of Agriculture as para extension system in the villages.

The selected respondents were contacted individually by the DAATTC Scientists and obtained their inputs using an interview schedule developed for the study based on the objectives. The responses were tabulated using frequency and percentages.

Besides this, opinion of the selected farmers, extension scientists of the farm varsity and extension officers of Department of Agriculture, about utility of the three innovative information delivery methods and how these are helping in outreach of university sustainable farm technologies ,was Video documented.

4 .Results and Discussion

4.1 Flag method of extension

The Directorate of Extension, Acharya N.G. Ranga Agricultural University (ANGRAU) has introduced the “Flag Method of Extension” a simple effective transfer of technology tool in the selected DAATTCs during *Kharif*, 2010. Accordingly, the selected District Agricultural Advisory and Transfer of Technology Centre (DAATTCs), have implemented the Flag method of Extension for the benefit of the farmers. The flag method facilitates the farmer to get associated with the extension functionary of the area and make him/her feel that some one is really concerned about his / her crops even in their absence in the field at the time of the diagnostic visit of the extension functionary.

The DAATTC/KVK Scientists while on tour, visit the road side / nearby farmer’s fields put up an yellow / conspicuously seen Flag labeled with **Name of the**

centre, Contact no, Date of visit, Crop, Problem identified and Remedial measures, in the farmer's field with the help of a twig / stick / support of plant material at a strategic point to be visible to the farmer when ever he/she visit the field (next day or a day after). It is also possible to either print or write general hints for increasing productivity / Schemes of Department of Agriculture / useful tips for farming, on the backside of the Flag, so that farmer will be able to get additional useful information.

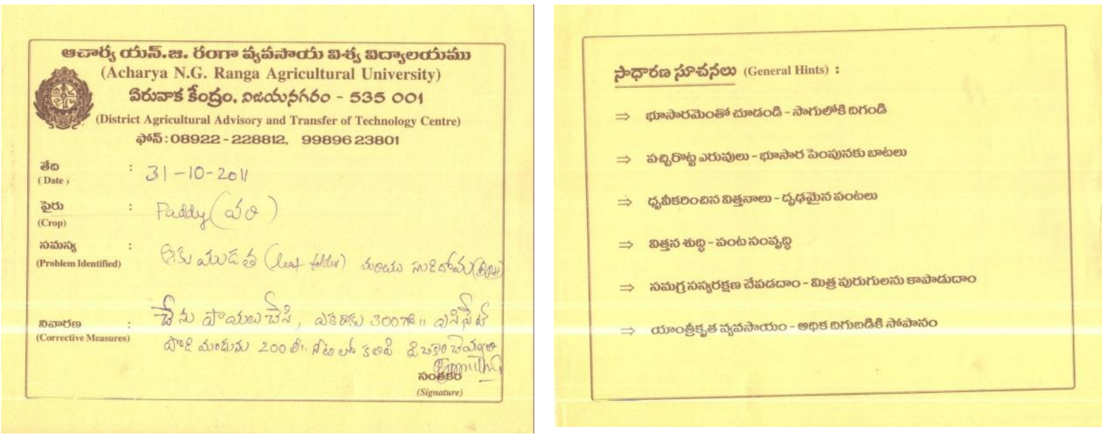

Fig 1.Model Flag

Whenever the flag is seen by the concerned farmer, he / she reads the message written on the Flag and initiate action on the message. If the farmer requires any clarification, he / she calls on the Scientists / Extension functionary and clarify his / her doubts. This way the Flag method not only provides immediate solution to the diagnosed field problem even in the absence of the farmer, but also brings awareness and buildup rapport with the Extension Scientists of ANGRAU eventually strengthening the Scientist-farmer linkage.

Fig.2 Flag Placed in a rice field

As a teaching method, according to USE, it is an Individual Contact method and according to FORM, it is a Written Method of extension.

4.1.1 Benefits realized by the farmers

As seen from the Table 1, providing immediate solutions to the problems, developed a feeling that someone is really concerned about them and their crops and farmers get advisory services at field level even in their absence are the significant benefits reported by the farmers.

Table 1: Benefits realized by the farmers due to flag method

S.No.	Particulars	Farmers		Adarsa Rythus	
		F	%	F	%
1.	Providing immediate solutions to the problems	140	93.33	60	100.00
2.	Farmers get advisory services at field level even in their absence	100	66.67	50	83.33
3.	Increased awareness of farmers about DAATTC /KVK services	98	65.33	42	70.00
4.	Enhanced contacts among farmers, DAATTC/KVK and Department of Agriculture staff	84	56.00	40	66.67
5.	Farmer felt that someone is really concerned about them and their crops	112	74.67	48	80.00
6.	Timely actions by the farmers	80	53.33	36	60.00

4.1.2 Uses of flag in outreach of technology

Table 2 revealed that all the respondents opined that Flag method is simple and inexpensive method that helps the Department of Agriculture and ANGRAU in wider outreach. Farmers are able to save time in going to local input dealers for advice where in this way they are getting timely solutions that too by the technically competent scientists. As a result, helping the farmer in correct diagnosis, save cost of plant protection, reducing the indiscriminate use of pesticides, thereby minimizing the crop losses. Respondents have also reported that it leads to increased adoption of correct plant protection measures.

Table 2: Uses of flag in outreach of technology

S.No.	Particulars	Farmers		Adarsa Rythus	
		F	%	F	%
1.	Minimize the time in going to local dealers for advise	112	74.67	56	93.33
2.	Timely solutions	96	64.00	58	96.67
3.	Correct diagnosis	122	81.33	60	100.00
4.	Minimize crop losses	82	54.67	44	73.33

5.	Minimize cost of plant protection	100	66.67	40	66.67
6.	Effective utilization of travelling time of DAATTC scientists	62	41.33	60	100.00
7.	Increased acquaintance of DAATTC Scientists about the field problems	56	37.33	60	100.00
8.	Farmers are able to ask the input dealers the right input	94	62.67	60	100.00
9.	Increased adoption of correct plant protection measures	90	60.00	42	70.00
10.	Simple and inexpensive method	150	100.00	60	100.00

4.2. Developing farmer master trainers

Capacity building of farmers is one of the mandatory function of DAATTCs as well as KVKs of ANGRAU. Training is a learning process that involves the acquisition of knowledge, sharpening of skills and change of attitudes and behavior to enhance the performance of farmer. Hither to ,the extension units are trying to build the capacity of farmers / farm women / stakeholders by providing 1-2 days trainings on ad-hoc basis on any identified need based topic. In order to enrich the knowledge, skill and attitude of the farmers in a focused way, on a selected crop, an initiative called “Developing Farmer Master Trainers” was introduced in ANGRAU during 2011. It is the process wherein an identified 15-20 farmers selected from different accessible villages across the district, will be provided training (knowledge & skills) at critical stages of the identified crop. The training is staggered over the crop season to the same farmers who will be exposed to knowledge and skills at different critical stages of crop cycle, (4-5 trainings of 1 day duration) facilitating the Farmers as Master Trainers.

Fig.3.Orientation to the Farmer Master Trainers

Fig.4 Training of farmer master trainers at Critical stages of crop growth

Once they have developed mastery over the crop selected, they will be in turn used as Resource Farmer for training other farmers of their locality. The bio-data of such farmer master trainers will be with the Joint Director of Agriculture, DAATTC, KVK, Commissioner & Director of Agriculture, and the Director of Extension, ANGRAU for future use.

The video recorded statement shows that the farmers and extension personnel strongly opined that this methodology is helping the farmers in knowledge and skill up gradation on a selected crop technology and useful in farmer to farmer extension.

4.3 Innovative farmers network

With a view to encourage and motivate and also to develop competitive spirit among the farmers, five identified innovative farmers from each district on the occasion of DAATTC Foundation Day Celebrations were felicitated during 2011. As a follow up action, one innovative farmer from each District having communication zeal and skill, were invited for the workshop held during 1-2 June, 2012 at Hyderabad. The main objective of the workshop was to develop a Network of Innovative Farmers in the State and to further expand the extension outreach / dissemination of agricultural technologies.

During the workshop, it was decided that the following are the functions of Innovative farmers.

- Each farmer should educate / share his innovations/ experiences / learning for about at least 30 farmers (10 in his own village, 10 in his mandal and 10 in his district).

- Each Innovative farmer is Coordinator of 30 farmers network in the district.
- His efforts in that educational / dissemination process are to be noted in the dairy.
- He should actively participate in all the University meetings / activities.

Fig .5 Workshop on innovative farmers networking

- He should read the text short messages being sent by the University from time to time and share them with others in his network.
- He should interact with innovative farmers of other districts frequently.
- He should influence the local cable operator to telecast need based timely, messages using the CDs developed by the ANGRAU.

In recognition of their services, innovative farmers are being provided due respect and recognition as indicated below.

- They are provided with text short messages frequently from the ANGRAU related to the varieties / technologies developed at ANGRAU.
- They are invited for all University meetings/ activities in that district as a special invitee.

- The literature developed by local KVK / DAATTC is being sent to them from time to time.
- Opportunity is provided to share their experiences in Radio / TV channels.
- Preference is given for State / National level awards.

- He is the resource person for the farmers training programs conducted in their locality.

Regarding its effectiveness, the video statements shown that the farmers and extension functionaries stated this network is very active and useful in exchange of innovative practices among the farmers. Further they felt that because of this network the functional linkages among the farmers and scientists have been strengthened and facilitated in spread of technologies across the district, thereby enhanced outreach.

The findings of the paper says that as Madukwe (2006) stated, the above mentioned new methods have to be tried by the farm varsities to transfer their research findings for adoption by the farmers. The findings also got support from the Riesenberg (1989) view that the farmers preferred interpersonal methods namely flag, trained master farmers and farmers network in farm information sharing in adoption of new farm technologies.

4.4 ICTs interventions in Farm Information Delivery-On field cases

A) Annapurna Krishi Prasara Seva – Interactive Information Dissemination System (IIDS)

It is an integrated model to address the problems of farmers by using IVRS, Web and Mobile applications. The IIDS is developed under the NAIP sub project, undertaken by a Consortium led by Media Lab Asia, New Delhi and partnered by ANGRAU, National Institute of Rural Development and Mudra Institute of Communications, Ahmedabad. The IIDS was launched on 23rd March, 2013 as an alternative ICT model to meet the information needs of the farmers.

Benefits to the farmers

- Farmers' interaction directly with the concerned district Scientists of KVK/DAATTC over Toll Free number (1800-425-3141) and provided with personalized advisories.
- Advisories on Agriculture, Horticulture, Animal Husbandry and Fisheries.
- Farmer can record their queries 24x7 through Toll Free Number.
- Farmers are provided with Text & Voice messages in local language (Telugu).
- Farmers are provided emergency messages and alerts on their mobile from their KVK/DAATTCs.
- Farmers can record their best practices and experiences to share with other friends on toll free number.

Farmer should register to get above benefits through IIDS. No registration fee. Concerned district KVK/DAATTC is attending this farmer registration process. As a joint initiative of ANGRAU and Media LabAsia, the IIDS is being up scaled in all the districts of Andhra Pradesh and Telangana states through KVKs/DAATTCs. 31,000 plus registered farmers (as on March 2017) are being served with this IIDS.

In a study conducted by the NIRD (2014), the shift in the 'Source of Information is found among the IIDS farmers and it was noted that 92 per cent farmers who were earlier dependent for agricultural information on their friends & neighbor is reduced to 56 per cent and 68.7 per cent farmers who were dependent on Input dealers is reduced to 35 per cent due to the provision given to the farmers for direct interaction with the Krishi Vigyan Kendra (KVK) Scientists on Toll Free number.

B) <u>Mobile apps</u>

Eruvaka

- Provides crop management practices for Rice, Millets, Sugarcane, Pulses, Cotton, Maize and Oil seeds
- Services started in October, 2015
- Available both in Telugu and English languages
- Can be downloaded free of cost from Google play store.

Greeshma

- Disease management practices for Rice, Maize, Groundnut, Sugarcane and Sunflower crops
- Services started in November, 2015
- Available both in Telugu and English languages
- Can be downloaded free of cost from Google play store.

Krishi Vigyan

- Detailed crop management practices for Rice, Maize, Blackgram, Greengram and Coconut crops with photographs (in telugu language).
- It also provides plant population calculator, phone numbers of call centres of Agriculture, Horticulture & Fisheries departments; addresses of university KVKs & DAATTCs and videos of different pest and disease management practices.
- Services started in June 2016.
- Can be downloaded free of cost from Google play store.

Mana Verusanaga

- It gives all package of practices of Groundnut crop in telugu language for the benefit of farmers.
- Services started on 04th December 2016.
- Can be downloaded free of cost from Google play store.

C) Agritech Hub - Whatsapp:

- An instant Mobile based ICT Agro Advisory system.
- Services started on 16th March 2016.
- Farmers' queries are being answered and sent text and voice messages through Whatsapp (9441670829)
- 3 district groups (Chittoor, Nellore and Kadapa) were formed

5. Conclusions

It could be concluded from the study that the innovative information delivery methods introduced by the ANGRAU were found most useful in transfer of agricultural technologies particularly educating the farmers about pest, disease and micronutrient disorders, and facilitating them in timely adoption of corrective measures, leading to minimize the cost of cultivation and crop loss. Based on the farmer's feedback, it is now recommended that the state Department of Agriculture and ANGRAU can take up the printing of Flags and supply to the field force every crop season and provide sufficient training to filed extension personnel about these initiatives. Wide publicity among the farming community about these interventions is also suggested for proper use of the novel methods .It is also recommended that ,since these initiatives have lot of educational importance, the State Agricultural Universities in India should include these in the course curriculum and make use for enhanced outreach of sustainable farm practices.

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Educating the rural women for domestic utilization of soybean for household nutritional security

B.U.Dupare[6], S.D.Billore[7] and Purushottam Sharma[8]

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Soybean is a premier oilseed crop of India which is grown primarily by the farmers of Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Telangana mainly under rainfed conditions. As far as old record depicts, black seeded soybean was traditionally grown in Kumayu and Garwhwal region of Uttarakhand as well as North Eastern States since ages as a food plant. However, the efforts carried out under All India Coordinated Research Project on Soybean for its resurrection of yellow seeded soybean in Central India, particularly in Malwa Plateau of Madhya Pradesh has not only proved its agronomic and economic viability successfully, but also its suitable inclusion in traditional cropping systems, which fascinated the farmers to adopt the crop at large scale. This crop has been instrumental in uplifting the socio-economic status of millions of small and marginal farmers of Central India (Dupare *et al.* 2009, Sharma *et al.* 2016). Further, being a cash crop and its remunerative nature in shorter duration, the adjoining states to Madhya Pradesh readily adopted it. Still the growth of the crop is unabated

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on account of potential areas in other states of India. At present the crop covers about 11.48 mha producing around 14.12 million tons.

Even after its remarkable establishment in merely past four and half decades in the country positioning itself as premier oilseed crop, till recent years it has remained as an export oriented commodity on account of a vast scope and demand for non-GM Indian soy-meal in some of the countries. In recent past export of soy-meal is dwindling and calls for enhancement of domestic market. However, the growth in domestic consumption of soy-meal has been increasing and touching almost 60 per cent of the availability. It was never wise to export such a protein rich crop when the Indian populace can use it as food to reduce the protein-energy malnutrition rampant in the country. Although, the utilization of soybean for food uses has shown slow growth, still it has not reached at desirable level. Agarwal *et al* (2013) has reported that the domestic utilization in any form was found to be negligible except as vegetable oil, a by-product of solvent extraction units. Soybean being a leguminous food plant, beside enriching the soil health, also is a rich source of quality protein, vitamins, minerals like calcium and iron as well as presence of additional health beneficial compounds which are useful for avoiding certain cardiac and carcinogenic ailments (Riaz, 2006). With the major objective of promoting the food uses of soybean coupled with dissemination of nutritional properties and other health benefits of soybean, Indore based ICAR-Indian Institute of Soybean Research in addition to its major mandated R&D activities of production technologies, is also actively engaged in conducting various activities specially targeting the rural womenfolk to utilized soybean at domestic level in the form of various soybean based preparations.

Under the initiative taken by the Institute so far educated more than 2000 housewives and other clientele groups in the past 10 years through number of on and off-campus training programmes. The study was, therefore, conducted to know primarily, the nutritional intake profile of rural people, the associated impact of efforts of ICAR-IISR translating the actual use by the rural housewives of Madhya Pradesh. The study also included perception of common people and their awareness about the health benefits and utility of soybean for food preparation, domestic utilization pattern of soybean, and bottlenecks in this food chain as felt by the trained housewives.

Importance of Soybean in household nutritional security

Soybean if used in daily diet can do miracles towards minimizing the protein malnutrition to large majority of rural population and thus, improving nutritional security. It has lot of nutraceutical as well as medicinal properties. It is the richest and cheapest source of quality protein. It contains more than 40 per cent high quality protein which is full of essential amino acids. This gives immense opportunities for eradicating the protein calorie malnutrition in rural and tribal areas of India. It also contains 20 per cent oil with an appropriate ratio of omega-3 and omega-6 fatty acids, which is specially considered ideal in preventing cardio-vascular diseases. As far as vitamins are concerned, the mature soybean grains are also rich in different vitamins particularly B complex groups, viz. Thiamin and Riboflavin. The green soybean pods, particularly from vegetable type of varieties, as well as in its sprouted form can be a good source of Vitamin C and Vitamin A (Beta-carotene). Soybean is also an excellent source of Vitamin E *i.e*., Tocopherol, an antioxidant in nature. Besides this, it is also a rich source of calcium and iron which is especially good for womenfolk for escaping the risk of anemia as well as osteoporosis. The presence of isoflavone in soybean is known to provide relief in hot flashes experiencing menopause. In addition, it has 20-25 per cent carbohydrates and nearly 10 per cent fiber (including soluble fibers) which make it a complete health food crop.

As explained earlier, soybean also contains some compounds and properties of medicinal nature. Soybean based food preparations have low glycemic index thereby suitable for diabetic patients. Soy products are also good for people vulnerable to cardiac ailments as they are devoid of cholesterol with its oil containing more of polyunsaturated fatty acids which regulate the cholesterol levels. Soybean also contains a phyto-chemical called isoflavone which is anti-cancerous in nature (prosthetic cancer in men and breast cancer in women) Therefore, domestic utilization of soybean in the form of various processed soy products/ preparations contributes to a large extent in fulfilling the household nutritional security of Indian rural population.

Domestic utilization of Soybean

Soybean can be used domestically for preparation of various food products at kitchen level. It can be fortified with other ingredients also for enriching the nutritional value of traditional recipes. But it is recommended to consume soybean only after following proper processing techniques. Since mature soybean grains also contains an undesirable compound *i.e*., Trypsin inhibitor which is heat labile in nature therefore it can be used only after proper boiling or deep frying. It is also recommended to use about 25-50 g of processed soybean in the form of any soybean based food preparations on daily basis.

Soybean based food preparations:

Whole soybean based products: Soy Nuts (fried/roasted), Sprouted soy, full fat soy flour

Soy flour based fortified products: *Mathri*, Biscuits, *Shakkarpare*, *Papad*, *Sev*, *Chakli* etc.

Soy milk and associated products: Tofu, Yoghurt, *Shrikhand*

Soy okara based products: *Halwa*, *Upama*, *Paratha*, *Gulab Jamun*

Training Infrastructure: There is immense scope of entrepreneurial venture in various soybean processed products. The Bhopal based Soybean Processing and Utilization Centre of ICAR-

Central Institute of Agricultural Engineering is engaged in providing technical back up of potential up-coming entrepreneurs through regular training programmes on soymilk, tofu and other dairy and backer based soy products

The ICAR-Indian Institute of Soybean Research, Indore is primarily mandated for conducting basic and strategic research on soybean across the country for increasing its production and productivity and its dissemination through various extension approaches to various stakeholders. It is also engaged in disseminating the knowledge pertaining to domestic food uses of soybean to rural women through published literature, awareness campaigns, and agricultural exhibitions and on and off-campus training cum-demonstrations. The institute in the past has organized several activities in rural areas of Madhya Pradesh through execution of externally funded projects. The impact studies conducted in this regard reveled that there is a scope of popularizing the domestic utilization of soybean in the form of various soybean based food preparation using already popular traditional recipes.

It was observed that the trained women participants not only shared the knowledge received through training to their neighbors but also to their relatives located in other villages. Nearly one third of the respondents were found to use soybean in their daily diet in the form of fortified soy flour mixed with wheat, soy nuts, soy *pakora*, *etc*. The results of the study already conducted by Dupare *et al*. (2016) has proved inclination of rural people about the suitability of soybean processed products at domestic level.

Table 1: Utilization of Soy Products

Soy Preparation	**Utilization by the respondents (N=200, multiple response)**
Soy Flour (Fortified with wheat flour)	24 (12%)
Soy Nuts	15 (7.5%)
Soy *Pakora*	44 (22%)
Soy milk	5 (2.5%)
Tofu	39 (19.5%)
Preferred Soy Product (Soy Bari)	121 (60.5%)

(Source: Dupare et al, 2016)

From the data presented in Table 1, it was observed that majority of the respondent families (60.50%) were found to use soy nuggets (soy bari) as the most preferred soy products which they are using on regular basis in the rural areas of Madhya Pradesh. As it is easily available in the market outlets even in rural areas, they found it most economical and easily available soy product as protein substitute. Interestingly, out of different soy products, nearly 22% of the respondent families were found to have liking for Soy Pakora which is their most preferred soy product because of its crispy nature. However, the respondents from semi-urban area (adjacent to Indore city) are found to utilize tofu (soy *paneer*) which they are found to consume on regular basis. Only 12% of the respondent families are utilizing soybean for fortification with wheat flour without following proper processing techniques. However, a small proportion of respondent families (7.5%) are found making use of fried soy nuts (snack) regularly as well as during festive seasons.

Conclusions:

Soybean is one of the most viable alternatives for eradicating the protein calorie malnutrition in the country. Soybean, the richest source of protein along with numerous health benefits has a capacity to contribute towards household nutritional security by way of its domestic utilization in the form of processed soy products and its fortification. The efforts towards popularization of health benefits of soybean and processing techniques for various soybean based food preparations carried out by ICAR-IISR in the rural area of Madhya Pradesh has been successful in educating the rural population towards acceptability of the same in their daily diet. Soybean based food preparations are slowly making inroads into rural households as they becoming aware of its nutraceutical and medicinal properties. The commercially available products such as Soy Nuggets and Soy Granules are by now very popular among the predominant vegetarian type of rural households. Further, their awareness and inclination about the processing techniques for making of various soybean based food preparations can change the health and nutritional status of common people of rural background. More and more systematic and concerted efforts are needed to make these people aware of domestic utilization of soybean as food products associated health benefits, as the commodity is amply available, particularly in rural sector of the Country.

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Role of Cluster Front line Demonstrations in transfer of Redgram (PRG-176) production technologies in Nagarkurnool Dist of Telangana state

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Introduction:

Nagarkurnool is a district in the southern region of the Indian state of Telangana. It was part of the Mahabubnagar district prior to re-organisation of districts in the state. The major soil group is red earth comprising loamy sands (dubba). These are brown to red in colour and poor in fertility Sandy loams (chalka).

Pigeonpea [C*ajanus cajan* (L.) Millsp.] is a major grain legume (pulse) crop grown across the tropical and subtropical regions of the globe. It is the fifth prominent grain legume in the world (Narendra et al., 2016). It is predominantly grown during rainy season both as a sole and intercrop (Jat and Ahlawat, 2010) under rainfed conditions (Umesh et al., 2013). It finds a promising place in crop rotations and mixtures as it has the capacity to fix atmospheric N in the root nodules (Quit and Dalal, 2015) and add organic matter to the soil from leaf fall.

Over a period of time, a number of improved pulses varieties and production technologies have been developed, but full potential of these varieties as well as technologies could not be exploited due to low rate of adoption Thus, factors limiting the productivity can not be

The aim of these Cluster Front line Demonstrations is to raise production through transfer of farm technology and showcasing the impact of advanced technology in the farmers fields to believe the technology for adoption.

Details of the problems/constraints:

In the low fertile red soils cotton crop is grown continuous under rainfed situation, in the irrigation available area maize is grown. In both crops redgram is grown as inter crop for family consumption only. The extraction of higher nutrients due exhaustive unsuitable crop selection lead to poor soils formation. lack of sufficient irrigation facilities for long duration varieties which are facing terminal drought, Wilt in redgram, Pest attack farmers are getting lower yields

Technology Demonstrated:

Improved short duration PRG-176 variety, seed treatment with Trichoderma @ 10gm/kg seed, *Rhizobium* @ 200 g/3kg at the time of sowing. During flowering stages of the crop was stressed due to moisture for that recommended 13-0-45 and 19-19-19 (10 g/l). For the control of Spodoptera, Helicoverpa & Pod fly we recommended IPM practices in this we have given Neem oil @ 2 ml/lt, Choloropyriphos +Nuvan and Flubendiamide@ 50 ml/acre. Pre emergence Herbicide Pendimethalin 12l/acre

Results : Among the demonstrated plots of redgram spacing followed according to the fertility status of the soil and type of soil, In red soils 90x20 and 120 x 20 cm under rainfed and irrigated situations and In black soils 180x 20 cm is followed. In both soils i.e red soils and black soils the crop is grown after onset of sufficient moisture of 70mm rain in july.

Under the farming situation of red soil with irrigation with 90 x20 cm average yield of 19.2q/ha recorded highest being the 26.25 q/ha and lowest 15.25 q/ha over the check plot 12.5 q/ha, recorded the percent yield increase of 34.9. In the demonstrated plots the total cost of cultivation incurred was Rs.27,500/- , with a gross returns of Rs. 96960/-, net returns Rs. 69,460 and B:C ratio 3.52 which was much higher than the check plot 28,600, Rs. 63,125, Rs. 34,525,2.30 respectively.

Under the farming situation of red soil with irrigation with 120 x20 cm average yield of 13.5 q/ha recorded highest being the 15.75 q/ha and lowest 12.0 q/ha over the check plot 11.75 q/ha, recorded the percent yield increase of 12.9. In the demonstrated plots the total cost of cultivation incurred was Rs.27,250/- , with a gross returns of Rs. 68,175/-, net returns Rs. 40,925/- and B:C ratio 2.50 which was much higher than the check plot Rs. 28,750/-, Rs. 59,337, Rs. 30,587, 2.18 respectively.

Under the farming situation of red soil under rain fed situation with spacing of 90 x20 cm average yield of 12.0 q/ha recorded highest being the 21.25 q/ha and lowest 7.75 q/ha over the check plot 7.75 q/ha, recorded the percent yield increase of 35.4. In the demonstrated plots the total cost of cultivation incurred was Rs.26,800/- , with a gross returns of Rs. 60,600/-, net returns Rs. 33,800/- and B:C ratio 2.26 which was much higher than the check plot Rs. 27,900/-, Rs. 39,137, Rs. 11,237, 1.46 respectively. Similarly under 120 x20 cm spacing average yield under demonstration of 7.25 q/ha which was 31% higher than check 5q/ha with higher B: c ratio of 1.37 over check 0. 95

Among all the 50 demonstrations the highest yield was recorded in black soils under irrigation with a spacing of 180x 20 cm. average yield of 25.25 q/ha recorded highest being the 29.0 q/ha and lowest 22.5 q/ha over the check plot 17.75 q/ha, recorded the percent yield increase of 29.7. In the demonstrated plots the total cost of cultivation incurred was Rs.27,200/- , with a gross returns of Rs. 1,27,513/-, net returns Rs. 1,00,313/- and B:C ratio 4.68 which was much higher than the check plot Rs. 28,400/-, Rs. 89,637, Rs. 61,237, 3.30 respectively.

Feed back of the farmers involved:

Farmers were enthusiastic to grow redgram as sole crop as the cost of cultivation is very less and PRG-176 did not get wilt in the current year. The yields realised are much higher than their conventional grown pinky variety. They are in want of a variety which is completely resistant to wilt, pod borer with yield potential of 30q/ha with minimum two irrigations. The MSP for Redgram should be 10,000/q to cultivate the redgram crop over cotton.

Table 1: Yield details

Details	**No. of Farmers /demos**	**Area (ha)**	**Yield (q/ha)**				**% Increase in yield**
			Demo			**Check**	
			High	**Low**	**Average**		
Red soil Irrigated							

90x20	24	9.6	26.25	15.25	19.2	12.5	34.9
120x20	4	1.6	15.75	12.0	13.5	11.75	12.9
Red soil Rainfed							
90x20	10	4	21.25	7.75	12.0	7.75	35.4
120x20	8	3.2	11.25	5.75	7.25	5.0	31.0
Black soil							
180x20	4	1.6	29.0	22.5	25.25	17.75	29.7
Total	50	20					

Table 2: Economics

Details	**No. of Farmers /demos**	**Area (ha)**	**Economics of demonstration (Rs./ha)**				**Economics of check (Rs./ha)**			
			Gross Cost	**Gross Return**	**Net Return**	**BCR (R/C)**	**Gross Cost**	**Gross Return**	**Net Return**	**BCR (R/C)**
Red soil Irrigated										
90x20	24	9.6	27500	96960	69460	3.52	28600	63125	34525	2.30
120x20	4	1.6	27250	68175	40925	2.50	28750	59337	30587	2.18
Red soil Rainfed										
90x20	10	4	26800	60600	33800	2.26	27900	39137	11237	1.46
120x20	8	3.2	26550	36613	10063	1.37	27650	25250	-2400	0.95
Black soil										
180x20	4	1.6	27200	127513	100313	4.68	28400	89637.5	61237	3.30
Total	50	20									

Theme II Food and Nutritional Security

AGRICULTURAL EXTENSION IN PROMOTING HOUSEHOLD NUTRITIONAL SECURITY – RELEVANT SUCCESS STORIES

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Introduction: Extension is a nonformula educational function that applies to any institution that disseminates information and advice with the intention of promoting knowledge, attitudes, skills and aspirations, although the term "extension" tends to be associated with agriculture and rural development. Extension is multidisciplinary. It combines educational methodologies, communication and group techniques in promoting agricultural and rural & Public Sector Agricultural Extension development. It includes technology transfer, facilitation, and advisory services as well as information services and adult education. It is dependent for success on other agricultural development processes such as marketing and credit services, not to mention economic policy and physical infrastructure. In short, it is a function that is dependent for success on other factors, including other services and institutions. In many cases its success depends on the ability to shift program direction and development to stakeholders and program users.Aligning agriculture to improve household nutrition security requires agricultural research and development specialists to understand nutrition objectives and be able to contribute to integrated agriculture-health programs

The concept of food security developed over the last 50 or more years addressed primarily the need for the production and access to adequate food grains to feed the world’s increasing population. Nutrition security, a later development, was a much broader concept since nutritious and safe diets alongside adequate biological and proper social environments ensures appropriate growth and development in childhood and helps promote health and prevent disease in adulthood. The need for a paradigm shift in policy formulation from focusing on food security at the aggregate level to nutrition security at the level of each child and adult implied that the definition ‘food and nutrition security’ integrates both the conceptual frameworks of food security and nutrition security. This integrated approach aspires not merely to address the micronutrient malnutrition which is a bigger problem than food energy deficiency, but is a food-based approach that also tackles non-food factors such as water, sanitation and care practices.
The term ‘nutrition security’, on the other hand, emerged in the mid-1990s and focused on food consumption by the household or the individual and on how that food is utilized by the body and thus in principle is more, than food security. Building on UNICEF’s (2008) conceptual framework of malnutrition (Fig -1), the International Food Policy Research Institute (IFPRI) in 1995 proposed that ‘nutrition security’ be defined as ‘adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times. The concept of nutrition security is hence broader than food security since the term utilization in nutrition also

encompasses biological utilization (Fig-2). Shetty (2009) chances of introducing harmful change that would adversely impact on women, infant & young children.

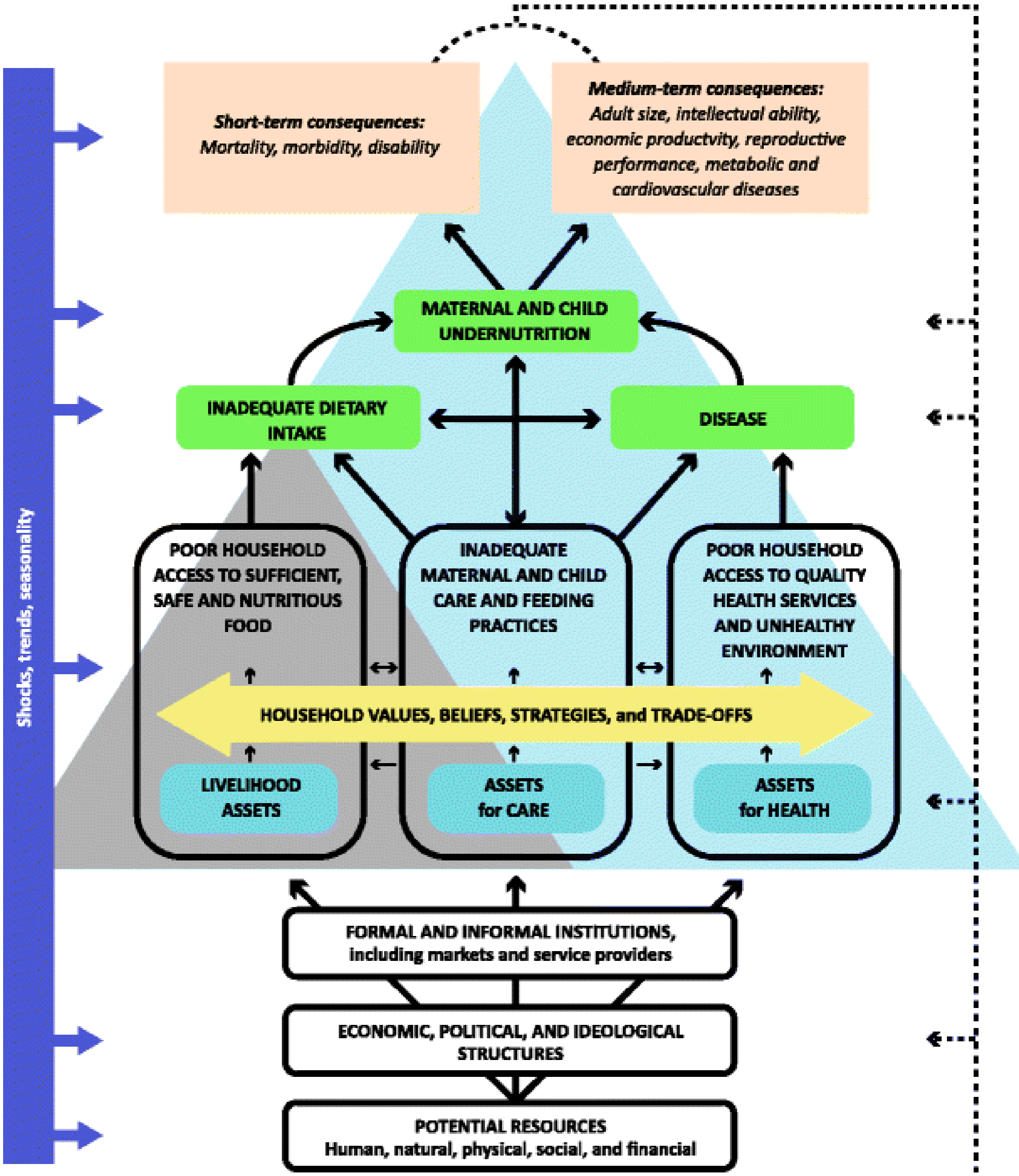

Fig1. Conceptual Framework of malnutrition adopted from UNICEF,2008

Food Technology can directly contribute to food security through enhancement of nutrient density establishment of tiny cottage scale for processing industry in rural areas would help to empower a rural woman which contributes livelihood security. Value addition/processing is need of the hour. Post harvest management will save the food.

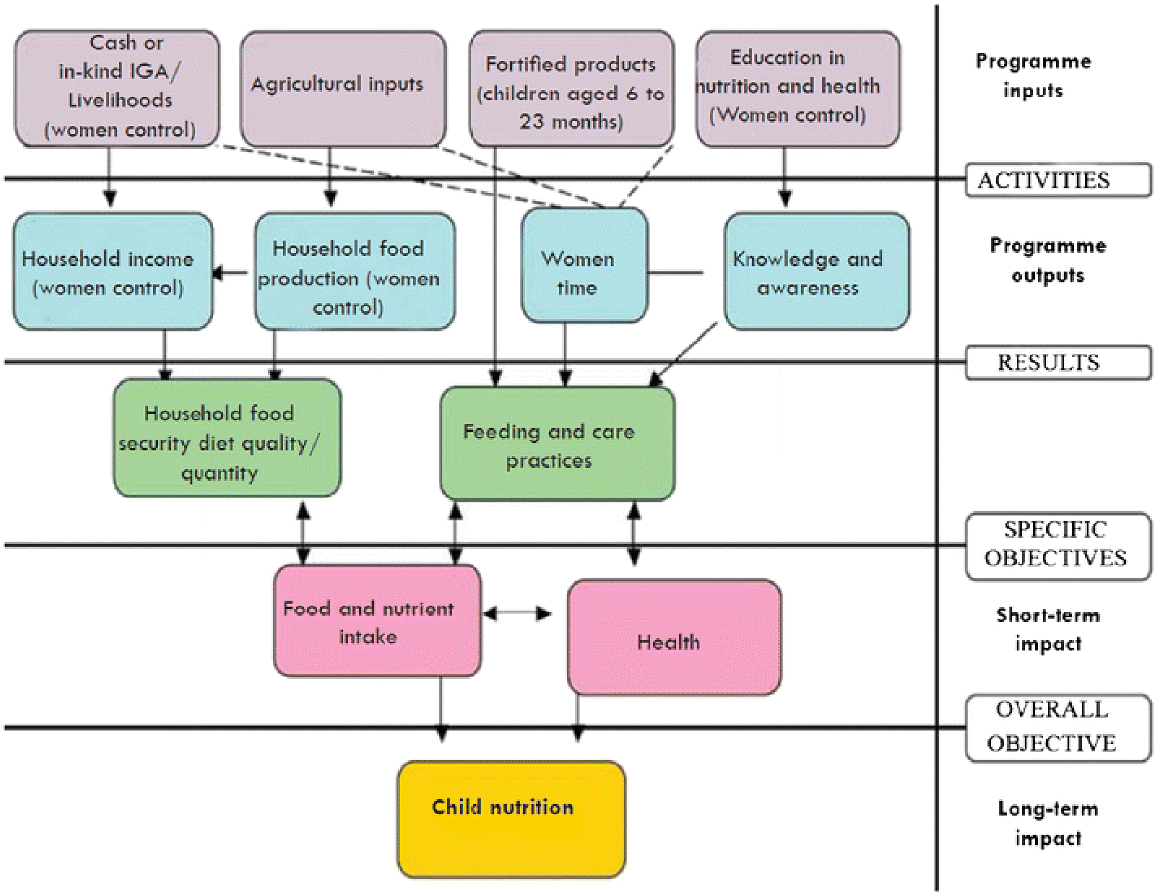

Fig -2. Path ways through which the intervention is expected to affect the nutritional status of the children (Shetty,2009)

Rural employment opportunities should be increased by promoting post harvest opportunities and value addition, entrepreneurship at the village level and this will increase the net income of the farmers. The promotion of agriculture, small scale rural industry, the rural economy gets a big boost and also corrects the rural- urban imbalance and prevents migration.

Food processing has huge potential to dramatically improve rural livelihoods by raising farm incomes through value addition in agricultural produce. "India is home to a wide-range of raw material suited for the food processing industry because of its diverse agro-climatic conditions. A very small percentage of these are processed into value added products at present. So, the scope, potential and opportunities are huge in this industry.

Several Programs: National Nutrition Policy (1993); National Nutrition Plan of Action (1995); National Nutrition Mission (2001) **not at achieved nutrition goals** .**Reasons:** Nutrition is a poor cousin even in health and agriculture planning and execution, Nutrition improvement is not a stated goal with measurable parameters in **National Food Security Mission, National Horticulture Mission and National Rural Health Mission.**

The Most important National Nutrition Programs in India are : Integrated child Development services program (ICDS) ,The targeted public distribution system (TPDS) ,Food for work ,The National Mid, Day meals program (NMMP) ,Micro nutrient (Iron folate; Vitamin A; Iodized salt) schemes . Rural employment opportunities s should be increased by promoting post harvest opportunities and value addition, entrepreneurship at the village level and this will increase the net income of the farmers. The promotion of agriculture, small scale rural industry, the rural economy gets a big boost and also corrects the rural- urban imbalance and prevents migration.

In the 21st century, climate changes, water scarcity, increasing world population, rising food prices, and other socioeconomic impacts are expected to generate a great threat to agriculture and food security worldwide, especially for the poorest people who live in arid and sub arid regions. These impacts present a challenge to scientists and nutritionists to investigate the possibilities of producing, processing, and utilizing other potential food sources to end hunger and poverty. To improve household nutrition security requires agricultural research and development specialists to understand nutrition objectives and be able to contribute to integrated agriculture-health programs.

Research carried out by Vijayakhader: Since the paper deals with the food security, nutrition security, health security and livelihood security, it deals with product development for livelihood and nutritional security; women empowerment for food security and rural development .

Experimental methodology used starting from Surveys, Chemical analysis, Biochemical estimations, bio-availability studies on rats as well as human subjects; clinical observations and histological studies were used as per the study design. **Product development, value addition, Technology transfer, Entrepreneur skills development, income generation activities and creating awareness through Nutrition Education were also used.**

Home based low cost energy protein rich preparations using Horse gram for vulnerable groups: The horse gram which is commonly used for cattle feed can be diversified for human consumption with less investment**.** Processed horse gram flour was prepared using Puffing and Roasting, Processed Soya bean flour was prepared by Dehulling and Roasting. The low cost energy protein rich products namely RAGINA and EPRF were prepared using the simple home scale processing methods like germination, roasting and puffing, to improve the nutritional status. Horse gram has been identified as potential food resource for the tropics and also occupies an important place among pulses because of its ability to resist severe drought conditions. Soya bean (Glycine max) is one of the best vegetable proteins and has tremendous potential to meet the protein deficiency in the cereal based Indian Diets at a low cost.**Product development can be taken as income generating activity in the rural areas by the illiterate women. Products can be included in supplementary feeding programs** in order to improve the nutritional status of the vulnerable groups of the population **(Vijayakhader & P.Ashlesh, 1998).**

To study the effect of feeding malted food on the nutritional status of vulnerable groups

Amylase Rich Malted Mixes (ARMM) two types were formulated using Ragi / Wheat and suitable products namely Laddu, Roti, Kheer, and Porridge were prepared using formulated malted mix. The ARMM's found to be nutritional dense. For the supplementation of malted mixes 8 villages of Lepakshi Mandal, Ananthapur District was selected. Preschool children (400), pregnant women (100) and Lactating women (100) were selected and fed with two types of malted mixes (Ragi / Wheat) for a period of 3 months. Anthropometric data, Food intake showed a significant increase in the preschoolers, pregnant women and Lactating mothers. Clinical assessment showed considerable reduction i.e. (50%) in nutritional deficiency symptoms and morbidity rate of all the subjects. Training program were conducted to 40 members by lecture and method demonstrations using developed education material such as Posters, Flip book, Manual and CD-Rom. After the training 60-70% improvement was observed in Knowledge, Attitude and Practices scores of the trainees, project profile for bulk production was also developed. Supplementation of ARMM's helped to improve the nutritional status of the vulnerable groups of population in rural areas especially with regard to protein, energy, iron, and calcium and B-complex vitamins. Promotion of malt based small scale food industry not only provides opportunity for rural women to **develop entrepreneurship** and employment but also provided **Food and Nutritional Security** through income generation. The then Honorable Minister for Agriculture Dr.N.Raghuveera Reddy was very much impressed and interested to introduce ARMM in the ongoing ICDS supplementary feeding programs based on research results**(Vijayakhader & Umamaheswari, 2012)**

Therapeutic food supplementation in ICDS projects of Andhra Pradesh: Total 2267 children of age range of 1-3 years were selected (892 children from rural ICDS project, Saravakota; 507 children from new ICDS project, Kottem; and 778 children from tribal ICDS project, Seethapeta) for a period of 1 year. The three types of supplements were prepared and distributed by A.P. Foods, Hyderabad. The supplements were distributed either in the form of Laddu or as in the form of powder. Nutritive value of 100g of supplements provides 400 to 480 Kcal 12.5 to 13.8 g proteins.

It was very encouraging to note that **92% of grade III children showed improvement** in their weight and height; **80% of moderately malnourished; 42% of mildly malnourished and 44% with normal grade showed improvement.** It was also observed that there was positive correlation between the calorie and protein intake and also improvement in weight and height. All 100% of mothers as well as Anganwadi workers preferred these supplementary foods better as compared to earlier supplied food i.e. ready to eat food**(Yasoda Devi & Vijayakhader, 2004).**

Studies on Fisher Women in the Coastal Eco System of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu: Two Equipments **I) Low Cost Ice Cream Freezer** II**) Fresh Fish Vending and Display Table** have been fabricated and the patents were received on 13th October, 2003. The technology has been licensed to Smt.G.Varalakshmi, W/o. Sri G.Satya Kiran, M/s. Yogi Industries, and Secunderabad for manufacturing these two equipments for a period of two years. She is the sole authority to manufacture in the country. After expiry of two years the technology on low cost ice cream freezer was licensed second time to another women entrepreneur namely Mrs. Lakshmi Bhuvaneswari W/o Devi Hariprasad, D.No.23/321, Bachupeta, Hindu College Road, Machilipatnam – 527 001 on 16th September, 2006 for a period of 6 years. **These equipments were fabricated mainly to improve the Health Security (Vijaya Khader, R.N. Kumar, J.Lakshmi, K.Dhanapal, H.M.Kasim, R.Sathiadas and N.S.Sudhakar. 2004).**

Role of Women in Fisheries in Coastal Eco-System of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu: Fish eaters in the study area comprise 47 per cent of the total population ranging from 237 per cent in Tamil Nadu to 85 per cent in Kerala. Though the position of Tamil Nadu in terms of number of coastal districts and possession of coast line including the number of landing centers is envious, the number of fish eaters in the state is minimal. **Andhra Pradesh employs 32 per cent of its fisherwomen in fish curing/drying/net making and 27 per cent in processing plant works. (Vijaya Khader, R.Sathiadas and H.Mohamad Kasim ,2005).**

Tribal mother's attitude towards lactation performance: Tribal women are mostly involved in food preparation (25%) where as men are involved in occupational activities. Majority (85%) of tribal women do not think lactation as a necessity to take special care about either food because they were lactating. Majority of mothers (66%) were aware of the reason for decrease in lactation performance. Only a small number of mothers (5%) knew that sickness and insufficient food (2%) played a role in decreasing the lactation performance. As nursing mothers, they do not receive any special attention from the family members regarding the additional intake of food. A positive change was observed in lactating mothers through **Nutrition Education(Vijayakhader, Vimala,Sarojini & Rajya Lakshmi,1996)**

Effect of Jawahar Rojgar Yojana Programme during lean season on the Nutritional Status of Women in Landless Labour Families of Drought prone areas : The study was conducted in eight villages of four interior Mandals having low rainfall (500-750mm) in Ananthapur a drought prone district of Andhra Pradesh. A household survey was conducted to screen the families having at least one women of child bearing age from the eight selected villages of the four Mandals. A total of 120 families were selected for the study of which 60 families were JRY beneficiary families' where at least one member of the family was being employed under JRY scheme and 60 families were non-JRY beneficiary families. **The study showed that the additional income gained by the landless labourer families during the lean season from Jawahar Rojgar Yojana (JRY) programme had beneficialeffect on the nutritional status** as assessed by the anthropometric measurements as well as clinical observations. The results indicated the past malnutrition status of the population in Ananthapur district because of the repeated and prolonged droughts**(Uma Maheswari and Vijaya Khader – 2001)**

Coping mechanisms adapted for food security at household level in drought prone areas of Ananthapur, Andhra Pradesh. A study was carried out in eight villages of four interior Mandals having low rainfall (500-750 mm), in Ananthapur a drought prone district of Andhra Pradesh. Families having at least one women of child-bearing age were enumerated. Two rounds of survey were conducted to understand the difference in coping mechanisms operating between peak and lean seasons. The study centered around the empirical examination of eight major groups of coping mechanisms comprising of land, livestock, economic, food procurement and production, food consumption and distribution, food storage, social and health based mechanisms adapted by the families. The various economic activities under taken by the women in the study area included Agriculture, Agriculture labour, basket making, Beedee making, brick making, broom making, cattle rearing, firewood collection, flour mill, fodder collection, forest produce collection, goat / sheep rearing, laundering, mat weaving, non-agricultural labour, petty trade, pottery, poultry rearing, ring making, sericulture, tailoring, tamarind peeling, vegetable vending and weaving clothes etc. **Most often children especially girls were involved in home based trades like groundnut shelling, beedi making, tamarind peeling etc.** A few of the mechanisms were found to be beneficial and can be encouraged **(Uma Maheswari & Vijaya Khader, 2003)**.

Rural Women as Entrepreneurs in Mushroom Cultivation: Every woman is an entrepreneur as she manages, organizes and assures responsibility for running her house. It has been increasingly realized that women possess entrepreneurial talent which can be har nessed to create employment opportunities. In the rural areas a woman can easily manage 4-10 beds depending on the space available, helping them to earn Rs.180 to Rs.450 per month. The results of the studies revealed that **spawn multiplication can be done by women as a co-operative venture and mushroom cultivation can be undertaken at household level as an income-generating activity (Vijaya Khader, 1994)**

Family income and nutritional status of pre-scholars' in rural areas of Tenali division: The increase in the annual per capita income of the family increased slightly the nutritional status of pre-scholars .The results also reveal that no significant difference was observed between the body weight of children and income of the parents in all the age group. In spite of having high purchasing power, **lower educational status of the mothers** and also low nutritional awareness, majority of the children are in Grade 1 degree malnutrition. **(Vijayakhader & Kavitha, 1993)**

Transfer of home level preservative techniques of selective fruits and vegetables to rural women in Guntur district : There was a significant, negative correlation between age of the respondents and gain in knowledge .There was a significant positive correlation of socio economic variables such as educational status, family income, and land holding on gain in knowledge**(Vijaya Khader and Bharathi, 1994)**

Operational feasibility of RPO supplementation to pre-school children in Anganwadi centers of ICDs Project

Vitamin A deficiency causes many health problems especially among children. A study was undertaken to screen the effect of supplementation of Red Palm Oil (RPO) obtained from the fruits of tree **Leis guineensis Jac.**The oil is rich in B-carotene, a precursor of Vitamin A.

Supplementation of crude RPO to Anganwadi Children increased the attendance of children, increase in heights and weights of children. Decrease in Grade 11 and Grade 111 malnutrition was observed in respect of sex. **(Vijayakhader and Aruna, 2008)**

Impact of women's supplementary income on families' nutritional Status: The Study was carried in 4 villages of Rajendranagar Mandal and Ranga Reddy District (Vegetable venders, Agarbathi labourers, Shopkeepers, Washers, Fruit venders, Tea and Snack workers .The results reveal that the supplementary income of women has a positive impact on socio-economic status of the family. This impact as felt on food and nutrition in take of the family **(Vijaya Khader, 1999)**

Impact of dairy programme on the nutritional status of women and preschool children in Vihiga District, Kenya Africa: The dairy program in Kenya has a significant impact on the overall improvement of the family in specific to improving production, consumption and marketed surplus of milk. Food and nutrient intake and nutritional status of women and preschool children from participant households improved. The prevalence of under nutrition in pre school children in participant households was lower (1.7%) than that of children in non participant households(2.9%).Stunting was 8.7 % and 21.4% in preschool children from participant and non- participant households respectively. Less percent (6.7%) of women in participant households had body mass index less than 18.5, wheras 7.3% of women from non-participant households fell below this cut - off point. **(Mary Khakoni Walingo & Vijayakhader, 2000)**

Success Stories : The National Agricultural Technology Project entitled **Studies on Fisherwomen in coastal ecosystem of Andhra Pradesh, Karnataka, Tamil Nadu and Kerala** explored the socio-economic status of fisherwomen and found the families wherein women are actively involved in one or other occupation has flourished and achieved all round development. **Seven Fisherwomen (3 from Kerala ;2from Karnataka and 2 from A.P) have attained the Training and Awareness from National Agricultural Technology Project, implemented in their places and enhanced their socio-economic status through various skill oriented training programmes and continuous day-to-day discussions with the Scientists.**

Impact of Research / Summary : Based on Vijayakhader work, Commissioner of Horticulture has issued the **G.O. on unit cost for Oyster Mushrooms cultivation Rs. 70,000/- by NABARD** and implemented from **1st August 1994** onwards (many people have availed the benefit) **41**

families have established mushroom cultivation in Guntur, Prakasham and Krishna Districts of Andhra Pradesh;**10** families have taken fruit and vegetable processing at village level ;**3** families have adopted the technology of Dehulling jowar and preparing value added products ;**10** self help groups have been organized at Karnataka and Kerala are mainly involved in various income generating activities. **Mrs Laura Bush, the First Lady of USA had discussions with Mrs Khader on 3rd March 2006 for 2 hours on food processing, income generating activities and gender issues**.

Alternative use of millets: The Deccan Development Society (DDS) NGO in Medak District, Andhra Pradesh are using the millet based recipes in **feeding program in 8 villages** for Anganwadi children (3 to 5 years age).

Technologies Developed ready for commercialization:

Entrepreneurship Technologies: Sorghum Food Enterprise / Geriatric Foods / Malted Infant Foods / High Fiber Vermicelli / Preservation of Palmyra Palm Fruit / Mushroom Cultivation.

Knowledge Empowerment Technologies: Multipurpose fresh fish Vending & Display Table / Low Cost Ice-cream Freezer

Value Addition Technologies : Value addition to Fruits / Value addition to Red Palm Oil / Fruit Powders / Horse gram Products & Soya Products.

Recognizing the value and potential of home gardens for enhancing food security and livelihoods, numerous initiates have been launched by governmental, non-governmental, and international organizations in many developing countries that are providing support and building local capacity to enhance the productivity and also for scaling up home garden activities.

Overall, the literature review supports the inclusion and promotion of home gardens as an eco-friendly sustainable agricultural practice to improve food security and enhance economic growth.

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Effect Of Supplementary Feeding On Growth Performance Of Local Kids Under Field Condition

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SUMMARY

The present on farm trial was conducted at nearby villages (Manikpur) of Krishi Vigyan Kendra, Muzaffarpur, district of Bihar, to assess the effect of supplementary feeding of locally made concentrate mixture on growth performance of local kids under field condition. Eighteen healthy non-descript local male kids having body weight 4.73±0.12 kg (aged 3-4 months) were selected and randomly distributed into three equal groups viz. T1 (Control i.e farmer practice- only grazing), T2- Grazing plus supplementary feeding of locally made concentrate mixture, T3- Grazing plus supplementary feeding of locally made concentrate mixture + two times deworming. The control (T1) group was maintained solely on grazing for 5-6 hours on local grazing land, kids of T2 and T3 groups were fed locally made concentrate mixture @ 3% of body weight along with grazing for 150 days. An additional deworming of kids (T3) was done two times at 60 days interval. The results showed that the average daily gain (g/day) was significantly ($P<0.05$) higher in T2 (56.26) and T3 (59.80) groups as compared to T1(34.40) (Control), whereas there was no significant ($P>0.05$) difference between T2 and T3 groups. Therefore, it is concluded that feeding of locally made concentrate mixture along with grazing improved growth performance in growing male kids.

INTRODUCTION

Among livestock, goat is one of the most important livestock for providing livelihood to small and marginal class of people in India. Hence, it is also called as poor man's cow. The country host is host to 135.20 million goats (19th Livestock census, GOI 2012).Goat in India are reared on community land, crop stubbles and top feed under extensive system of management with no supplementary feeding and results, do not meet their optimum requirement for growth and production. Therefore, the productivity of our local goats in respect of meat production is low due to lower dressing percentage. According to the latest land use statistics of the Ministry of Agriculture, Government of India, the total pasture land area decreased from 13.07million hectare (1970) to 10.31 million hectare in 2012(GOI, 2015). Hence, due to decreased and dwindling grazing lands, goats rearing has become a big constraint and that the supplementary feeding of goat or under stall feeding is gaining momentum. However, most of farmers of this district usually practice grazing of goats without supplementary concentrates feeding. The scientific approach to feed the goats is to argument enough concentrate along with suitable forages. However, there are little works has been done on semi-intensive system of rearing. Keeping view above condition, the present trial was conducted to study the effect of supplementary feeding of locally made concentrate mixture on growth performance of local kids under field condition.

MATERIALS AND METHODS

The present on farm trial was conducted at Manikpur villages of Muzaffarpur district(Bihar). Eighteen healthy non-descript local male kids 3-4 months age (Average body weight 4.73 kg) were selected and randomly divided into three equal groups viz. T1 (Control i.e farmer practice- only maintained on grazing), T2- Grazing plus supplementary feeding of locally made concentrate mixture ,T3- Grazing plus supplementary feeding of locally made concentrate mixture + two times deworming at 60 days interval. All the kids were dewormed before start the experiment with broad spectrum anthelmentic (Albendazole). Kids of T1 group (control- farmer practice) were maintained solely on grazing (5-6 hr). whereas supplementary locally made concentrate mixture @ 3% of body weight was offered to kids of T2 and T3 groups in addition to grazing. Dry matter, Crude protein, Ether Extract and Total ash were estimated as per standard procedure of AOAC (2003). The trial was last for 150 days and fortnightly bodyweight of all kids were recorded using electronic balance. The data were statiscally analysed as per Snedecor and Cochran (1980).

RESULTS

The crude protein, ether extract and total ash percent of locally made concentrate mixture was 19.5, 2.97 and 7.38 respectively. The mean total body weight gain of kids (kg) was significantly ($P<0.05$) higher in T2 (8.44) and T3 (8.97) as compared to control T1 (5.16 i.e ,farmer practicing) group. The similarly the average daily gain (g/day) was significantly ($P<0.05$) higher in T2 (56.26) and T3 (59.80) as compared to control T1 (34.40 i.e, farmer practicing) group, whereas there was no significant difference ($P>0.05$) difference between T2 and T3 groups. The additional higher weight gain (kg) of kids in T2 (3.28) and T3 (3.81) were also observed as compared to control (T1). Therefore, it is concluded that feeding of locally made concentrate mixture along with grazing and deworming improved growth performance in growing male kids.

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Table: Growth performance of local kids in different feeding regime

Particulars	**Farmers practice (control-T1)**	**T2**	**T3**
Number of animals	6	6	6
Initial body weight (kg)	4.71	4.8	4.7
Final body weight (kg)	9.86^{a}	13.24^{b}	13.67^{b}
Total weight gain (kg)	5.16^{a}	8.44^{b}	8.97^{b}
ADG(g)	34.4^{a}	56.26^{b}	59.8^{b}
Total Feed intake (Kg)	-	25.5	25.5
Additional Cost of feed (Rs)	-	515.10	555.10

Additional weight gain (kg)	-	3.28	3.81

Means having different superscripts in a row differ significantly (P<0.05)

Cost of concentrate mixture @ Rs20.20/ kg. and deworming cost Rs. 40.00

Food and Nutritional Security in India Compared other South Asian Countries

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ABSTRACT

South Asia is having the largest number of undernourished children in the world, and within South Asia, India's share of having the undernourished children is the highest. This paper aims to examine the headway of food and nutritional condition of South Asian countries with special focus on India. South Asia comprises India, Pakistan, Bangladesh, Iran, Nepal, Afghanistan, Sri Lanka, Bhutan and Maldives, but for this study, we have not included Bhutan and Maldives due to less than a million populations. We have used Food and Agriculture Organisation FAO food security indicators from 1990 to 2016 with detailed analysis of food availability, accessibility, stability and utilisation. In food availability and stability parameters, most of the countries of South Asia including the region as a whole performed better, whereas, in thecase of food access indicators like prevalence of undernourished and food utilisation indicators like stunting among children and anaemia among pregnant women; many South Asian countries underperformed and failed to meet up the targets set for millennium development goals (MDGs). Overall, Iran and Sri Lanka performed better; India, Bangladesh, Pakistan and Nepal performed at mediocre level and Afghanistan performed worst in almost all the indicators. The experience of achievements in MDGs will be helpful in planning for sustainable development goals with more emphasis on undernourishment, stunting among children and anaemia among women especially in countries like Afghanistan and India, which are lagging behind in these indicators.

Keywords: Food security indicators, Sustainable indicators, Monitoring food and nutrition security, Sustainable Development Goals, Millennium Development Goals, undernourishment, Food utilisation indicators.

INTRODUCTION

South Asia covers about 5.1 million km², which is 11.51% of the Asian continent or 3.4% of the world's land surface area. The population of South Asia is about 1.749 billion or about one fourth of the world's population, making it both the most populous and the most densely populated geographical region in the world. Overall, it accounts for about 39.49% of Asia's population (or over 24% of the world's population) and is home to a vast array of peoples.The food security challenge is great in the South Asian countries–Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka–where more than 40% of the world's poor live and some 51% of the population is food–energy deficient (Hill et al., 2007). With just 3% of the world's land, South Asia has about one-fourth of the world's population (1.6 billion people). All countries in South Asia are classified into low income or low middle income category. Poverty and hunger are the most pivotal problems faced by this region. About 43% of poor and 36% ofundernourished population of the world is concentrated in South Asia (Chand, 2012). All these countries of South Asian region except India have been the net importer of food as their own production has been insufficient to fulfil their domestic requirement. Despite rapidgrowth of some of the economies in the region;there was no discernible decline in incidence of poverty, hunger andmalnutrition.

Food security exists when all people, at all times, have both physical and economic access to sufficient, safe and nutritious food to satisfy their dietary needs and food preferences to live active and healthy lives.Since India, being the largest country within South Asia and home for the largest number of undernourished children, this paper focuses on the trends in the food-security indicators in India compared with other South Asian countries. The results show that in food-availability indicators, most of the South Asian countries are in comfortable position; however, in food access, stability and utilisation parameters, these countries performance was not up to the mark. Endurance of undernourishment, stunting among children and anaemia among pregnant women are significantly higher in most of the South Asian countries except Iran and to some extant Sri Lanka. India’s position is ‘*not better’* than other South Asian countries thoughsevere forms of malnutrition in the country plummeted noticeably. Stunting among children and anaemia among pregnant women have shown a downward trend but is still not better than manycountries. The World HealthOrganisation (WHO) reported that 2.5 millionchildren in India die every single year owing to malnutrition. Italso stated that China has only 7% of its children (under 5 years) are underweight, on the other side, India has this number alarminglyhigh at 42.5%. The progress in reducing malnutrition has been languid; the rate of reduction in malnutrition is less than 2% per annum. World over there are some studies which focused on food security indicators (Vaitla et al., 2017, Maxwell, 1996, Reddy et al., 2015, Maxwell et al., 1999, Riely et al., 1999, Feber et al., 2009, Carletto et al., 2013. Santeramo 2015, Sraboni et al., 2014, Reddy and Bantilan, 2012). There are some studies focusing on food and nutrition security in India compared with some other countries (Reddy *et al.*, 2016; Reddy, 2016), but there was no study which assess performance of South Asia specifically and its member countries in meeting the millennium development goals (MDGs) relating to food and nutrition security from 1990 to 2015, this study will try to address this literature gap.

OBJECTIVES AND METHODOLOGY OF THE STUDY

Given the importance of reducing food and nutrition security in South Asia, this paper aims to study the trends in food and nutrition security indicators in South Asian countries from 1990 to 2015. This period is purposively selected as it corresponds to target time line set to assess the progress of the all MDGs. During this period (1990 to 2015)MDG Goal 1, Target 1.9 targeted to reduce the undernourishment by half and also MDG Goal 7 Target 7.C targeted to 'halve the proportion of people without sustainable access to safe drinking water and basic sanitationby 2015'.

Among the South Asian countries selected for the study, Bhutan and Maldives were not included, as thepopulation in these countries was less than a million, Table 1 gives country-wise population and GDP per capita all nine South Asian countries. There are significant differences among countries in GDPper capita (in purchasing power equivalent). Iron and Sri Lanka are at the top, whereas Afghanistan and Nepal at the bottom. India and Pakistan were at the middle within South Asia. India is the largestpopulated country within South Asia, followed by Pakistan, Bangladesh, Iran, Nepal, Afghanistan and Sri Lanka.

Table 1: Country-wise population in South Asia

Sl. No.	Country	Projected Population (million) in 2015	GDP per capita $ (in PurchasingPower Equivalent) in 2014
1	India	1,299	5,439
2	Pakistan	192	4,590
3	Bangladesh	159	2,979
4	Iran	79	16,507
5	Nepal	28	2,265
6	Afghanistan	27	1,844
7	Sri Lanka	21	10,667
8	Bhutan	0.8	7,456
	Not Selected Countries		
9	Maldives	0.3	11,954
10	Southern Asia	1,806	5,572

FAO Food Security Indicators

Following the recommendation of experts gathered in the Committee on World Food Security Round Table on hunger measurement hosted at FAO headquarters in September 2011, an initial set of indicators aiming to capture various aspects of food insecurity is presented here.

Indicators are classified along the four dimensions of food security :availability, access, utilisation and stability and the choice of the indicators has been informed by expert judgment and the availability of data with sufficient coverage to enable comparisons across regions and over time.

Food Availability: The term Food Availability is defined by the World Food Programme as ‘the amount of food that ispresent in a country or area through all forms of domestic production, imports, foodstocks and food aid’ (WFP (World Food Programme), 2009, p.170).Food-availability indicators are (i) average dietary energy supply(DES) adequacy, (ii) average protein supply and (iii) average supply of protein of animal origin.

Food Access: The World Food Summit defines Food Access as having ‘physical, economic and socialaccess’. Food access indicators are as follows: (i)GDP per capita (in Purchasing Power equivalent), (ii) road density, (iii) domestic food price index, (iv) prevalence of undernourishment, (v) share of food expenditure of the poor and (vi) depth of the food deficit.

Food Utilisation: The World Food Summit’s definition of utilisation is ‘safe and nutritious food which meets their dietary needs’. Food utilisation indicators are (i) access to improved water sources, (ii) access to improved sanitation facilities,(iii) prevalence of anaemia among pregnant women and (iv) stunting among children.

Food Stability: As stated by the World Food Summit, stability must be present ‘at all times’ in terms ofavailability, access and utilisation for food security to exist. Food stability indicators are (i) per capita food production variabilityand(ii) domestic food price volatility.

RESULTS

a. Food-availability Indicators

Food-availability indicators are (i) Average Dietary Energy Supply (DES) adequacy, (ii) Average protein supply and (iii) Average supply of protein of animal origin.

(i) *AverageDietaryEnergySupply(%)*

This indicator expresses the Dietary Energy Supply (DES) as a percentage of the average dietary energy requirement (ADER). Each country’s average supply of calories for food consumption is normalised by the average dietary energy requirement (ADER) estimated for its population to provide an index of adequacy of the food supply in terms of calories.

Based on food balance sheets data of FAO, average dietary energy suppy (DES) is calculated on 3 year average to reduce the impact of errors in recording of annual stock variations. In almost all countries,dietary energy supply (DES) is sufficient to meet its population energy needs except Afghanistan (Table 2). Energy supply in India was 8% more than the required; in the case of Iran, it is 38% more than the required. In thecase of South Asian region as a whole, it was 10% higher than the energy requirements.

Table 2: Average dietary energy supply adequacy (%)

Country	**1990–1992**	**2000–2002**	**2014–2016**
Iran	135	128	138

Nepal	106	108	121
Sri Lanka	97	102	115
Bangladesh	99	104	108
India	105	105	108
Pakistan	108	106	108
Afghanistan	102	89	99
South Asia	106	106	110

(ii) *Average Protein Supply*

In most of the developing countries including South Asia,malnourishment in protein supply exists. National average protein supply (expressed in grams per caput per day) among the selected countries is given in Table 3. The tabular data manifests that considering India as a reference country, protein supply in Iran, Nepal and Pakistan is above India, but inAfghanistan, Sri Lankaand Bangladesh protein supply is less than India. Overall, in South Asia, protein supply increased from 56 g/capita/day in 1990–1992 to 61 g/capita/day by 2009–2011. Protein supply was stagnant in India since the 1990s, whereas it was significantly and steadily increased for Bangladesh. In spite being immobile in protein supply, India was quite ahead of Bangladesh in protein supply throughout the 1990s and 2000s. India's per capita supply was less than Indian Council of Medical Research ICMR recommended 60 g/capita/day.

Table 3: Average protein supply (gram/capita/day)

Country	**1990–1992**	**2000–2002**	**2009–2011**
Iran	78	82	86
Nepal	56	57	65
Pakistan	58	60	64
India	55	56	59
Afghanistan	60	52	58
Sri Lanka	48	53	57
Bangladesh	45	50	55
South Asia	56	57	61

(iii) Average Supply of Protein of Animal Origin

The quality of protein intake was assessed by the protein source from animal origin. National average protein supply of animal origin (expressed in g/capita/day) includes the following groups: meat; animal fats and products; milk and products; eggs, fish, seafood and products; aquatic products andothers. Across the world, thesupply of protein from animal sources has been growing. India's consumption level of animal protein is less compared toPakistan, Iran, Sri Lanka and Afghanistan, but more than that of both Nepal and Bangladesh (Table 4). The table indicates that in South Asian region, average supply of protein of animal origin was increased from 10 g/capita/day in 1990–1992 to 14 g/capita/day in 2009–2011, whereas in India, it has increased from 9 to 12 g/capita/day during the same period. However, these differences may be attributable to religious and social issues rather than economic issues.

Table 4: Average supply of protein of animal origin (g/capita/day)

Country	**1990–1992**	**2000–2002**	**2009–2011**
Pakistan	19	22	26
Iran	17	19	24
Sri Lanka	11	14	15
Afghanistan	16	13	12
India	9	10	12
Nepal	9	9	11
Bangladesh	5	7	10
South Asia	10	11	14

b. Food-access Indicators

Food-access indicators are (i) Gross Domestic Product per capita (in purchasing power equivalent), (ii) road density, (iii) domestic food price index, (iv) prevalence of undernourishment, (v) share of food expenditure of the poor and (vi) depth of the food deficit.

(i) *Gross DomesticProductPer Capita (inPurchasingPowerEquivalent)*

Percapita income provides information on the possibility of economical access to markets. Gross Domestic Product (GDP) per capita isbased on purchasing power parity (PPP). PPP-GDP is defined as GDP converted to international dollars using PPP rates. An international dollar has the same purchasing power over GDP as the US dollar has in the United States. GDP at purchaser's prices is the sum total of gross value added by all resident producers in the economy plus any product taxes minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources (FAOSTAT, 2016). FAOSTAT is a website of Statistics Division Food and Agriculture Organization of the United Nations which provide information of progress of food security indicators every year. Data are in constant 2011 international dollars. The percapitaGDP was much higher in Iran(16,360), followed by Sri Lanka(10,328) and India(5,144) (Table 5). Pakistan, Bangladesh, Nepal and Afghanistan had less percapita income than India. The figures show that the economic access to food was higher in Iran, followed by Sri Lanka and India, least was in Nepal and Afghanistan. Overall percapitaGDP of South Asia has increased from 2,327 PPP-$ in 1990–1992 to 5,327 PPP-$ by 2012–2014.

Table 5: Gross domestic product per capita (in purchasing power equivalent)

Country	**1990–1992**	**2000–2002**	**2012–2014**
Iran	10,954	12,244	16,360
Sri Lanka	3,798	5,511	10,328
India	1,781	2,590	5,144
Pakistan	3,152	3,510	4,482
Bangladesh	1,313	1,691	2,846
Nepal	1,233	1,564	2,185
Afghanistan		1,088	1,873
South Asia	2,327	3,057	5,327

ii. Road Density

Road density (km of road/100 km^2 of land area) basically highlights on the possibility of physical access to markets.Total road network comprises of motorways, highways, and main or national roads, secondary or regional roads and all other roads in a country. A motorway is a road designed and built for motor traffic that separates the traffic flowing in opposite directions. Sri Lanka(174 km/100 km^2), Bangladesh(161 km/100 km^2) and India(139 km/100 km^2) performed better than other countries(Table 6). Again, Afghanistan's performance is low with just 3.5 km/km^2 mainly due to internal conflicts. The reasons behind the less road densities in Nepal and Iran are mountainous terrain and large tracts of deserts respectively. Overall, in South Asia, it is seen that road density increased from 40 km/100 km^2 in 1990–1992 to 79.2 km/100 km^2 by 2009–2011. Moreover, during the last decade, there was significant increase in road access in all South Asian countries.

Table 6: Road density (km per 100 km^2 of land area)

Country	1990–1992	2000–2002	2009–2011
Sri Lanka	146.1	139.9	173.9
Bangladesh	135.4	139.8	161.0
India	64.6	102.7	139.4
Pakistan	22.5	31.4	32.9
Nepal	9.0	10.2	13.5
Iran	7.7	9.3	11.8
Afghanistan	1.0	1.5	3.5
South Asia	40.1	59.9	79.2

iii. *DomesticFoodPriceIndex*

Domestic food price level index is an important indicator for global monitoring of food security because it compares the relative price of food across countries and over time.In other words, the domestic food price level index can also be defined as an indicator of the relative price of food in a country. The indicator is calculated from the 2011 International Comparison Programme (ICP) data from the World Bank as well as general and food consumer price indices (FPIs) from the International Labour Organisation (ILO)which are made consistent and available on FAOSTAT. Specifically, the ratio of food and non-alcoholic beverages expenditure to actual individual consumption is calculated in Purchasing Power Parity (PPP) terms relative to that of United States. To control inflation, this ratio is forecasted and back casted using the ratio of a country's food consumer price indices (FPI) and general consumer price index (CPI) using 2011 as base year, relative to the United States (FAOSTAT, 2016).

The domestic food prices in India are stable, when compared with the other countries (Figure 1). The low and stable food price index in India is an indicator of increase in competitiveness of food products. However, the increase in prices of protein-rich food like pulses and animal sources of protein is a cause of concern, given the increase in the demand for protein foods. The highest food price index was in Nepal (10), followed by Bangladesh (8), Pakistan and Sri Lanka (7). Only the food price index (FPI) in Iran is less than India. There was a sudden decrease in food price index in both Iran and Sri Lanka in the year 2006 and then these lower levels continued.

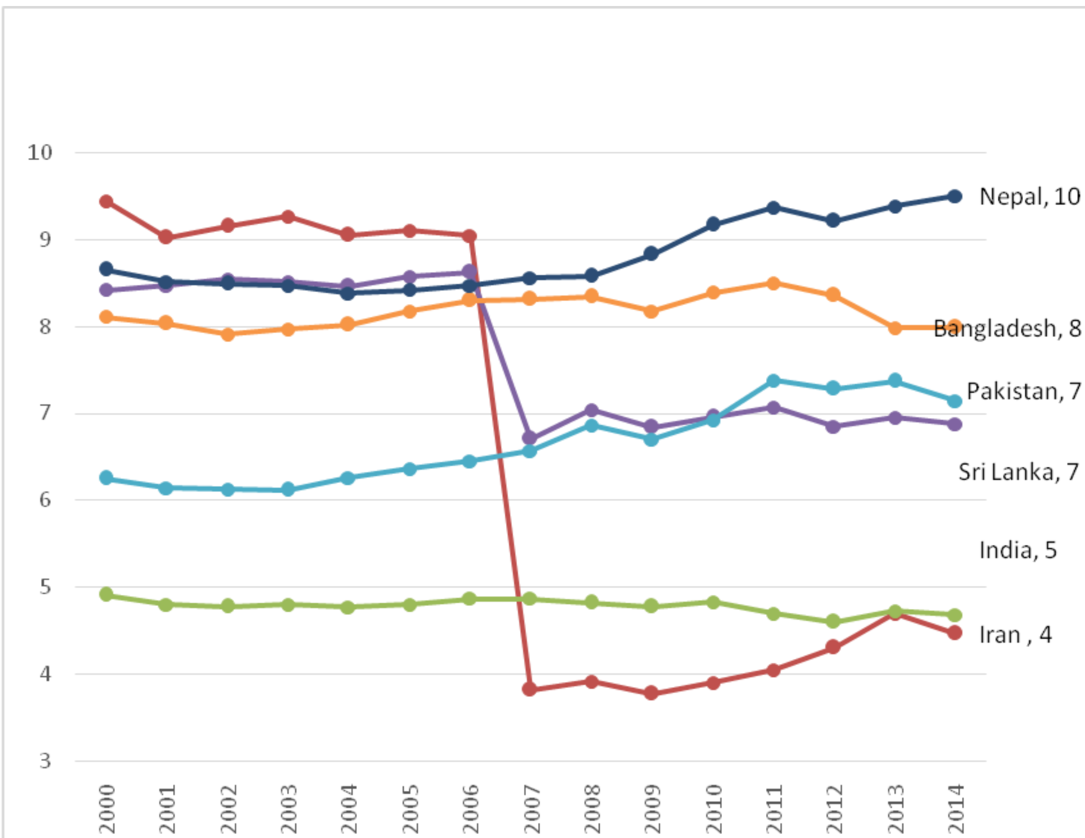

Figure 1: Domestic food price index

iv. *Undernourishment*

Undernourishment is the traditional FAO hunger indicator adopted as official millennium development goals (MDG) indicator for Goal 1, Target 1.9.The prevalance of undernourishment expresses the likelihood that a randomly selected individual from the population consumes an amount of calories that is insufficient to cover her/his energy requirement for an active and healthy life. The indicator is computed by comparing a probability distribution of habitual daily dietary energy consumption with a threshold level called the minimum dietary energy requirement. Both are based on the notion of an average individual in the reference population.More details on the methodology for computing the prevalence of undernourishment are in Annex 2 of the State of Food Insecurity in the World 2013 Report.

Prevalence of undernourishment has been reduced from 23.9% in 1990–1992 to 15.7% by 2014–2016 in South Asia. Undernourishment was much higher in Afghanistan (26.8%), followed by Pakistan (22%), Sri Lanka (22%), Bangladesh(16.4%) and India(15.2%)(Table 7),but, it is low in Nepal(7.8%) and Iran(less than 5%). However, undernourishment was higher in India and South Asia compared with world, but decreasing steeply. However, there is wide variation‘year-on-year’ mainly due to the high fluctuations in food production as well as availability for human consumption.

Table 7: Prevalence of undernourishment (%)

Country	**1990–1992**	**2000–2002**	**2014–2016**
Afghanistan	29.5	46.7	26.8
Pakistan	25.1	23.4	22.0
Sri Lanka	30.6	29.7	22.0
Bangladesh	32.8	20.6	16.4
India	23.7	17.5	15.2
Nepal	22.8	21.9	7.8
Iran	5.1	5.6	<5.0
South Asia	23.9	18.5	15.7

v. *Shareof Food Expenditureof the Poor (%)*

According to the Engel's Law, the higher the income of a household, the lower the proportion of income spent on food. When applied at the national level, this indicator reflects the living standard of a country, as well as the vulnerability of a country to food price increases. Due to the lack/unreliability of income data, this indicator has been built as the ratio between food consumption and total consumption, hence using total consumption as a proxy income. Finally, given the higher vulnerability of the poorer households to food price increase, this indicator only encompasses the share of food consumption of the lowest income quintile of a country population.

It is the proportion of food consumption over total consumption (food and non-food) for the lowest income quintile of the population. This indicator captures the monetary value of food obtained from all the possible food sources (purchases, ownproduction, gift, in-kind payment etc.) rather than just the monetary value of purchased food because the way in which the share of food expenditures is defined in the sources of data,. Total consumption expenditures include both food and non-food expenditures and exclude non-consumption expenditures such as taxes, insurances and others.Overall, share of food expenditure of the poor decreased from 68% in the 1990s to 64% in the 2000s. It is lowest in Iran (only 35%), but highest in Pakistan (75%), Nepal (73%), Bangladesh (68%) andSri Lanka (67%). In India, it was 64%, whereas in Afghanistan, it was 49%(Table 8).

Table 8: Share of food expenditure of the poor(%)

Country	**1990s**	**2000s**
Iran	40	35
Afghanistan	52	49
India	69	64
Sri Lanka	60	67
Bangladesh	66	68
Nepal	69	73
Pakistan	80	75
South Asia	68	64

vi. *Depth of Food Deficit*

The depth of the food deficit indicates how many calories would be needed to lift the undernourished from their status, everything else being constant. The average intensity of food deprivation of the undernourished, estimated as the difference between the ADER and the average dietary energy consumption of the undernourished population (food-deprived), is multiplied by the number of undernourished to provide an estimate of the total food deficit in the country, which is then normalised by the total population(FAOSTAT, 2016).

Depth of food deficit is an indicator of severity of food deficit among different countries. Depth of food deficit in South Asia was decreased from 169 kcal/capita/day in 1990–1992 to 114 kcal/capita/day in 2014–2016. Food deficit was higher in Sri Lanka (192 kcal/capita/day), followed by Afghanistan (173 kcal/capita/day), Pakistan (172 kcal/capita/day), Bangladesh (116 kcal/capita/day) and India (109 kcal/capita/day) (Table 9).

Table 9: Depth of food deficit (kcal/capita/day)

Country	**1990–1992**	**2000–2002**	**2014–2016**
Iran	31	39	31
Nepal	149	147	51
India	165	122	109
Bangladesh	247	139	116
Pakistan	179	172	172
Afghanistan	202	326	173
Sri Lanka	228	268	192
South Asia	169	130	114

c. Food Stability Indicators

According to various reports on climate change, world is going to see more frequent floods and droughts in the future. This will increase the occurrence of supply shocks in food availability and increase volatility of food production and price fluctuations. Hence, there is a need for understanding and assessing the food stability indicators.We have considered two food stability indicators – (i) domestic food price volatility and (ii)per capita food productionvariability.

i. *DomesticFoodPriceVolatilityIndex*

The domestic food price volatility compares the variations of the domestic food price index across countries and time. The domestic food price volatility index measures the variability in the relative price of food in a country. The indicator is calculated from the monthly domestic food price level index using monthly Consumer Price Index (CPI) and general Food Price Index (FPI) and PPP data from the ICP conducted by the World Bank (see the relative price of food indicator for more information). Month-to-month growth rates are calculated and the standard deviation of these growth rates is calculated over the previous 8 months (8-month rolling standard deviation). The average of these standard deviations is then computed to obtain an annual volatility indicator. In India, the price volatility index is less (8) compared with Pakistan (13), Iran (13), Nepal (10), but higher than Bangladesh (5) and Sri Lanka (8). Low price volatility is due to nationwide food procurement system at minimum support price (Figure 2).

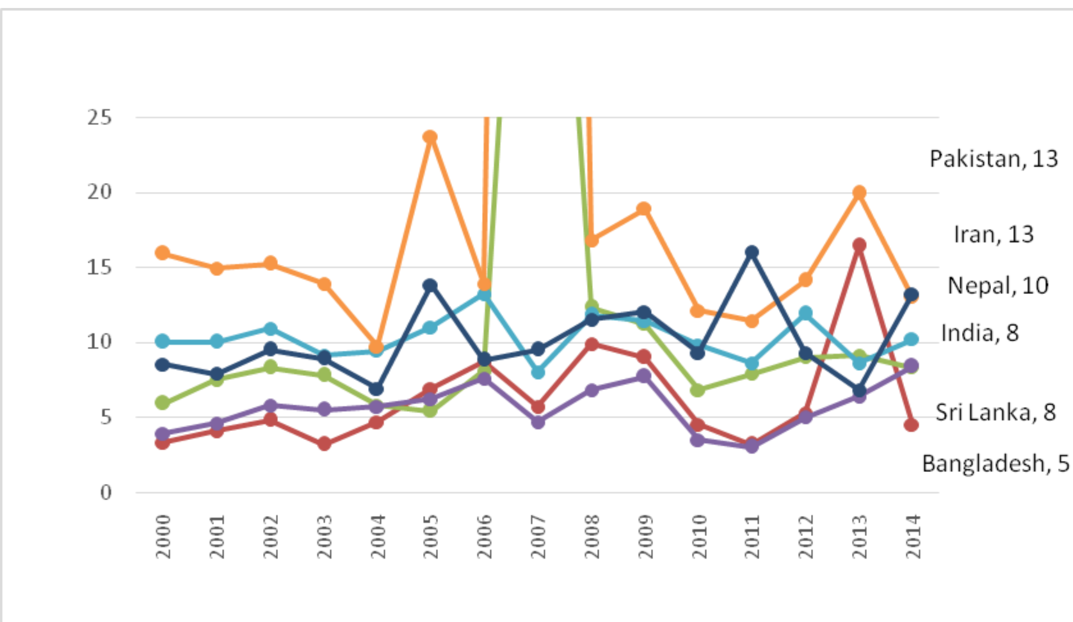

Figure 2: Domestic food price volatility index

ii. *Per CapitaFoodProductionVariability*

The per capita food production variability compares the variations of the per capita food production across countries and time.Per capita food production variability corresponds to the variability of the 'food net per capita production value in constant 2004–2006 international dollar ($)' as disseminated in FAOSTAT. Percapita food production variability was higher in small countries like Iran(9 Constant 2004–2006 thousand international $ per capita), Nepal(8), Afghanistan(6), Pakistan(5), but lower in agricultural dependent large countries like India, Bangladesh and Sri Lanka (only 4) (Figure3).

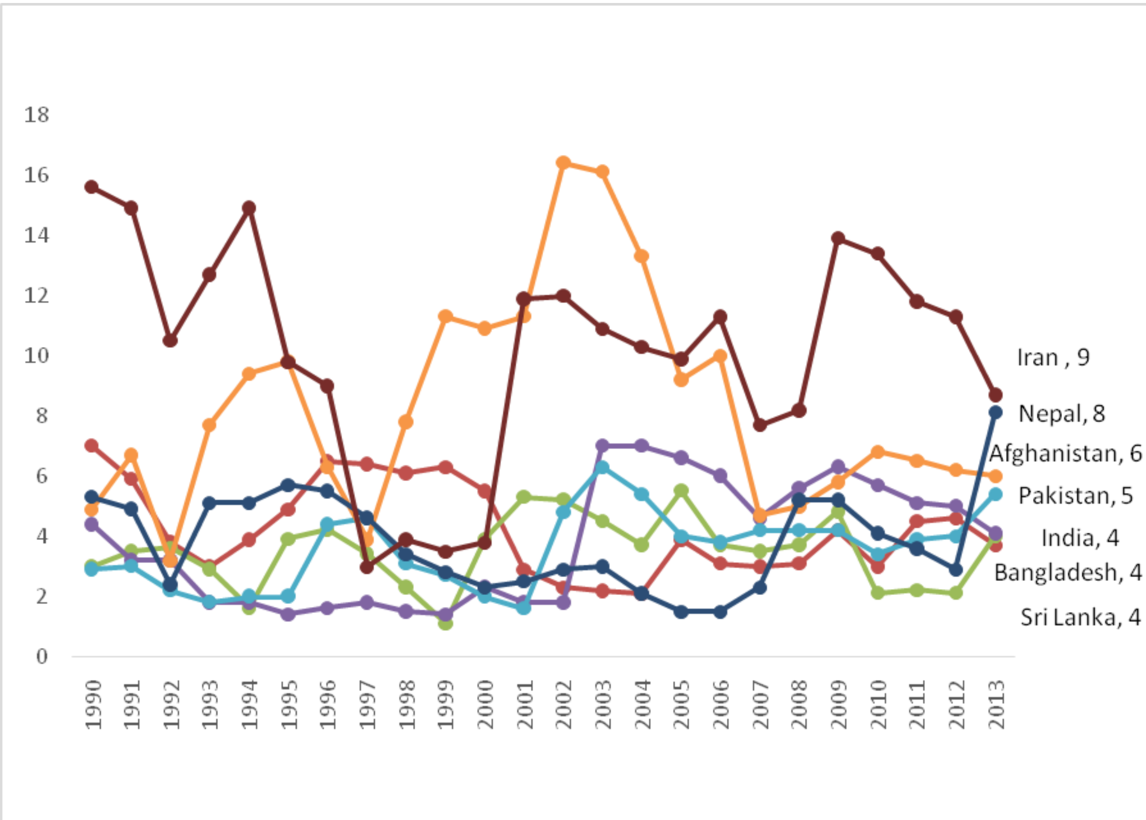

Figure 3: Per capita food production variability

d. Utilisation Indicators

Percentage of population with access to improved drinking water sources provides information useful to assess the utilisation dimension of food security outcomes. It corresponds to the MDG 7 target 7.C: 'halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation'.

Indicators of the Study

The study considered four food utilisation indicators:

(i) *AccesstoImprovedWater Sources*

Access to an improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring and rainwater collection. Unimproved sources include vendors, tanker trucks and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 l a person a day from a source within 1km of the dwelling.Bangladesh, India, Nepal and Pakistan achieved the MDG of halving the proportion of the people without sustainable access to safe drinking water. South Asia region also achieved this goal, but Afghanistan, Iran and Sri Lanka did not achieve. However, even in 2012–2014, about 47% of the population in Sri Lanka, 14.5% in Pakistan and10.2% in Nepal did not have access to safe drinking water(Table 10). In South Asia, population without access to safe drinking water reduced from 26.8% in 1990–1992 to 8.4% in 2012–2014, which was 68% reduction as against 50% target under MDG.

Table 10: Percentage of population without access to improved drinking water sources

Country	**1990–1992**	**2000–2002**	**2012–2014**
Afghanistan	7.7	5.7	3.9
Bangladesh	30.5	19.2	5.5
India	28.5	18.5	6.9
Iran	13.5	11.3	8.9
Nepal	33	21.8	10.2
Pakistan	31.1	23.3	14.5
Sri Lanka	78.7	68	46.6
South Asia	26.8	18.4	8.4

(ii) *Access to Sanitation*

Percentage of population without access to sanitation facilities provides information useful to assess the utilisation dimension of food security outcomes. It corresponds to the millennium development goals (MDG) 7 Target 7.C: ‘halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation’.

Access to improved sanitation facilities refers to the percentage of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained. Only Sri Lanka and Iran achieved MDG 7 Target 7.C ofhalving the proportion of the people without sustainable access to sanitation. In South Asia region, population without access to sanitation was reduced from 77.3% in 1990–1992 to 54.5%% by 2012–2014 (Table 11). In India, about 61.5% of the population don't have access to sanitation facilities; this figure iseven more for Afghanistan (68.9%) in 2012–2014. Even Pakistan, Bangladesh and Nepal performed better than India.

Table 11: Percentage of population without access to sanitation facilities

Country	**1990–1992**	**2000–2002**	**2012–2014**
Sri Lanka	28.2	17.8	5.4
Iran	28.5	20.1	10.2
Pakistan	76.2	61.3	40
Bangladesh	64.4	53.5	41.3
Nepal	93.8	76.6	57.4
India	82.8	73.4	61.5
Afghanistan	79.5	76.1	68.9
South Asia	77.3	67.3	54.5

(iii) *AnemiaAmongPregnant Women*

Anaemia is a condition in which the number of red blood cells (and consequently their oxygen-carrying capacity) is insufficient to meet the body's physiologic needs. Iron deficiency is thought to be the most common cause of anaemia globally, but other nutritional deficiencies (including folate, vitamin B12 and vitamin A), acute and chronic inflammation, parasitic infections and inherited or acquired disorders that affect haemoglobin synthesis, red blood cell production or red blood cell survival, can all cause anaemia. The prevalence of anaemia is an important health indicator. 'Prevalence of anaemia in pregnant women is the percentage of pregnant women whose haemoglobin level is smaller than 110 g/l.In its severe form, it is associated with fatigue, weakness, dizziness and drowsiness. Children under age five and pregnant women have the highest risk for anaemia'.

The percentages in the prevalence of anemia among pregnant women given in the Table 12 shows that almost all South Asian countries performed pathetically. Prevalence of anaemia was 51% during the entire period of 1990 to 2011. Only Sri Lanka and Iran showed some improvement. The prevalence of anaemia among pregnant women is higher in India even compared with most underdeveloped countries like Kenya, Bangladesh and Egypt(Reddy *et al.*, 2016). This high level of anaemia which is an indication of undernutrition and malnutrition needs to be addressed. To tackle this, there is a need for widening of the food security basket to include protein-rich pulses, animal-based products to make the food security programme truly nutrition security programme (Table 12).

Table 12: Prevalence of anaemia among pregnant women (%)

Country	**1990–1992**	**2000–2002**	**2009–2011**
Sri Lanka	39.7	31.7	25.9
Iran	37.3	28.4	26.2
Afghanistan	49.6	46.2	44.3
Nepal	59	54.8	45.0
Bangladesh	53.5	51.3	48.2
Pakistan	48.7	46.4	49.7
India	**52.2**	**55.1**	**53.9**
South Asia	51.0	52.0	51.0

(iv) *StuntingamongChildren*

Percentage of children (under 5 years) who are stunted belongs to a set of indicators whose aim is to gauge nutritional imbalance, malnutrition leading to 'undernutrition' (assessed by underweight, stunting and wasting) and overweight. Child growth is the most widely used indicator of nutritional status in a community and it is also globally recognised as a consequential public-health indicator for monitoring health in populations. Furthermore, children who suffer from growth retardation owing tosubstandard diets and/or recurrent infections tend to have a greater risk of suffering illness and death.Percentage of stunting (height-for-age less than two standard deviations of the WHO Child Growth Standards median) among children aged 0–5 years were given in Table 13 below. In stunting among children, theperformance of Iran and Sri Lanka was better during the last 25 years as well as it meets the millennium development goals (MDGs) target(Table 13). Apart from this, it is also clear from the data presented in the Table 13, that the percentage of children under 5 years of age who are stunted was only 6% in Iran and14.7% in Sri Lanka. In South Asian region as a whole stunting among children declined from 52% in the 1990s to 39% in 2015, indicating that it did not meet the MDG milestone in stunting among children.

Table 13: Percentage of children under 5 years of age who are stunted

Country	**1990s**	**2000s**	**2015**
Iran	22.4	7.1	6.0
Sri Lanka	27.9	18.3	14.7
Pakistan	48.6	41.5	44.0
India	52.2	46.3	40.0
Bangladesh	67.6	49.8	38.7
Nepal	60.7	53.2	40.5
Afghanistan	53.2	59.3	59.0
Southern Asia	52.0	44.0	39.0

High but Declining Share of Food Expenditure in Total Expenditure

The experience of all countries along withSouth Asian countries during the last 25 years manifests that there was a limitation in share of food expenditure in total income. This decline in share of food expenditure indicates the Engel's Law which states that the higher the income of a household, the lower the proportion of income spent on food. Due to insufficient income data, this indicator has been built as the ratio between food consumption and total consumption, hence using total consumption as a proxy income. Given the higher vulnerability of the poorer households to food price increase, Food and Agriculture Organisation (FAO)reckoned the share of food expenditure to total expenditure for the lowest income quintile of a country population.

Proportion of food consumption over total consumption (food and non-food) for the lowest income quintile of the population and percapita GDP is given in Figure 4.GDP per capita isbased on Purchasing Power Parity (PPP). The graphical presentation depicts the share of expenditure on food decreased by 9.5% if percapita income increased by 100 $ in terms of PPP indicating that, in the low-income countries, the share of expenditure going to food is far higher.Hence, penurious section will be exposed to fluctuations in prices, if we don't have food security provisions and other social safety nets in-built in the government programmes. Given that the declining share of the food expenditure due to demonstration effect and increasing expenditure on non-food items like mobile phones, TVs, two-wheelers,there was a possibility of increase in undernourishment and malnutrition among poorer sections of the society especially poor countries. Under these circumstances, it may be better to provide subsidised food rather than the money transfer to maintain food security at household level.

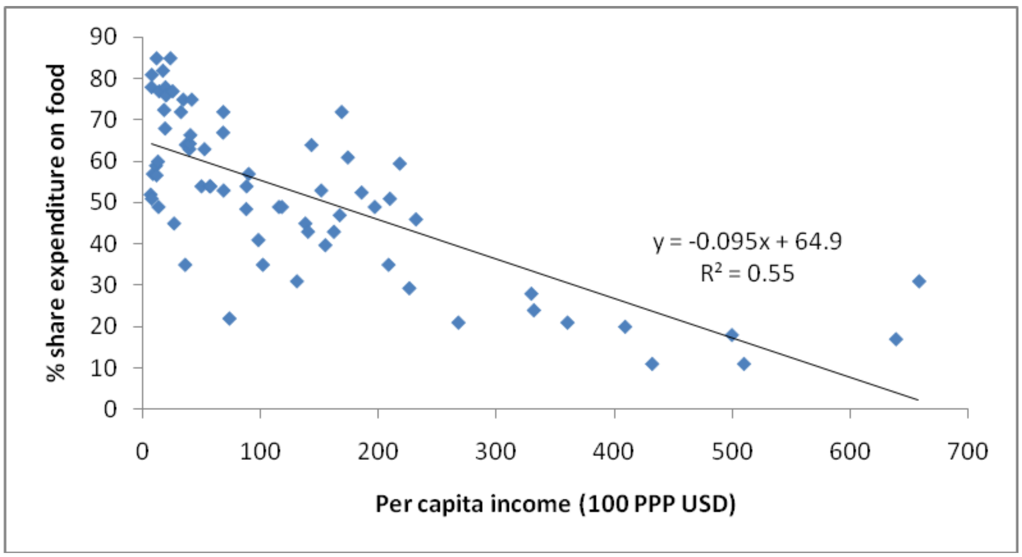

Figure 4: % food expenditure and per capita income across countries

CONCLUSIONS

South Asia is known for its largest population of undernourished, malnourished children and higher levels of anaemia among women. Although GDP growth rates are high, still most of the poor in these countries are not able to afford nutritious food. The study examined the progress of South Asian countries in food and nutritional indicators from 1990 to 2015 with the goal to assess how different countries meet targets under MDGs in food and nutritional security by using FAO food security indicators. We have examined the food indicators under food availability, access, stability and utilisation categories. The FAO food and nutrition indicators are good indicators for the year-to-year cross comparison of the countries position in food and nutrition security. However, they are not substitutes for the comprehensive National Sample Survey Organisation (NSSO) consumption surveys. They can only complement the NSSO consumption data.

Even though under the MDGs, each country has to reduce its undernourished population by half by 2015 from base year of 1990, South Asia as a region and most of the countries failed to reach this target. Even the MDG goal of half of the population without access to drinking water and sanitation by 2015 from 1990, level is also not achieved by many countries. The countries like Iran and Sri Lanka performed better than other countries. Although Afghanistan, Nepal and Pakistan performed worst in most of the MDGs, India's performance was better in some indicators like food availability and access, but worst in utilisation indicators. Food stability indicators are far better in India compared with other countries mainly due to the price stabilisation policies and government procurement and distribution of major food grains like rice and wheat under Food Security Act through widely networked public distribution system(Chand, 2010; IRADE, 2007, Reddy, 2015). Still anaemia among pregnant women and stunting among children are major problems in all South Asian countries which need to be addressed through policy intervention.

The lower increase in food price index in India is an indicator of increase in competitiveness of food products especially cereals including rice and wheat in India compared withthe world. However, the increase in prices of protein-rich food like pulses and animal sources of protein is a cause of concern and needs to be addressed through policy intervention (Narayanan, 2014). The recent increase in minimum support rice (MSP) of pulses and policies to import contract for pigeonpea with Myanmar and Mozambique is right policy intervention to reduce prices of protein-rich pulses. The experience of achievements in MDGs will be helpful in planning for sustainable development goals with more focus on undernourishment, stunting among children and anaemia among women especially in those countries like Afghanistan which are lagging in the race.

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Agrarian Economy of Telangana

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Abstract

The paper examined the agricultural sector growth in Telangana from the last two decades by using various government reports and statistical abstracts of the Telangana state. Telangana agricultural sector is in a transition from cereal based cropping systems to commercial crops based cropping systems with larger contribution from fruits and vegetables and commercial crops like cotton and soybean. The commercialization of agriculture resulted in high input-high output-high risk for which many small and marginal farmers are not able to cope with and ultimately end up in huge debt with higher cost of production in agricultural sector. Livestock sector growth is also significant, now its contribution is equal to crop sector to gross state domestic product. Telangana agriculture is dominated by small and marginal farmers, whose income from agriculture and allied activities is meager, resulted in most of them shifted to agricultural labourer during the past decade. The number of cultivator's decreased and agricultural labourer increased during the past and this change is more among women. Farm mechanization increased

in the recent years, resulted in increased scale economies with small farmers getting less profit compared to large farmers per unit area. The real problem is as the farm incomes reduced, there was no increase in alternative income sources in rural areas for the farming community. Although many agricultural households engaged in multiple activities like casual labourer, non-farm incomes, but the actual income share from these sources is very limited in Telangana compared to Andhra Pradesh and All-India.Small and marginal farmers profitability was adversely effected by the rapid spread of farm mechanization, hence there was a need for special programmes to support small farmers' incomes on a long term basis. The input costs are increasing more than gross returns, resulted in decrease in profitability. There was a need for strengthening custom hiring centres in all the villages for easy availability of modern tools and farm equipment to the farmers. The tenant farmers are especially at risk in the event of yield loss or output price reduction, as they have to pay tenancy fee of about 30% of the average farm returns, even though their yields are lower than average. Hence there was an urgent need for addressing the tenancy farmer's problems through institutional innovations and subsidy programmes. In policy front to facilitate this diversification of agricultural sector, state government should focus on increasing irrigation facilities, providing veterinary services through livestock service centres and rural service centres for promoting overall development of the rural economy to create employment in not only agriculture, but also in off-farm and non-farm activities. However, in this transition period farmers income may fluctuate widely, hence there was a need for price support and crop and livestock insurance for every farmer in Telangana irrespective of the farm size.

Introduction

The Telangana state is a newly formed state and majority of the rural population depends on agriculture in the state. About 86% of the farmers are small and marginal with very limited asset base, their costs are increased but the increase in returns are much below the increase in costs, resulted in reduction in the net returns, increase in indebtedness and farm distress. The cost structure ofcrops is in a transition stage from the subsistence to commercial agricultural with rapid mechanisation, more dependent on casual labourer and hired services in most of the agricultural operations staring from land preparation to harvest(Reddy and Bantilan, 2012 and Radhakrishna Report on Andhra Pradesh). Although paddy is a major crop, diversification towards cotton and horticultural crops (now horticulture contributes to 40% of the total agricultural value of production) and livestockis playing a significant role in agricultural growth of the state. The recent structural changes with high demand push to high value crops like horticultural crops, meat, milk and other animal products is the driving force behind the rapid changes in Telangana agriculture. Keeping this, the paper examined changes in the farmers situation not only in crop sector but also in horticulture and livestock sector to understand the impact of changes in the agrarian economy on farmers' incomes and livelihoods in Telangana. The specific objectives of the paper are:

1. To understand the macro-level changes in agrarian economy of Telangana state
2. To analyse the growth in crop and livestock sector and also changes in input composition at district level over the past decade;
3. To map out the strategies for achieving inclusive and sustainable agriculture growth in Andhra Pradesh

Methodology

The data was collected from various government statistical publications. Mainly season and crop reports of Directorate of Economics and Statistics, and Statistical Abstract of Government of Andhra Pradesh and Situation Assessment Survey of National Sample Survey Organisation have been used. The data for the study mainly covers from 1990 to 2015-16 depending on the availability on the various parameters. This study covers changes in land use pattern, farmer's situation in terms of sources of incomes, crop returns and indebtedness. The study also covers trends in production of food crops, non-food crops, horticultural crops and livestock products. Recently, there is faster growth in area under fruits, vegetables, palm oil, spices and other high value crops, the extent of spread of area and its implications on farmer's incomes were examined. It is also projected that the future growth of these crops will be higher than that of the traditional crops. Hence, this study pool together the data on fruits, vegetables and other high value crops to cover the entire agriculture sector in the state.All the ten districts were considered while analysing major indicators of development and agrarian change including land use pattern, area, production and yield and gross value of output. The data pertaining to the districts of Rangareddy and Hyderabad were pooled and presented under Ranga Reddy district for some variable wherever the data was a time series spanning from 1970s.

Results

Telangana state is predominantly rural with 61.12% of the population lives in rural areas and mostly depends on agriculture. In the state, share of agricultural sector in State Gross Domestic Product (SGDP) was 13%, while share of services was 61% and the remaining 22.5% was contributed by industry. The crop sector and livestock contribution is equal at5.9% of SGDP each. Within crop sector horticulture contributes to 40%. Small and marginal farmers share was 86% in total cultivators, their incomes are meagre from crop sector, hence there was a proletarianization of small farmers in the last decade in addition to feminization of agriculture. Agricultural holders engaged in multiple activities, but they are not getting a minimum reasonable income from agriculture and also not able to get sufficient income from alternative sources like non-farm sector or labour. This resulted in distress and indebtedness of agricultural holders. The area under high yielding varieties reached saturation in crops like maize, paddy and cotton, yet in some crops adoption of high yielding varieties islagging behind.Increase in area under cotton, maize, fruits, vegetables andsoybean contributed to high agricultural growth. Although share of horticultural crops in area was about 13% of cropped area, its contribution to agricultural GDP was 40%, hence providing more income to farmers. The growth in the value productivity is faster in horticulture compared to field crops. Therefore, with a view to enhance the farmers income, the horticultural sector needs more attention. There is high growth of small ruminants like sheep and goat in the state. The momentum acquired by the state with respect to the livestock growth need to be continued. The farmers need to be provided with adequate credit facilities to start new livestock enterprises.Agricultural growth is uneven across the districts. The districts like Adilabadneed special attention to improve infrastructure including irrigation and development of input and output markets. In thedistrict, there is a need to strengthen agricultural allied activities like agricultural research and extension to take advantage of suitable soil and plenty of rainwater and climatic conditions.In Mahbubnagar, frequent droughts are a majorproblem in increasing agricultural productivity and incomes. In this district livestock based agriculture like sheep and goat rearing needs to be encouraged. There is a need for wider adoption of micro-irrigation and effective implementation and development of watershed programmes and early completion of ongoing irrigation projectsfor increasing area under irrigation to increase productivity.Encouragement for crop diversification towards high value crops like soybean, maize, fruits, vegetables, palm oil, cotton, red chillies and other spices to increase the value of production to maximise profitability per hectare is necessary, but needs support in terms of price stabilisation from government.Pulses (especially chickpeas, urad and moong) and oilseeds (soybean and sunflower) have the potential to increase farmers' income under rainfed areas especially in rice fallows. Adilabad and Mahbubnagardistricts are lagging in the adoption of inputs like fertilizer. Hence special emphasis is required and incentives must be provided to increase modern input use to enhance crop yields.Conservation of natural resources is critical for growth of Telangana agriculture. The moisture availability was the most critical factor that determined the farm productivity. Therefore, every effort should be taken to promote water conservation. Renovation of tanks under Kakatiya Mission is showing results on the ground and also watershed approach needs to be promoted with right spirit. Irrigation development in the state is spearheaded by bore well irrigation. Excessive digging of borewells is leading to issues of un-sustainability. Small farmers will be adversely effected by the indiscriminate deepening of wells, which is capital intensive. This is leading to issues of inequality in accessing irrigation water. Therefore, cultivation of water intensive crops in those regions with severe limitation of water needs to be discouraged. Appropriate regional crop planning taking into consideration the resource constraints are the need of the hour. Micro-irrigation helps to use irrigation water more efficiently. Given the high priority accorded by the central government in promotion of drip and sprinkler irrigation, the state need to accord top priority in popularising it. This would help in growth of horticulture sector as well. Lack of availability of quality inputs, notably seeds through public sector to counter the monopoly of private sector is critical in ensuring agricultural growth in the state. Awareness and utilization of funds under Prime Minister KishiSinchayiYojana(PMKSY) and Prime Minister FasalBhimaYojana(PMFBY) and RastriyaKrishiVikasYojana(RKVY) needs to be given top priority. In the context of climate variability, often resulting in drought conditions, farmers need to be provided with adequate crop insurance. The experience suggests that the lack of timely disbursal of insurance claim discourage farmers from its adoption. Therefore, the existing insurance schemes needs to be examined for farmers' friendliness, and tuned to the requirement of the farmers.

Telangana macro-economic trends

The gross state domestic product increased significantly over the last ten years from 2004-05 to 2015-16 from 90 thousand crores to 237 crores in constant prices. The share of agriculture in Gross State Domestic Product (GSDP) of Telangana was reduced to 13% in 2015-16 (Table 1).Year-to-year growth in GSDP is erratic. The declining share of agriculture is a good sign, if the growth in employment intensive secondary sector absorbs surplus labour. But the growth in employment in the rural non-farm sector is subdued to absorb the labour released from agricultural sector.

Table 1.Share of agriculture in GSDP of Telangana

Sector	2004-5	2005-6	2006-7	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Share of agril.	18	19	17	15	16	17	17	15	13

GSDP (Rs.1000 Crore)	90	104	116	174	189	197	206	217	237
Year-on-year growth		15.9	11.6	18	8.7	4.1	4.8	5.3	9.2

Source: Socio-Economic Outlook, 2015; GSDP is at constant prices of 2004-05

The declining share of agriculture is also accompanied by a structural shift within agricultural sector. Share of crop sector was decreased from 9.6% of GSDP in 2011-12 to 5.9% of GSDP in 2015-16 mainly driven by the declining area under food crops with simultaneous increase in area under horticultural and commercial crops like cotton. Now horticulture contributes to about 40% of the crop sector (Table 2). In year 2015-16 livestock sector contribution is equal to that of crop sector (5.9% of the GSDP) mostly driven by the increase in demand for goat and sheep meat, poultry and milk products. During the drought year's(2014-15 and 2015-16) crop sectors contribution is drastically reduced, but livestock and fisheries sector contribution is stable or increased. Given that the Telangana agriculture is mostly dependent on monsoons, it is advisable to encourage livestock farming by the farmers not only to adopt and mitigate the impact of the bad monsoons but also to create employment among small and marginal farmers and also agricultural labourer. Performance of tertiary sector is much better and stable with year-on-year growth never below seven percent from 2012-13. Now the tertiary sector contributing to about 60.5% of GSDP, but it is not a major employment provider for the persons who are withdrawing from agricultural sector as it is more skill intensive with less number of jobs. The secondary sector growth is subdued, but better than the agricultural sector and now it contributing to about 22.5 % of the GSDP. Within secondary sector construction sector contributed higher share followed by manufacturing.

Table 2. Contribution of sub-sectors to agricultural GSDP

	% share in GSDP					Growth (%)			
Sector	2011-12	2012-13	2013-14	2014-15	2015-16	2012-13	2013-14	2014-15	2015-16
Crops	9.6	10.3	9.8	7.8	5.9	8.0	1.7	-14.2	-18.2
Livestock	5.6	5.9	5.7	5.7	5.9	8.0	2.3	8.2	12.2
Forestry	0.6	0.6	0.5	0.5	0.4	-0.6	-2.5	1.4	-2.7
Fishing	0.4	0.5	0.5	0.5	0.6	10.4	14.4	8.5	17.8
Agril. and allied	16.1	17.2	16.5	14.5	12.9	8.8	2.1	-5.3	-4.5
Secondary	27.3	23.5	23.2	22.4	22.5	-12.2	4.8	3.8	8.6
Tertiary	52.5	55.2	56.6	58.9	60.5	7.7	8.9	11.8	11.0
All	100	100	100	100	100	2.3	6.2	7.5	8.1

Source: Socio-Economic Outlook, 2015-16, Telangana

Average rainfall of Telangana state was 907, which is lower than the national average and not sufficient to fill all the tanks and rivers flowing from the state. Rainfall in Adilabad, Khammam and Nizamabad is above 1000 mm, but Mahbubnagar and Nalgonda experience savior shortage of rainfall year after year.

The low and erratic rainfall in Telangana is a major hindrance for agricultural growth in the state which effected badly agricultural growth in 2014-15 and 2015-16.

Population trends

Total population Telangana is 350 lakhs as per census 2011, of which rural population is 214(61%) (Table 3). Population growth was peaked between 1971 and 1991 with a decadal growth of 28 to 29 %, but after that it reduced to 19% between 1991 and 2001 and further reduced to 14% between 2001 and 2011. Share of rural population continuously decreased from 81% in 1961 to 70% by 1991, to 68% by 2001 and 61% by 2011. Steepest decline in share of rural population was observed between 2001 and 2011.

Until 2001, the decadal growth rate of cultivators increased. But between 2001 and 2011 the growth rate was negative, and absolute number of cultivators declined from 33 lakh in 2001 to 30 lakh in 2011, while agricultural labourer increased significantly from 32 lakh to 46 lakh a largest increase in agricultural labourer. In absolute numbers, overall personsemgaged in agriculture (cultivators plus agricultural labourer) increased from 65 lakh in 2001 to 76 lakh in 2011, inspite of its steep decline in contribution of GSDP, resulted in increase in concentration of poverty in agricultural sector.

Table 3.Population dependent on agriculture

Year	Total population (in lakhs)	Growth Rate	Rural Population(lakh)	Cultivators (lakh)	Agricultural labourer	Total (cultivators and agricultural labourer)
1951	108		85 (79%)	38	16	55
1961	127	18	103(81%)	29	17	46
1971	158	24	125(79%)	24	22	46
1981	202	28	151(75%)	31	28	59
1991	261	29	182(70%)	34	40	74
2001	310	19	211(68%)	33	32	65
2011	350	14	214(61%)	30	46	76

Source: Socio-Economic Situation Outlook, 2016

Table 4.District level indicators

District	Average growth rate of GDDP from 2005-06 to 2013-14	Percapita income in 2014-15	Urbanization (%) in 2011	% increase in urban population between 2001 and 2011	% change in rural population between 2001 and 2011	Share of agriculture in DDP in 2003-04		
						crop	livestock	Agriculture
Adilabad	5.9	76,921	28	16	8.7	20	4	24
Hyderabad	10.0	2,94,220	83*	38*	-3.7*			

Karimnagar	9.3	90,184	25	40	1.0	17	6	23
Khammam	8.0	1,02,919	23	29	4.1	15	6	21
Mahbubnagar	10.1	80,121	15	64	9.9	16	11	26
Medak	12.0	1,21,639	24	89	1.2	12	7	19
Nalgonda	10.4	1,14,353	19	54	0.6	14	8	22
Nizamabad	9.4	78,828	23	39	2.2	13	4	17
Rangareddy	12.3	1,80,039				4	10	14
Warangal	8.0	81,221	28	60	-3.5	22	5	27
Telangana		1,29,182	39	41	2.4			

Source: Statistical Abstracts, Telangana *Hyderabad included Rangareddy

The percapita DDP was much higher in urban centres like Hyderabad (Rs.2,94,220/-) and Rangareddy(Rs.1,80,039/-) compared to state average of Rs. 1,29,182 in year 2014-15 (Table 4). The lowest percapita income was in Adilabad(Rs.76,921/-), Nizamabad(Rs.78,828/-), Mahbubnagar(Rs.80,121/-), Warangal(Rs.81,221/-) and Karimnagar(Rs.90,184/-). During the last decade growth rate in GDDP was highest in districts around Hyderabad like Rangareddy, Madak, Nalgonda, with growth rates were less in faraway districts from Hyderabad like Adilabad, Khammam and Warangal. It shows that there was a some backwash effect with the development of Hyderabad, which is absorbingskilled manpower and capital from distant districts which is also visible from the migration from the distant rural centres to urban centres mainly to Hyderabad. DDP growth rates were also lower in the districts with larger share of agriculture and less urbanization likeMahabubnagar in spite of nearness to Hyderabad.

Between 2001 and 2011, rural population increased by just 2.4%, where as urban population increased by 41%. This trend is similar in all districts, with Warangal recorded a negative growth which indicating the attractiveness of urban migration and distress situations in rural areas across all districts.

Historically, in Telangana agriculture played a significant role, however its share in GSDP is gradually reduced to just 12-13% in the recent years. Now service sector contributing to up to 61% of GSDP. Within agricultural sector share of livestock was increased and now contributes to about 44% of agricultural and allied sectors.

Employment situation in the state

Labour force participation was 66.8% in the state in 2013-14 (table 5). It was much higher in rural (75.7%) than in urban areas (51.8%). Worker participation rate also shows similar trends. As expected unemployment rate was higher at 6.6% in urban areas, while in rural areas only 1.1 % are unemployed. In the state 55.6% of workers contributing to only 16.5% of state GDP, indicates that there was a lot of productivity gap between agriculture and non-agricultural sectors. This gap can only be reduced with shift in labour from agriculture to non-agricultural sector. In the rural areas agriculture contributing to 74.2% of employment and in urban areas it contributes to 6.9%. Low unemployment rates in rural areas mostly indicates that the rural poor cannot afford to be unemployed as it shown from low percapita incomes; they take up whatever the work available even at very low wage rates and work conditions to meet their daily needs.

Table 5.Sector wise employment in telangana in 2013-14

Sector /status	Rural	Urban	Total
Labour force participation rate (LFPR)	75.7	51.8	66.8
Worker population rate (WPR)	74.8	48.4	65.0
Unemployment rate	1.1	6.6	2.7
Agriculture and allied	74.2	6.9	55.6
Industry	12.9	30.8	17.8
Services	12.9	62.3	26.6

Source: NSSO 70th round

The district wise work participation shows that there was a much inter-district differences in WPR, with more urbanized districts with low WPR and rural districts showing higher WPR (Table 6). Overall there was a slight increase in WPR from 46% to 47% between 2001 and 2011. The growth is more in Hyderabad and Adilabad and negative in Mahbubnagar and Medak.

Table 6.Work participation rate (%)

	Work Participation Rate		
District	2001	2011	% change
Adilabad	45	48	3.1
Hyderabad	29	36	6.6
Karimnagar	49	50	0.7
Khammam	48	50	2.2
Mahbubnagar	52	51	-0.5
Medak	48	48	-0.9
Nalgonda	49	50	0.8
Nizamabad	49	49	0.0
Rangareddy	40	41	1.3
Warangal	48	49	0.3

Telangana	46	47	1.4

Source: Population Census, 2001 and 2011

Table 7.Number of cultivators and agricultural labourer in lakhs (2011)

District	Cultivators			Agrillabour			Cultivators plus agricultural labourer			Ratio of labour to cultivator
	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	
Adilabad	3.6	2.3	1.3	4.9	2.1	2.7	8.5	4.4	4.1	1.4
Karimnagar	3.6	2.3	1.3	7.6	3.4	4.2	11.2	5.7	5.5	2.1
Khammam	2.3	1.5	0.7	8.1	3.6	4.4	10.3	5.1	5.2	3.5
Mahabubnagar	5.7	3.6	2.1	9.3	3.7	5.6	15.0	7.3	7.7	1.6
Medak	3.5	2.2	1.3	5.7	2.5	3.2	9.2	4.8	4.5	1.6
Nalgonda	3.3	2.2	1.1	8.6	3.5	5.2	11.9	5.7	6.2	2.6
Nizamabad	2.8	1.8	1.0	4.5	2.3	2.2	7.3	4.0	3.3	1.6
Rangareddy	3.0	1.9	1.1	3.7	1.6	2.1	6.7	3.5	3.2	1.2
Warangal	4.0	2.6	1.5	7.6	2.9	4.6	11.6	5.5	6.1	1.9
Telangana	31.8	20.3	11.5	59.9	25.7	34.2	91.7	45.9	45.7	1.9

Source: Population census, 2011

Table 7 presents district wise composition of cultivators and agricultural labourers. As per the population census 2011, there were 91.7 lakh main workers dependent on agriculture in the state, out of which 45.9 workers are male and another 45.7 were female workers(Table 7). There were 31.8 lakh cultivators and 59.9 lakh agricultural labourer. Number of male cultivators (20.3 lakh) was higher than female cultivators (11.5 lakh). But number of agricultural labourer were higher among females (34.2 lakh) compared to men (only 25.7 lakh). Population dependent on agriculture was higher in Mahbubnagar(15 lakh) followed by Nalgonda (11.9 lakh), Warangal(11.6 lakh), Karimnagar(11.2 lakh) and Khammam(10.3 lakh). Lowest population dependent on agriculture were in Rangareddy (6.7 lakh), Nizamabad(7.3 lakh), Adilabad(8.5 lakh) and Medak (9.2 lakh). Khammam, Nalgonda and Karimnagar does have higher agricultural labour to cultivator ratio(more than two: two labourer for each cultivator), indicating unequal distribution of land holdings in these districts as against low labour cultivator ratio in Ranga Reddy(1.2) and Adilabad(1.4). Higher labour to cultivator ratio among women(3.0) compared to men (1.3) indicating the feminization of agricultural labour. Again Khammam, Nalgonda and Karimnagar were having more than 3 labourer for one cultivator among women.

Table 8. Increase in cultivators and agricultural labourers between 2001 and 2011

District	% change in absolute numbers in cultivators and labourers in 2011 over 2001								
	Cultivators			Agricultural labour			Cultivators plus agricultural labourer		
	Persons	Male	Female	persons	Male	Female	Persons	Male	Female

Adilabad	5	4	7	42	45	39	23	21	27
Karimnagar	-19	-18	-20	30	38	24	9	8	9
Khammam	-21	-22	-20	32	34	30	15	11	20
Mahabubnagar	2	-1	9	20	28	15	13	12	13
Medak	-10	-12	-7	19	24	15	6	4	8
Nalgonda	-21	-20	-23	29	40	22	10	9	11
Nizamabad	-12	-13	-11	31	37	26	10	10	11
Ranga Reddy	6	5	7	26	39	17	16	19	13
Warangal	-13	-13	-14	25	29	23	9	5	12
Telangana	-9	-10	-8	27	34	23	12	10	13

There was reduction in cultivators (9% reduction), but increase in agricultural labourer(27% increase) between 2001 and 2011, indicating proletarianization of cultivators in Telangana. Overall, there was increase in persons dependent on agriculture between 2001 and 2011, but there was significant structural change towards feminization and casualization of agricultural sector (table 8). Persons dependent on agriculture increased by 12%, the increase was higher among women (13%) then among men (only 10%). The largest decrease in cultivators was in Nalgonda (21%), Khammam (21%) and Karimnagar(19%). The largest increase in agricultural labourer was in Adilabad(42%), Khammam(32%) and Nizamabad(31%). These three districts also reported the largest increase in female labourer. The above figures indicate that there was a clear trend of proleterisation of cultivators during the past decade and also feminization of agricultural labourer.

Table 9.Share of number of small and marginal farmers (% to total farmers)

	1971			1991			2011			
District	Marginal	Small	Small and marginal farmers	Marginal	Small	Small and marginal farmers	Marginal	Small	Small and marginal farmers	Average land holding size (ha)
Adilabad	31	17	48	43	22	65	50	28	78	1.40
Karimnagar	54	17	71	61	21	82	67	22	89	0.96
Khammam	34	21	55	47	25	72	62	23	85	1.14
Mahaboobnagar	21	17	38	41	24	65	58	25	83	1.23
Medak	41	22	63	55	23	78	68	22	90	0.97
Nalgonda	31	19	50	46	23	69	59	25	84	1.19
Nizamabad	52	20	72	61	21	82	67	24	91	0.92
Rangareddy	26	20	46	42	24	66	58	26	84	1.22

Warangal	47	20	67	56	24	80	67	21	88	1.01
Telangana	39	19	58	51	23	74	62	24	86	1.12

Since 1970s, the share of small and marginal farmers was increasedin the total cultivators (Table 9). Now, in Telangana 86% of the farmers are small and marginal based on 2011 census data. Share of marginal farmers was increased from 39% from 1970 to 62% in 2011. And the average land holding is just 1.12 hectares. This also explains the above argument of shifting from cultivation to agricultural labourer. Share of small and marginal farmers is highest in Nizamabad(91%) followed by Medak(90%), Karimnagar(89%) and Warangal(88%). Whereas the share was less in Adilabad (78%), Mahabubnagar(83%),Nalgonda(84%), Rangareddy(84%) and Khammam (85%). Less share of small and marginal farmers in Adilabad explain the increase in dependence as cultivators to some extent.

Table 10.Area share of small and marginal farmers

	1971			1991			2011		
District	Marginal	Small	small and marginal	Marginal	Small	small and marginal	Marginal	Small	small and marginal
Adilabad	4	7	11	10	17	27	17	28	45
Hyderabad	3	7	10	9	15	24	24	29	53
Karimnagar	10	12	22	21	23	43	31	32	63
Khammam	6	11	16	13	20	33	26	28	53
Mahabubnagar	2	5	7	10	16	25	22	29	51
Medak	7	12	19	16	20	36	30	31	61
Nalgonda	4	8	12	11	16	27	23	30	53
Nizamabad	11	14	25	21	23	43	34	36	70
Warangal	8	12	20	19	25	43	29	30	58
Telangana	6	9	14	14	19	32	25	30	55

Although 86% of the farmers are small and marginal, their share in cultivated land was only 55% in 2011. Marginal farmers share in total number of farmers was 62%, but their share in cultivated land was only 25%(Table 10). %). Small and marginal framers cultivate more than 60% of area in Nizamabad(70% of cultivated area), Karimnagar(63% of area) and Medak(61%). While in Adilabad and Mahabubnagar their share is less than the state average. The area share of small and marginal farmers increased from 14% to 32% between 1971 and 1991 and further to 55% by 2011.

Changing relationship between Farm size and profitability

Given that 86% of the farmers are small and marginal farmers, it is important to see the profitability of small farmers in the recent years. We have presented the cost of cultivation and returns in table 11 for the year 2013-14. The results show that there was a tendency of increasing profitability with the increase in farm size among all crops in Telangana. This is mainly due to rapid adoption of cheaper farm machinery in the large farms to replace the human and bullock labour which is becoming costly and scarce in the recent years. Although there was no systematic relationship between farm size and productivity, there was a significant inverse relationship between farm size and cost of cultivation, resulted in increased profitability on large farms. This is a disturbing trend and increased distress among small and marginal farmers. From the above analysis it is clear that small and marginal farmer's income are too minuscule from their crops, so they have to depend on non-farm sources of income to sustain their livelihoods.

Table 11. Farm size and profitability relationship (20013-14) for Telangana state (per hectare)

Crop	Farm size group	Yield (qtl)	Cost (Rs.)	Gross Return (Rs.)	Net return (Rs.)	Fertilizer (kg)	Labour (days)	Animal labour (days)	Machine labour (hours)
	Small	16	68271	66948	-1323	220	1832	7	21
	Medium	15	65544	64444	-1100	225	2045	6	18
	Large	17	65321	70655	5334	229	2040	6	21
Cotton	All	16	66280	68111	1831	225	1977	6	20
	Small	57	65184	72228	7044	233	1455	6	16
	Medium	54	59170	69896	10725	219	1361	4	13
	Large	56	58671	71473	12802	208	1298	5	16
Maize	All	55	60441	71215	10774	217	1355	5	15
	Small	54	67744	76528	8785	237	1227	2	16
	Medium	55	65047	77767	12720	238	1050	2	14
	Large	56	62170	78083	15913	225	1128	1	17
Paddy	All	55	64614	77509	12895	232	1143	2	16

Source: Calculated from Cost of Cultivation Scheme unit data

An examination of the employment status of persons of agricultural households shows that other sources of employment and income are meager in Telangana compared to Andhra Pradesh and All-India(Table 12). Self-employed in non-agriculture (2.8%), casual labourer in public works(1.9%), casual labourer in non-agriculture (1.6%) and agriculture (1.2%) are some of the few activities in which persons of self-employed in agriculture engaged during the off-season.

Table 12. percentage distribution of persons who were self-employed in agriculture during July-Dec 2012 by principal status during Jan-Jun 2013 for Andhra Pradesh and Telangana

State	self employed		regular wage/ salaried employment		Casualwagelabour in public works	casual labour in		unemployed	out of labour force	all
	agriculture	non-agriculture	agriculture	non-agriculture		agriculture	non-agriculture			
Andhra pradesh	83.3	0.2	0.2	0.4	0.4	13.3	0.4	0	2	100
Telangana	91.4	2.8	0	0.2	1.9	1.2	1.6	0	1.4	100
All India	**84.9**	**1**	**0**	**0.5**	**0.8**	**4.2**	**3.1**	**0.3**	**5.2**	**100**

Source: NSSO 70th round

Table 13. Per 1000 distribution of agricultural household by major source of income during last 365 days for Andhra pradesh and Telangana state (2012-13)

State Number per 1000 agricultural households engaged in

	Cultivation	livestock	other agricultural activity	non-agricultural enterprises	wage/ salaried employment	others
AP	903	570	82	161	682	234
Telangana	974	519	65	123	575	293
All India	**926**	**719**	**74**	**147**	**495**	**191**
	per 1000 distribution of agricultural households by major source of income					
	Cultivation	livestock	other agricultural activity	non-agricultural enterprises	wage/ salaried employment	others
AP	592	46	16	35	280	31
Telangana	868	18	5	18	62	29
India	**635**	**37**	**11**	**47**	**220**	**51**

Source: NSSO 70th round

In Telangana, agricultural households engaged in multiple occupations, with majority in cultivation followed by livestock, wage/salaried employment(table 13). However, they are not getting significant income from these multiple sources as they may be engaged in these activities only for a few days or on temporary basis.

Agricultural households get Rs.6311 from all sources, of which major income share is from crop cultivation (Rs.4227), followed by wages(Rs.1450), rearing animals(Rs.374) and non-farm business (Rs.260)(table 14). However, income from labour and animal rearing was much higher among marginal farmers, while income from cultivation increased with farm size. Non-farm business income was higher among large farmers. However, even large farmers with more than 10 hectare area were getting average income of just Rs. 13,040.

Table 14. Average monthly income and consumption expenditure (Rs.) per agricultural household by farm size 2012-13

size class of land possessed (ha.)	income from wages	Net receipt from cultivation	net receipt from farming of animals	net receipt from non-farm business	total income	total consumption expenditure	Net investment in productive asset
< 0.01	1507	641	1390	549	4087	6646	-126
0.01 - 0.40	618	965	2186	28	3797	4324	343
0.410-01.00	1911	3147	167	184	5409	4688	718
1.01-2.00	1182	4390	464	254	6290	4917	220
2.01-4.00	1112	5970	-17	535	7600	5696	647
4.01-10.00	1861	11474	-326	31	13040	6781	760
10.00+	736	5307	1019	1531	8593	8507	1403
All size	1450	4227	374	260	6311	5061	546

Source: NSSO 70th round

Land use

Out of the total geographical area of 112 lakh ha, net cultivated area was 37.3%, current fallows 14%, other fallows 7.3%, forest covers 22.7% of area, area put to non-agricultural use 8%, barren and uncultivable land 5.4% and remaining 5.3% is cultivable waste, permanent pasture, and miscellaneous tress in 2015-16(Figure 1). Over the years, land put to non-agricultural uses increased at the cost of net cropped area and waste lands.

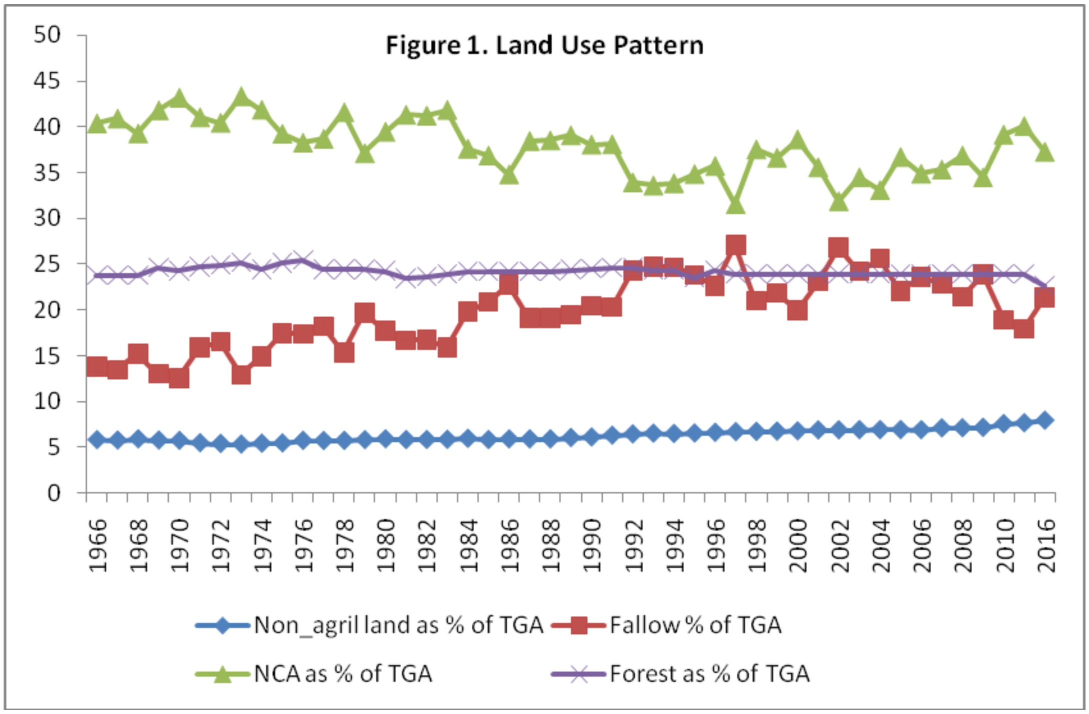


Table 15.Land use by district (2014-15)

District	forest area	barren and uncultivated area	non-agril. Use	cultivable waste	pasture land	tree crops	current fallow	other fallow	NCA	Total	Cropping Intensity
Adilabad	42.8	2.7	3.8	1.2	0.9	0.5	7.2	6.2	34.6	100	108
Rangareddy	9.8	3.6	15.1	3.4	4.2	0.8	20.2	12.3	30.6	100	111
Khammam	42.0	6.1	8.8	1.0	2.7	1.4	5.6	1.8	30.6	100	112
Mahabubnagar	13.9	4.8	5.4	1.5	1.0	0.4	16.3	9.8	47.0	100	113
Medak	9.4	5.4	7.8	1.9	3.0	0.4	17.8	5.5	48.7	100	117
Nalgonda	5.8	8.5	9.0	2.0	4.5	0.5	18.6	10.0	41.0	100	125
Warangal	28.9	4.0	5.6	0.9	3.5	3.8	7.5	9.9	35.8	100	129
Karimnagar	21.2	8.1	8.1	2.1	3.5	0.9	10.6	2.3	43.2	100	137
Nizamabad	21.3	5.9	12.3	1.6	2.5	0.2	12.3	7.5	36.5	100	155
Total	22.7	5.4	7.9	1.6	2.7	1.0	12.5	7.2	39.0	100	121

There were some inter-district variation in the land use pattern, share of net cropped area was more in Medak and Mahbubnagar, land put to non-agricultural uses was more in Rangareddy and Nizamabad (Table 15). Area under current fallows was higher in Rangareddy followed by Nalgonda, Medak, Mahabubnagar and Nizamabad. Area under other fallows also higher in these districts, indicating that the more and more farmers are putting the land under fallow due to various reasons including wealth effect due to increased land prices, erratic rainfall and labour shortage especially in districts like Rangareddy, Nalgonda and Medak which are near to Hyderabad. Cultivable waste was more in Rangareddy due to increased land prices and attraction to convert agricultural land for housing. Pasture land was more in Nalgonda and Rangareddy. Area under miscellaneous trees was more in Warangal district. Overall, cropping intensity in the state was 121%. Cropping intensity was more in Nizamabad(155%), Karimnagar(137%) and Warangal(129%) and less in Adilabad(108%), Rangareddy(111%). Forest land was higher in Adilabad and Khammam and less in Nalgonda and Medak. Barren and uncultivated land was more in Nalgonda and Karimnagar and less in Adilabad and Ranga Reddy.

Seasonal impact on cropped area

In the past decade, average cropped area in kharif season increased slightly from 35.3 lakh hectare to 39.6 lakh hectare, while in rabi season it was increased from 12 lakh hectares to 12.7 lakh hectare(Table 16). But coefficient of variation was also increased from 8.4% to 10.2% in kharif and 10.8% to 17.8% in rabi season. Indicating increase in variability in cropped areas in both rainy and post-rainy seasons due to climate change and increased erratic rainfall incidences.

Table 16.Season wise total cropped area (lakh hectare) 2015-16

Year	Kharif	Rabi	Year	Kharif	Rabi
1991	37.7	12.7	2004	35.9	10.8
1992	37.9	11.5	2005	34.2	9.9
1993	33.4	11.2	2006	38.2	13.0
1994	32.4	12.0	2007	35.3	13.1
1995	32.5	12.7	2008	36.3	13.9
1999	37.4	14.3	2012	44.2	12.9
2000	37.9	11.4	2013	44.5	12.4
2001	36.4	11.4	2014	46.4	16.0
2002	33.5	11.6	2015	41.8	11.4
2003	33.5	8.9	2016	40.9	8.1
Mean	35.3	12.0	Mean	39.6	12.7
CV	8.4	10.8	CV	10.2	17.8

Cropping pattern change

In the past decade there was an increase in share of area under non-food crops in total cropped area across all districts. The area under non-food crops increased from 26% in 2003-04 to 42% in 2014-15(Figure 2). It is mainly driven by the expansion of area under cotton due to the introduction of Bt cotton varieties and red chillies in some districts. The cotton area increased even in dry lands, farmers attracted for the huge returns due to cotton cultivation and expanded cotton area under irrigation by digging new bore wells to reap higher productivity. However, expanding area under Bt cotton and chillies also increased risk infarming to most of the small and marginal farmers. Cotton and chillies are high cost-high return-high risk crops, which brings in disaster for small and marginal farmers who did not have risk bearing ability.

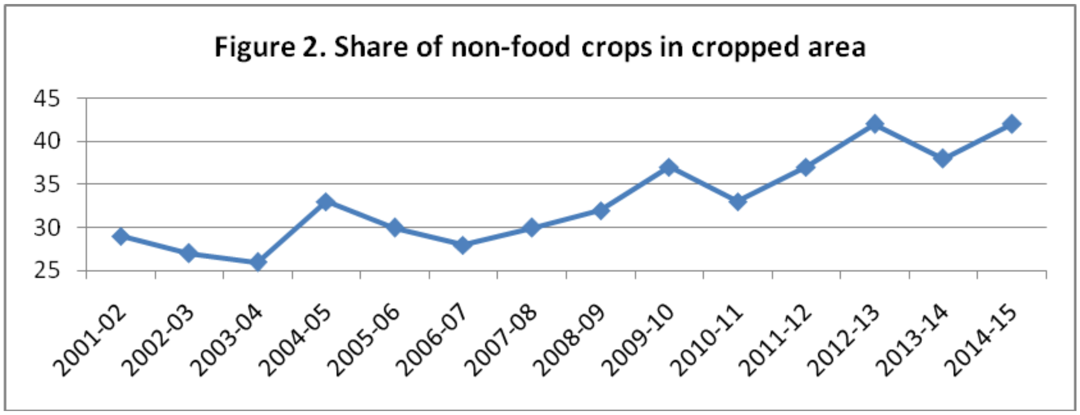


Figure 2. Share of non-food crops in cropped area

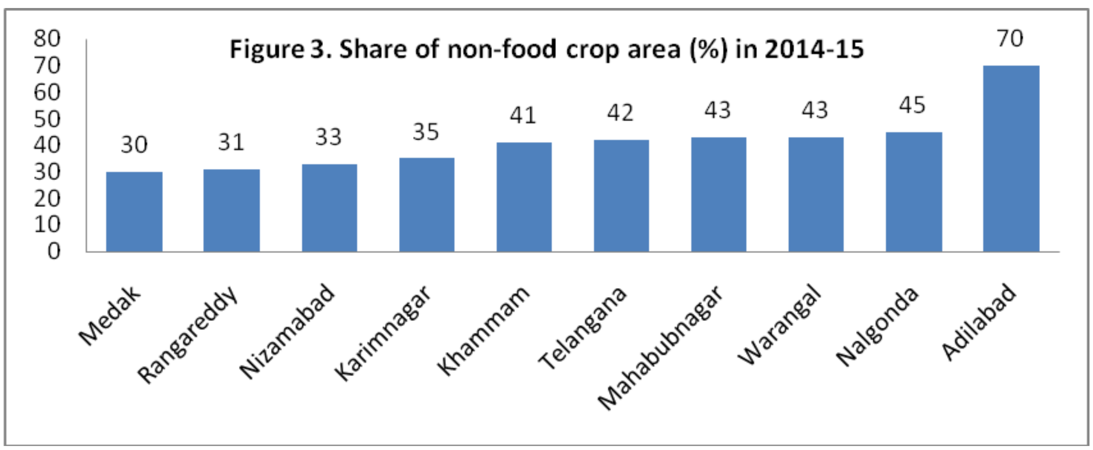


Figure 3. Share of non-food crop area (%) in 2014-15

Most of the irrigated-dry lands were converted to non-food crops (cotton, red chillies) during the past decade, mostly in districts like Adilabad, Nalgonda, Warangal and Mahabubnagar(Figure 3). However, farmers prefer to grow paddy wherever secured watersource is available from ponds and canals.

Table 17.Share of major crops in area by district (2015-16)

Crop	Adilabad	Nizamabad	Karimnagar	Medak	Rangareddy	Mahabubnagar	Nalgonda	Warangal	Khammam	Telangana	lakh ha	% to GCA
Rice	**4**	**16**	**17**	**9**	**6**	**7**	**19**	**10**	**14**	**100**	**16.0**	**27.9**
Maize	**3**	**11**	**13**	**19**	**16**	**16**	**0**	**15**	**6**	**100**	**8.0**	**14.0**
Reggram	16	2	1	11	33	28	6	3	1	100	2.5	4.4
Pulses	14	7	4	14	24	19	5	8	5	100	4.8	8.4
Food grain	**6**	**13**	**13**	**13**	**12**	**12**	**11**	**11**	**10**	**100**	**30.1**	**52.4**

Groundnut	1	1	5	0	12	48	10	18	5	100	1.4	2.4
Soybean	38	47	5	8	1	0	0	0	0	100	3.1	5.4
Oilseed	23	31	6	7	4	19	3	5	2	100	5.5	9.6
Chillies	2	2	5	1	2	8	5	32	45	100	0.9	1.5
Turmeric	14	33	18	4	15	0	0	16	0	100	0.6	1.0
Sugarcane	0	16	4	55	5	1	1	0	16	100	0.5	0.9
Mango	6	2	15	8	13	8	7	10	33	100	1.1	2.0
Cotton	**18**	**1**	**11**	**9**	**9**	**10**	**15**	**14**	**13**	**100**	**18.8**	**32.7**
Total	12	11	12	11	10	11	11	12	11	100	57.4	100

Cotton(33% of cropped area), paddy(28%) and maize(14%) are major crops in Telangana(Table 17). Major paddy growing districts are Nalgonda, Karimnagar, Nizamabad and Khammam. Major maize growing areas are Medak, RangaReddy, mahabubnagar and Warangal. Pulses occupy about 8.4% of the gross cropped area, predominant pulse crop is redgram with 4.4% of GCA. Food grains (cereals plus pulses) occupy about 52.4% of GCA, with higher share in Nizamabad, Karimnagar and Medak followed by Rangareddy and Mahbubnagar. Oilseeds occupy 9.6% of GCA, mainly contributed by newly introduced soybean(5.4%) and traditional groundnut (2.4%). Soybean area mostly concentrated in Nizamabad and Adilabad, while groundnut area was in Mahabubnagar and Warangal. Cotton is a major single crop occupying largest area in Telangana with 32.7% of GCA, its spread is uniform across the districts with larger share in Adilabad, Nalgonda and Warangal. Among spices, red chillies are prominent which occupy about 1.5 % of GCA, mostly in Khammam and Warangal. Commercial crops like turmeric were mostly concentrated in Nizamabad, Karimnagar and Warangal. Sugarcane was mostly grown in Medak, Nizamabad and Khammam. Mangos are mostly in Khammam and Karimnagar.

Table 18. Percent of difference in district yield compared to state average (2014-15)

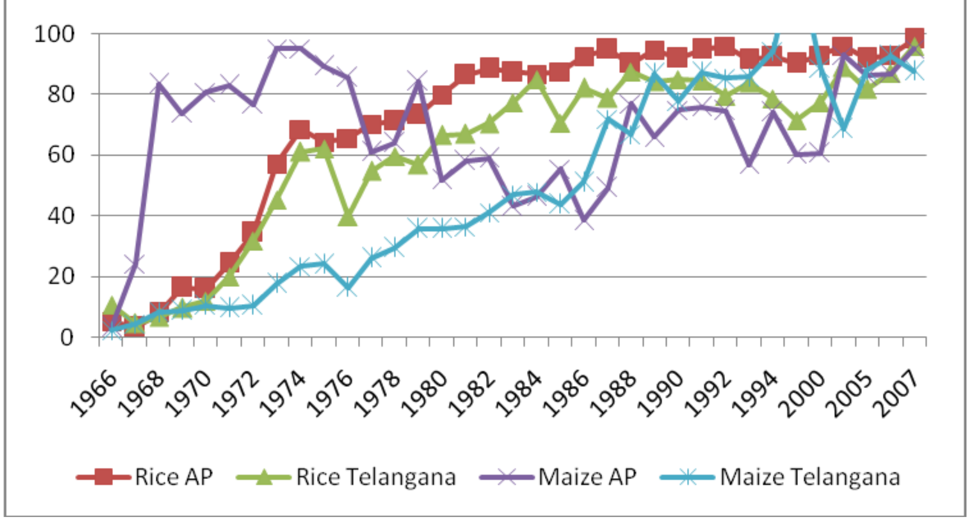
Crop	Adil abad	Nizamaba d	Karimnag ar	Meda k	Rangared dy	Mahabubnag ar	Nalgon da	Warang al	Khamma m	Telangan a (kg/ha)
Rice	-22	14	11	2	-19	-19	0	-4	-2	3211
Maize	-12	48	50	-47	-11	-43	-43	47	47	3338
Reggram	66	-47	46	-36	-19	-9	-4	3	5	495
Pulses	35	-3	24	-11	-17	3	-37	-12	-8	644
food grain	-38	28	38	-25	-28	-36	8	25	16	2763
Groundnut	0	49	8	-38	-16	7	-35	-5	-2	1907
Soybean	-23	27		-4		-7				1081
Oilseed	-43	-8	-17	-21	-7	6	-6	12	662*	1442
Chillies	-66	7	-23	-87	4	-1	-11	-14	24	3456

Turmeric	30	-24	26	-52	-31	0	1	1		4975
Sugarcane	-1	0	-8	3	-14	-6	-5		-5	8783
Mango	-54	0	14	0	0	-42	162	-28	-16	6055
Cotton	-11	-44	29	-17	-18	-18	-22	26	45	360#

*mainly due to palm oil;# lakh bales of 170 kg

Table 18 presents percentage difference in districts yield compared to average state yield. In paddy district average yields were more in Nizamabad (14% higher than state average) and Karimnagar and less in Adilabad(22% lower than state average), Rangareddy and Mahabubnagar(table 15). In maize yields were more in Karimnagar (50% more than state average) and Nizamabad, but less in Medak(47% lower than state average), Mahabubnagar and Rangareddy. In case of pulses yields were more in Adilabad(35% higher than state average) and Karimnagar, but less in Nalgonda(37% lower than state average) and Rangareddy. In case of redgram, yields were higher in Adilabad (66% higher) andKarimnagar but lower in Medak and Nizamabad. Overall, food grain yields were higher in Karimnagar, Nizamabad and Warangal, but lower in Adilabad and Mahabubnagar. Oilseeds and chillies yields were higher in Khammam, but lower Adilabad and Medak. Cotton yields were higher in Karimnagar, Khammam and Warangal, but lower in Nizamabad, Nalgonda, Rangareddy and Mahabubnagar. Overall, in Khammam, Karimnagar and Naziabad yields were higher for many crops while in Adilabad, Medak and Rangareddy yields were low. The inter-district differences in yields were very high in most of the crops, which can be reduced through adoption of improved technology especially in districts like Adilabad and Mahbubnagar.

Figure 4. % area under HYVs in rice and maize



The adoption rate of high yielding varieties was presented in figure 4. the HYV adoption was nearing saturation in most of the major crops like paddy, maize and cotton. Although adoption of HYVs started late in Telangana compared to Andhra Pradesh, it picked up in the recent years and now catch up with AP districts.

Table 19. Composition of horticultural crops in area and production (2015-16)

Horticultural crops	Area	Production
Fruits	54%	55%
Vegetables	22%	36%
Plantation crops	4%	1%
Spices	19%	8%
Flowers	1%	0.2%
Total	7.01 lakh ha	74.79 miliontonnes

Although share of horticulture area in gross cropped area was only 14%, it contributed to 40% of the crop value added in Telangana in 2015-16. As per the 1st Advanced Estimates, horticulture crops are grown in an area of 7.01 lakh hectares in 2015-16 producing about 74.79 MTs output(table 19). Of the total horticulture cultivated area, fruits constitute around 54.5%, followed by vegetables and spices with 22.2% and 19.1% respectively. Floriculture constitute about 0.4% ofarea under horticulture. Out of the total production of horticulture in 2015-16, fruits constitute around 55%followed by vegetables, spices and flowers with 36%, 8% and 0.2% respectively.Out of the total horticulture area, highest area is covered by mango 29%, followed by mosambi 19%. Amongvegetable crops, tomato and onion cover around 33% and 15% of the area respectively and 39 % and 16%of production under vegetable. Among spices, the turmeric and red chilli cover around 41% and 31% ofthe area and 55% and 20% of production respectively. Among flowers, marigold covers around 50% of thearea and 65% of production.

Table 20.Sources of irrigation (% of gross irrigated area)

Sl. No.	Source	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
1	Tanks	10.5	3.2	10.2	7.2	7.0	8.9	4.5
2	Canals	13.8	7.9	16.8	15.1	4.7	14.9	9.6
3	Wells	72.8	86.4	70.4	75.3	86.3	74.0	83.7
4	Other Sources	2.9	2.5	2.6	2.4	1.9	2.2	2.3
5	Total	100	100	100	100	100	100	100
	Area (lakh)	27.2	21.3	30.0	28.6	25.6	31.5	25.3

Overall, gross irrigated area was stagnant between 25.3 lakh ha and 31.5 lakh ha in Telangana(Table 20). The share of tanks is fluctuated widely between 3.2 % and 10.5 % as its irrigation capacity depends on mostly monsoons. Share of canals is showing declining trend from 13.8% in 2008-9 to 9.6% in 2014-15. Overall, share of wells increased from 72.8% in 2008-9 to 83.7% in 2014-15. Growing share of wells is not a good sign, given that the costs to farmers are huge and ground water table is declining du to over exploitation. It is to be noted that during the drought year of 2014-15, the gross irrigated area declined from 31.5 lakh ha in previous year to 25.3 lakh ha. During the drought year share of canals and tanks reduced with the increased share of wells, this burdens the farmers with additional investment during the drought years. This increases the distress among farmers during drought years.

Table 21.Sources of irrigation (2014-15)

			% of Net Irrigated Area				GIA*100/NIA	
District	Tanks	Canals	Tube wells	dug wells	other sources	total	Irrigation Intensity	NIA as % of NCA
Khammam	19	29	27	21	5	100	123	44
Rangareddy	1	1	94	2	4	100	133	28
Mahabubnagar	2	12	80	2	5	100	133	29
Adilabad	10	6	62	19	2	100	137	15
Warangal	6	3	41	49	1	100	137	60
Medak	1	1	93	5	1	100	148	31
Nalgonda	5	26	56	8	4	100	152	44
Karimnagar	6	Neg.	16	78	Neg.	100	159	62
Nizamabad	Neg.	7	91	Neg.	2	100	184	57
Total	6	10	55	27	3	100	146	39

Out of total net cropped area, only 39% was irrigated in Telanagana in year 2014-15(table 21). However, about 46% of net irrigated area was irrigated more than once, resulted in 146% irrigation intensity. The irrigation intensity was highest in Nizamabad (184%) followed by Karimnagar(159%)(Table 18). The irrigation intensity was less in Khammam (123%), followed by Rangareddy(133%) and Mahabubnagar(133%). The net irrigated area varies widely among districts from only 15% in Adilabad to 62% in Karimnagar. The share of irrigated area was highest in Karimnagar(62%), followed by Warangal(60%), Nizamabad(57%) and Khammam(44%). The least share of irrigated area was in Adilabad(15%), Rangareddy(28%) and Mahabubnagar(29%). In net irrigated area share of tube wells and dug wells together constitute 82%, canals contributes to 10% and remaining 6% contributed by tanks. The high dependence on wells needs to be reduced in the long run to reduce cost of cultivation in the state and to make agriculture profitable. Share of irrigated area through tanks was higher in Khammam and Adilabad, through canals was highest in Khammam, Nalgonda.

Table 22.Share of gross irrigated Area under major crops

Crops	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Rice	51	64	60	54	62	55

Maize	8	6	8	10	8	10
Total Pulses	1	1	1	1	1	1
Total Food grains	**62**	**72**	**69**	**65**	**72**	**67**
Chillies	4	2	3	3	2	3
Turmeric	2	2	2	2	2	2
Sugarcane	3	3	3	3	2	3
Total Food Crops	79	85	84	81	84	82
Non-Food Crops						
Groundnut	8	6	5	7	6	6
Total Oil Seeds	12	7	7	9	8	8
Cotton	8	7	8	9	7	8
Total Non Food Crops	21	15	16	19	16	18
Gross Area Irrigated	100	100	100	100	100	100

About 67% of the gross irrigated area of the state was devoted to food grain crops (including cereals and pulses), mainly paddy (55%) and maize (10%)(table 22). Pulses occupy only 1 % of gross irrigated area. Share of other food crops like chillies (3%), turmeric (2%), sugarcane(3%) also significant. Share of food crops in irrigated area was 82.3%. Among non-food crops, share of cotton (8%) followed by groundnut (6%) was significant. Share of oilseeds were only 8%. It shows that even though cotton, chillies, vegetables and fruits are major income earners their share in irrigated area was not high when compared to food grains. Hence there is a scope for increasing irrigated area under cotton, chillies, fruits and vegetables by replacing some of the irrigated area under paddy, especially in districts like Nalgonda and Mahbubnagar where water is scarce.

Table 23.Coverage under micro-irrigation

District	ground water net irrigated area (1000 ha)	% area covered under micro irrigation from 2003-04 to 2013-14 (ha)			
		Drip	Sprinkler	Total	Balance Potential Area
Adilabad	61	27	28	56	44
Mahabubnagar	205	39	15	54	46
Medak	131	36	15	51	49
Rangareddy	72	33	17	49	51
Nalgonda	186	41	5	47	53
Khammam	94	26	10	36	64
Nizamabad	170	15	4	19	81

Warangal	257	13	4	17	83
Karimnagar	311	9	3	12	88
Total	1486	24	8	32	68

Net irrigated area underground water was 1486 thousand hectares in Telangana. Only 32% of net irrigated area underground water was covered by either drip or sprinkler irrigation(Table 23). It indicates that still 68% of the area irrigated by ground water was not covered under micro-irrigation and in the coming future, there was a need for expand the micro-irrigation in these areas. Most of the area is in Karimnagar, Warangal, Mahabubnagar and Nalgonda. Spread of drip irrigation is more (24% of the ground water irrigated area) compared to only 8% by sprinklers. Unexplored potential area was much higher in Karimnagar(88% of ground water irrigated area) followed by Warangal (83%), Nizamabad(81%), Khammam(64%) and Nalgonda(53%).

Livestock

Livestock contributes to 5.9% of GSDP and its contribution is increasing year after year. Now contribution of livestock to GSDP is almost equal that of the crop sector(including agriculture and horticulture) in terms of value addition Except cattle population, population of all other species increased from 1987 to 2012(Table 24). There was a much higher growth in buffaloe compared to cattle population especially among female buffaloe. When compared to even female buffaloe, growth rate in sheep, goat and poultry are much higher. This is mainly due to increased demand for consumption of meat and milk as consumers income increased over the years.

Table 24.Livestock population since 1987 to 2012

Species	livestock population (in million)			% change over 1987
	1987	2003	2012	
Cattle	6.7	4.9	5.0	-25.0
adult female cattle	1.8	1.4	2.0	10.4
Buffaloes	2.9	3.8	4.2	45.5
adult female buffalo	1.4	2.0	2.8	102.2
Sheep	3.0	11.4	12.9	331.9
Goat	2.0	3.2	4.7	131.7
Total livestock	14.9	23.6	27.0	81.7
Poultry	16.7	40.6	69.2	313.6

Production of milk increased from 1.9 million tonnes in 2002 to 4.4 million tonnes by 2016, eggs also doubled from 6.1 billions to 11.2 billions, meat increased from 1.9 lakh tonnes to 5.4 lakh tonnes and wool increased from 3.0 million kg to 4.6 million kg during the same period(figure 5). Now Telangana has become hub for poultry activities in south India. Given the high potential of increasing demand for livestock products in the coming decades, there was a good potential to expand livestock production with semi-intensive production systems in the areas adjacent to urban centres and even in faraway rural areas with sufficient market and road infrastructure.

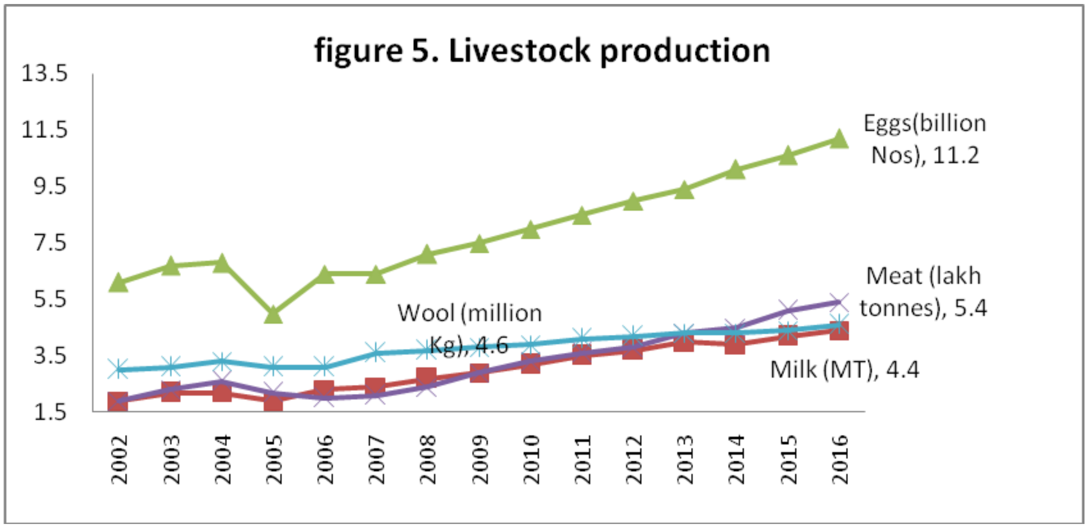


Table 25. District wise composition of livestock population, 2012

District	Cattle	Buffalo	Sheep and Goat	Poultry	Cattle	Buffalo	Sheep and Goat	Poultry
	Population (1000)					Change over 1966 (%)		
Nizamabad	335	400	1398	3581	-22	163	428	1301
Rangareddy	338	299	1145	15157	-21	81	195	4173
Karimnagar	403	471	2050	5325	-49	87	174	606
Medak	442	436	1653	25820	-28	125	264	6869
Nalgonda	496	788	2440	9052	-44	103	198	1128
Warangal	586	489	2196	5251	-26	78	303	841
Khammam	591	571	973	2214	-11	93	264	256
Mahbubnagar	823	415	4416	12714	-7	69	415	2369
Adilabad	975	320	1242	1839	55	198	548	456
Telangana	4990	4189	17513	80953	-18	102	286	1700

Cattle population was more in agriculturally backward districts like Adilabad and Mahabubnagar, where still there was some demand for drought animals for agricultural operations like ploughing and land preparation(table 25). But growth rates were negative, as the Indian agriculture is moving from cattle based land operations to tractor based operations. Unlike cattle buffaloes are preferred by farmers for milk production. Buffalo population was highest in Nalgonda, Khammam and Warangal and the growth rate was reasonable given the high marketing potential for milk production through public and private cooperatives. The goats and sheep rearing were predominant in Mahabubnagar, Nalgonda and Warangal. Given the high and increasing demand for meat, most of the farmers are opting sheep and goat rearing again in the adjacent districts of Hyderabad.   Poultry production is mostly concentrated in Medak, Rangareddy, Mahabubnagar and Nalgonda given their proximity to the Hyderabad, the largest market for the poultry. Most of the poultry farmers were involved in contract framing in association with big poultry retailors like SUJANA and VENKATESWARA hatcheries. The growth in the poultry sector is spectacular with double digit growth year-on-year.

Trends in Input use

Labour

Labour is one of the very important input in agriculture contributing to 20 to 30% of total cost of cultivation. Labour has become scarce in rural Telangana, multiple factors like growing migration to urban centres, MGNREGA, increasing opportunities in construction works as contract labourers within and outside villages, resulted in significant increase in wage rates and scarcity of labour since 2006. To some extent it was leading to the farm mechanization, increased use of tractors and other farm machinery even by small farmers for timely completion of farm operations and also to reduce costs(Figure 6)

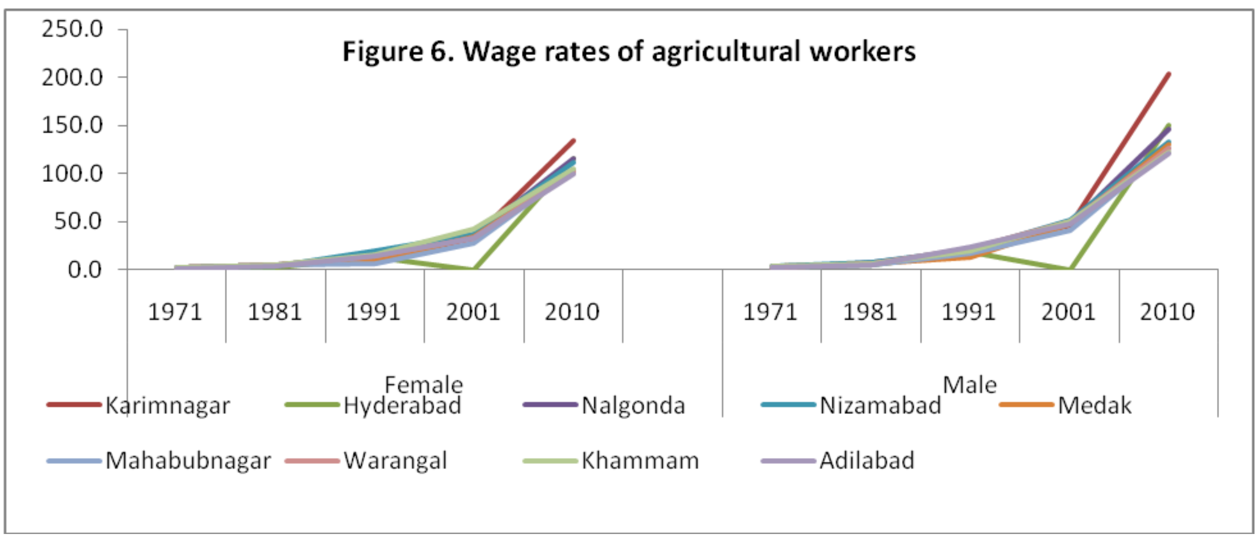


Table 26.Number of pump sets   (1000)

Year	Adilabad	Khammam	Nizamabad	Rangareddy	Medak	Nalgonda	Warangal	Karimnagar	Mahabubnagar	Telangana
1972	3	4	8	11	12	18	16	35	14	122
1977	6	11	24	20	23	38	34	53	32	240

1982	9	14	41	22	42	55	60	97	61	403
1987	14	19	48	28	56	78	93	112	58	507
1992	18	30	42	23	67	103	145	149	82	659
1999	29	38	74	42	81	97	140	155	112	768
2003	34	46	78	90	118	140	153	172	232	1062
2011	100	102	215	111	200	256	265	311	200	1760
% change over 2003	194	122	176	23	69	83	73	81	-14	66

In Telangana, ground water is a major source of irrigation contributing to about 82% of net irrigated area. Number of pumpsets is an indication of private investment in agriculture.Number of pumpsetsincreased from 122 thousand in 1972 to 659 thousand by 1992 and further increased to 1062 thousand by 2003 and to 1750 thousand by 2011 (Table 26). The number of pumpsets were higher in Karimnagar, Warangal and Nalgonda. But in the recent years growth was higher in Adilabad, Nizamabad and Khammam. After the introduction of Bt cotton in 2002, farmers in backward district like Adilabad also digging borewells to reap benefits from the Bt cotton cultivation. Alarming increase in pumpsets in districts with deep water table is posing a challenge for sustainable water use in Telangana.

Table 27.District wise percapitaconsumption(units) of electricity in agriculture and all sectors

District	2014-15		2013-14	
	Agril	All	Agril	All
Rangareddy	165	1348	162	1257
Khammam	173	600	168	571
Adilabad	188	554	166	523
Karimnagar	275	802	243	732
Warangal	368	738	373	703
Mahbubnagar	482	1018	502	942
Nizamabad	547	883	469	779
Medak	572	1644	516	1457
Nalgonda	589	1453	585	1352
Telangana	314	1320	245	1084

The percapita consumption of electricity in agriculture is an indicator for over all farm mechanization in the state. Average percapita consumption for agricultural purpose in the state was 314 units in 2014-15 and 245 units in 2013-14(Table 27). Consumption of electricity was highest in Nalgonda followed by Medak, Nizamabad, Mahabubnagar and Warangal. Percapita consumption was lowest in Rangareddy, Khammam, Adilabad and Karimnagar. It is also to be noted that the districts with more dependent on ground water and with little canal and tank irrigation facilities like Nalgona consumed more electricity than even more agriculturally advanced districts like Nizamabad and Karimnagar.

Table 28.Fertilizer use in 2014-15

	Tonnes				Kg/ha of NCA			
District	Nitrogen	Phosphorous	Potash	Total	Nitrogen	Phosphorous	Potash	Total
Karimnagar	12579	34966	12165	59710	25	68	24	117
Mahbubnagar	83514	33352	7619	124485	96	39	9	144
Adilabad	65363	15789	1870	83022	117	28	3	149
Medak	55797	12098	3043	70938	118	26	6	150
Khammam	76753	23883	9521	110157	189	59	23	271
Nalgonda	112831	36930	12004	161765	193	63	21	277
Warangal	108636	27802	9723	146161	236	60	21	317
Nizamabad	81227	19268	5415	105910	280	66	19	365
Rangareddy	120239	64120	21038	205397	524	280	92	895
Telangana	716939	268208	82398	1067545	164	61	19	244

Fertilizer consumption per hectare is a good indicator for input intensity in agriculture. The average fertilizer consumption per hectare in Telangana was 244 kg/ha as against 128 kg/ha for all India (Table 28). The highest consumption was in Rangareddy (895 kg/ha) followed by Rangareddy (895 kg/ha), Nizamabad (365 kg/ha), Warangal (317 kg/ha) and Nalgonda (277 kg/ha). The consumption was least in Karimnagar (117 kg/ha), Mahbubnagar(144 kg/ha) and Adilabad(149 kg/ha). The existing NPK ratio was 8.6:3.2: 1, while recommended ratio was 4:2:1, which needs to be corrected. Overall, fertilizer consumption in the state was much higher and needs to be rationalized through effective implementation of soil health card schemes and other related programmes.

Credit and indebtedness

70th Round of the National Sample Survey (NSS) on “All India Debt and Investment Survey” (data collected during January 2013 to December 2013) gives a picture of the credit structure, asset holding, liabilities, capital formation of the households etc. The average value of the asset for cultivator and non-cultivator in the rural Telangana household is Rs.13.9 lakh and Rs. 3.8 lakh respectively while at all - India level it is Rs. 28.7 lakh and Rs. 6.7 lakh respectively(table 29). The average asset value for rural household of Telangana is Rs. 6.38 lakh and that of urban Telangana is Rs 18.45 lakh, which is 2.9 times higher indicating high inequality between rural and urban population in the State. The Incidence of Indebtedness (IOI) among the households in rural areas of Telangana is twice higher than the IOI of rural All-India. Around 59% of rural household are indebted in Telangana state as against 31% in All-India. Indebtedness is higher among the cultivators as compared to other occupational category; about 74% of cultivators in Telangana are indebted. While the debt asset ratio among the rural and urban areas of Telangana is around 7.95 % and 8.58% respectively, in case of India it is as low as 3.23% and 3.7 % respectively(table 26).

Table 29.Incidence of value of assets, indebtedness and debt in Telangana and India

Rural	Average value of assets (Rs.lakh)	Incidence of indebtedness (in%)	Amount of debt (Rs.)	Debt-Asset Ratio
Telangana				
Cultivators	13.89	74	84423	6.1
Non-cultivators	3.80	54	39142	10.3
All-India				
Cultivators	28.73	46	70580	2.5
Non-cultivators	6.75	29	25741	3.8

Source: NSSO report on debt and investment survey (70^{th} round), Govt of India.

Indebtedness is one of the major problems that farmers face in the State. As per the "All India Debt and Investment Survey" by National Sample Survey (NSS), 74 percent of the total cultivators in the State are indebtedness. The Government of Telangana has announced a one-time crop loan waiver to end the perpetual indebtedness of farmers through the Crop Loan Waiver Scheme. Under the scheme, short term crops loans (including crop loans against gold) taken by farmers from scheduled commercial banks, cooperative credit institutions and regional rural banks and outstanding as on 31.03.2014are eligible for waiver. The eligible amount for debt waiver is up to Rs.1 lakh, including loan amount and interest up to 31.08.2014. The waiver is scheduled to be paid in four instilments. A total of 35.30 lakh farmers are availing benefits under the Crop Loan Waiver Scheme. District wise analysis shows that Mahabubnagar district has the largest beneficiary (5.99 lakh farmers) availing the scheme followed by Nalgonda (4.97 lakh farmers) and Warangal (4.04 lakh farmers). A total of Rs. 8,080 crore was disbursed in two instilments (Table 30). However, the benefits of the scheme is only realized if there was some efforts to reduce cost of cultivation to farmers through input subsidy etc.

Table 30. District wise number of beneficiaries and amount released under crop loan waiver schemes

District	No. of farmers benefited as per UCs(lakh)	total amount credited in 2 installments (Rs.Crore)
Adilabad	3.15	731.1
Karimnagar	3.73	831.3
Khammam	3.58	818.3
Mahabubnagar	5.99	1347.8
Medak	3.96	966.3
Nalgonda	4.97	1175.7

Nizamabad	3.80	786.8
Rangareddy	2.08	502.4
Warangal	4.04	920.3
Telangana	35.30	8080

Conclusion

Telangana agricultural sector is in a transition from cereal based cropping systems to commercial crops based cropping systems with larger contribution from fruits and vegetables and commercial crops like cotton and soybean.The commercialization of agriculture resulted in high input-high output-high risk for which many small and marginal farmers are not able to cope with and ultimately end up in huge debt with higher cost of production in agricultural sector. Livestock sector growth is also significant, now its contribution is equal to crop sector to gross state domestic product. Telangana agriculture is dominated by small and marginal farmers, whose income from agriculture and allied activities is meager, resulted in most of them shifted to agricultural labourer during the past decade. The number of cultivator's decreased and agricultural labourer increased during the past and this change is more among women. Farm mechanization increased in the recent years, resulted in increased scale economies with small farmers getting less profit compared to large farmers per unit area. The real problem is as the farm incomes reduced, there was no increase in alternative income sources in rural areas for the farming community. Although many agricultural households engaged in multiple activities like casual labourer, non-farm incomes, but the actual income share from these sources is very limited in Telangana compared to Andhra Pradesh and All-India.

Small and marginal farmers profitability was adversely effected by the rapid spread of farm mechanization, hence there was a need for special programmes to support small farmers' incomes on a long term basis. The input costs are increasing more than gross returns, resulted in decrease in profitability. There was a need for strengthening custom hiring centres in all the villages for easy availability of modern tools and farm equipment to the farmers. The tenant farmers are especially at risk in the event of yield loss or output price reduction, as they have to pay tenancy fee of about 30% of the average farm returns, even though their yields are lower than average. Hence there was an urgent need for addressing the tenancy farmer's problems through institutional innovations and subsidy programmes.

In policy front to facilitate this diversification of agricultural sector, state government should focus on increasing irrigation facilities, providing veterinary services through livestock service centres and rural service centres for promoting overall development of the rural economy to create employment in not only agriculture, but also in off-farm and non-farm activities. However, in this transition period farmers income may fluctuate widely, hence there was a need for price support and crop and livestock insurance for every farmer in Telangana irrespective of the farm size.

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Agriculture and Nutritional Security Linkages :Understanding the Cross Cutting Issues

Ch. Radhika Rani *, U. Hemantha Kumar **

Abstract

Agriculture has greater potential to impact the food and nutrition security of poor and rural households. Watershed programme is one of the major programmes for agriculture development in rainfed areas, where most of the poor live. Many studies focused on the positive impact of watershed development on productivity of crops and income. However, the cycle will not be complete if the increase in income concomitantly translates into nutrition security of the stakeholders in a watershed programme. The article attempts to understand the impact of watershed programme on nutrition security and it's inter household variations. The study was conducted in four states i.e., Telangana, Chhattisgarh, Jharkhand and Karnataka during 2014-15 with a sample of 640 households.

Small and marginal farmers have diversified their cropping systems with vegetable crops with an increase in irrigation in watershed villages. The income from agriculture was significantly more for the small and marginal farmers in watershed villages compared to non-watershed villages. The aggregate income from all the sources, including livestock and wage employment, was also more for all the categories of beneficiaries in watershed villages compared to non-watershed villages. This was resonated laterally in the form of increase in consumption of quality foods such as milk, meat, fruits and vegetables. While the increase in consumption of vegetables was more for small and marginal farmers by virtue of their increased production, the increase in consumption of meat was more for landless farmers by virtue of the increase in disposable income through wage employment.Inter household in- equity in consumption was observed with landless households consuming less pulses, vegetables, and milk compared to the consumption of SMF and LMF in watershed villages. The picture is not so bright as there were many children even within the watershed villages who scored less, anthropometrically.

This suggests the need for nutrition-specific and nutrition-sensitive interventions in the agriculture development programmes.

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Agriculture and Nutritional Security Linkages : Understanding the Cross Cutting Issues

Ch. Radhika Rani *, U. Hemantha Kumar *

Decreasing hunger and malnutrition are increasingly seen in the context of overall development, poverty reduction and the achievement of the Sustainable Development Goals from 2000 onwards. Agriculture has greater potential to impact the food security of poor and rural households. There have been renewed calls for greater integration of nutrition and agriculture policy as agriculture is the primary sector of employment for the poor (Kumar et al., 2014; IFPRI 2011; Kumar *et al.,* 2011; USAID 2010) and food expenditure occupy the largest budget share of the poor (Ahmed *et al.*, 2007). Watershed programme is one of the major programmes for natural resource management in rainfed areas, where most of the poor live. Many studies Turton et al, (1998), Shah (2001), focused on the positive impact of watershed development on cropping, agricultural productivity, employment generation and increase in income amongst others. However, to what extent the increase in these factors is leading to increase in nutrition security of a household in a geographical area where watershed development programmes were implemented successfully, is not studied so far. In addition to this, there are concerns regarding the distribution of the benefits accrued through a watershed program. Studies revealed the fact that when degraded ecosystems have been revitalized, there is an improvement in land productivity and water availability. However, water availability cannot be automatically ensured for all the stakeholders equally, as the ground water operates under the private property regime and the land owner has unlimited right over the water under his/her land and he is most likely over-extract the water (Joy and Paranjape, 2009). As the land productivity is concomitant with water availability, the issue of improvement of nutritional status of women and children particularly belonging to the land less category, as a result of implementation of watershed programme arises

Historically food security was the main focus of all developing nations in the context of adequate food supply to all. But with increased observation of inadequate food intake by certain sections of the community, the concept of food security has been changing, adding the dimensions of access (Sen, 1981), vulnerability (Watts and Bohle 1993) and sustainability (Chambers 1989).With an increasein focus on the malnutrition aspects of the women and children in most of the developing countries, the concept of nutrition security in addition to food security was brought into focus from mid-1990.'Nutrition Security', was defined as adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times (Quisumbing 1995), which transpires with the consumption of diverse food items.

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A good food security framework in the context of food availability needs to focus not only on productivity but diversification as well (Kumar, et al., 2006). Since nutrition security and agriculture are recognized as mutually reinforcing states, there is heightened interest in addressing these problems jointly (Barrett 2010). The two main path ways through which the agriculture influences the nutritional status of individuals are i) Increased diversified production systems which improves the consumption pattern of individuals ii) Increased income which improves the purchasing capability of the individuals. The paper therefore aims to understand the impact of increase in production of agriculture in a watershed programme on increase in nutrition security of its stakeholders.

Objectives of the study

1. To study the impact of watershed programme on cropping pattern, employment and income of the beneficiaries.
2. To examine the change in food consumption pattern of the beneficiaries in watershed villages *vis- a-vis* non-watershed villages.
3. To assess the impact of change in production and consumption on health of the beneficiaries of watershed programme.

Data and methodology

The study was conducted in four states namely, Telangana, Karnataka, Chhattisgarh and Jharkhand. In each state four watershed villages and two non-watershed villages as control villages were selected. The bio physical and agro climatic conditions of non-watershed villages were similar to that of watershed villages before the implementation of watershed programme in the villages. Table I indicates the sampling framework of watersheds and non-watersheds selected in four states.

Table 1: Details of the Watershed and Non-watershed Villages

Telangana	**Chhattisgarh**	**Karnataka**	**Jharkhand**
		Watershed Villages	
Gangapur	Basim	B.Mattakere	Aurad
(2008-NABARD)	(2002 - IWDP)	(2008- NABARD)	(2002-NABARD)
Kishtapur	Uperwara	Basapura	Bhubhui
NABARD	*(2002 –IWDP-III)*	(2008- NABARD)	(2003- (DPAP
Kottapally	Masania Kalan	Channappanapura	BudhaKocha
(1999-DPAP)	(2002 –IWDP-1)	2004-05(IWDP 2)	(2003-DPAP)
Antharam	Aamgaon	Kebbepura	Nichintpur
(2003-04- DPAP)	(2003-DPAP-8)	(2003-04 DPAP-Hariyali-I)	(2002-IWDP-1)
		Non-Watershed Villages	
Mailaram	BhilaiDabri	Hunasanalu	Bero
Marpally	Nandil	Kengaki	Dokad

Note: Figures in parentheses indicate the Project under which the watershed was funded and the date of Initiation

The farmers were selected in two groups i.e, large and medium (LMF) in one category and small and marginal (SMF) in another category. In each watershed village 10 LMF, 20 SMF and 10 landless households were selected on the basis of proportionate random sampling. In case of non-watershed village it was 5, 10 and 5 respectively. Thus the total sample of watershed villages in each state consists of 160 with 40 LMF, 80 SMF and 40 landless households. The total sample of non-watershed villages in each state consists of 80 with 20

LMF, 40 SMF and 20 landless households respectively. For the four states combined, the total sample was 640 in watershed villages and 320 in non-watershed villages.The needed information from the two respondent groups was gathered through pre-tested interview schedules. The data was analyzed by using tabular analysis with appropriate statistical tools like t-test. The major analytical tools are based on with and without framework, for the year 2014-15. For calculating crop diversification index the study used Simpson crop diversification index based on Chand and Chauhan (2002).

The impact on nutritional security was assessed through weekly recall of household consumption in the manner similar to that of NFHS-3 (National Family Health Survey). Body Mass Index (BMI), a widely used measure of nutritional status, was assessed to measure the nutritional status. Scales and measuring boards were used to measure women and men in the age group of 15 and 59 years and children between the age group of 5 and 15 years. This index excludes women who were pregnant at the time of survey and women who gave birth during the two months preceding the survey. A cut-off point of 18.5 was used to define thinness or acute undernutrition, and a BMI of 25 or above indicated overweight or obesity. To assess the nutritional status of children, anthropometric measures were taken in which all children under 5 years of age were weighed and measured. The interviewing team in every study village has included the ANM (Auxiliary Nurse Midwife) worker of that village who conducted the anthropometric measures such as stunting, wasting and underweight. There is variation in height and weight of the sample children which approximates normal distribution. Use of standard reference population as a point of comparison facilitates the understanding of nutrition status of the children in sample villages. The use of reference population is based on the new international reference population released by WHO in April 2006 (WHO Multicenter Growth Reference Study Group 2006) and accepted by the Government of India. The validity of these indices was determined by many factors, including the coverage of the children in the households and the accuracy of the anthropometric measures. Height and weight data of all the children of the sample households who are available at home was taken. However, the data of the children who were out of station during the period of the survey was not taken by the team. In terms of percentage, those children account to only 6 per cent. In addition, two of the three indices (weight-for-age and height-for-age) are sensitive to misreporting of children’s ages. However, their ages were cross-validated with other members in the household. This is the limitation of this exercise. Each of the three nutritional status indicators is expressed in standard deviation units (Z scores) from the median of the reference population.

Results

a) Land Use Pattern

The land use pattern presents an understanding on resilience capacity of natural resources base in the sample villages.The net sown area in terms of percentage of arable land was 100 percent in case of LMF and 86.30 percent in case of SMF of Watershed Villages. This was less in non-watershed villages with 72.4 percent in case of LMF and 53.40 percent in case of SMF (Table 2). In general, the area under irrigation, net sown area and the gross sown area of watershed villages was more than non-watershed villages across all the states. The average arable land holding size of Chhattisgarh and Jharkhand was greater compared to Telangana and Karnataka.The percentage of irrigated area out of net sown area of LMF of Telangana and Chhattisgarh was more with 93.8 and 93.7 percent compared to Jharkhand and Karnataka with 72.3 and 65.26 percent respectively. Whereas it was less for SMF of Chhattisgarh compared to the other three states.

Table 2: Land holding Status

States	**Land holding (Average in Ha)**									
	Large and medium farmers					**Small and marginal farmers**				
	Arable Land	**Non-arable Land**	**Irrigated Area**	**Net Sown Area**	**Gross sown Area**	**Arable Land**	**Non-arable Land**	**Irrigated Area**	**Net Sown Area**	**Gross sown Area**
				Chhattisgarh						
Watershed	10.4	0.61	9.7	10.4	20.7	0.93	0.30	0.73	0.93	1.9
Non-watershed	10.9	1.4	5.4	9.1	7.4	1.1	0.27	0.45	0.90	1.80
				Jharkhand						
Watershed	9.2	0.24	6.7	9.2	18.5	0.76	0.13	0.64	0.76	1.5
Non-	8.0	0.57	4.6	6.5	13.0	0.80	0.27	0.40	0.64	1.3

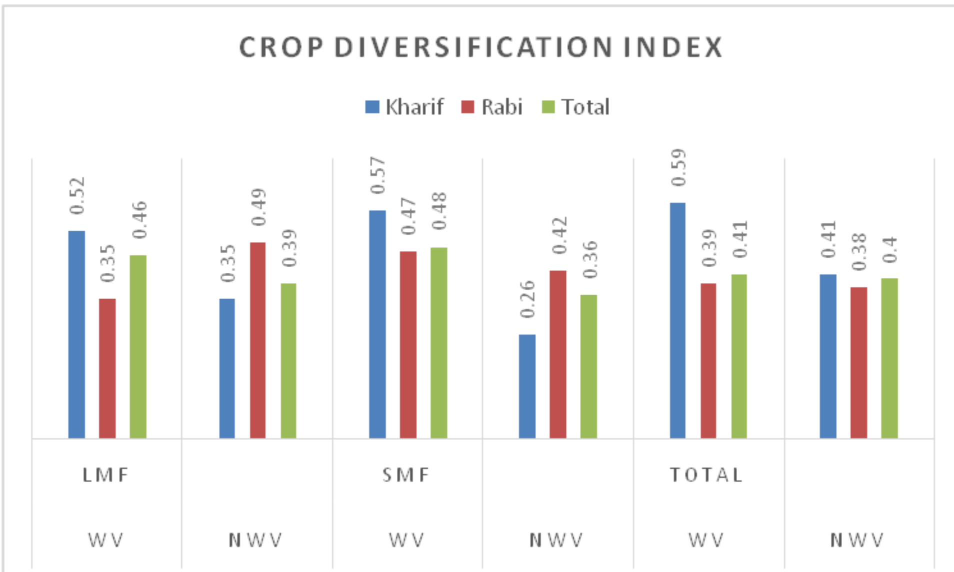
watershed										
Telangana										
Watershed	5.40	0	4.53	5.40	9.05	2.32	0.42	2.23	2.74	4.46
Non-watershed	4.95	2.02	3.89	6.97	8.02	1.89	1.23	1.23	1.63	2.12
Karnataka										
Watershed	4.78	2.88	3.72	5.70	8.93	1.67	0.3	1.96	2.34	3.94
Non-watershed	2.56	3.48	3.00	5.04	6.66	0.99	1.04	1.05	2.03	3.27
Average of four states										
Watershed	7.56	0.89	6.34	7.56	14.2	1.46	0.31	1.43	1.26	2.61
Non-watershed	6.29	1.97	3.98	4.56	8.16	1.29	0.68	0.71	0.69	1.89

Source: Authors

b) Crop Diversification

The change in cropping pattern was measured through Crop Diversification Index (CDI). Crop diversification takes place either through area augmentation or crop substitution. If carried out appropriately, it can be used as a tool to augment farm income, generate employment, and alleviate poverty and conserves soil and water resources. The Crop Diversification Index was calculated for the two category farmers in the watershed and non-watershed villages for both Kharif and Rabi. The figure below indicates that CDI was more during kharif than rabi for both category of farmers in watershed villages. This is because of the shift in cropping pattern to vegetables in these villages during kharif. Area under paddy or wheat was increased in the watershed villages with an increase in area under supplementary irrigation in both the cases of LMF and SMF during rabi. Overall, the CDI of watershed villages was higher with 0.59 in kharif, 0.39 in rabi compared to 0.41, 0.38 for non-watershed villages respectively.

Figure 1: Crop Diversification Index



c) Impact on Employment and Income

At the aggregate level the impact of WDP on employment was significantly more among the small farmers in the case of both male and female labour. In all the four states, the impact of WDP on employment was more on women of SMF category.The number of labor days for women of watershed villages were significantly higher by 57 in case of SMF and 17 in case of LMF compared to non-watershed villages (Table 4). The same in case of men were 48 and 25 respectively. Vegetables being a labor intensive crop taken up mostly in the lands of SMF category resulted in the reporting of more number of days of employment by both men and women in agriculture activity. Among the four states, both the men and women in SMF category of watershed villages of Karnataka benefitted with 75 and 95 days of additional employment compared to their counterpart in non-watershed villages. The employment days reported under non-agriculture activity by the farming and landless households include work under livestock and MGNREGS activities. With an increase in employment in agriculture, the employment in non-agriculture activities has come down for both the categories in watershed villages, more so, for men of SMF by 16 days. In watershed villages, the number of employment days of landless households for agricultural activities of men and women were more by 37 and 43 days compared to their counterparts in non-watershed villages. (Table 3).Similarly, for the same households the number of employment days for non-agricultural activities was more by 48 and 15 compared to non-watershed villages, both for men and women. Among the four states the impact of watershed program on farm employment of landless households was more in Karnataka followed by Telangana.

Table 3 :Availability of Labour Days for Farming Community

States	Availability of Labour Days (Average per HH)											
	Large and Medium Farmers				Small and Marginal Farmers				Landless			
	Agriculture		Non Agri-culture		Agriculture		Non Agriculture		Agriculture		Non Agriculture*	
	M	W	M	W	M	W	M	W	M	W	M	W
Chhattisgarh												
Watershed	140	160	25	15	155	180	32	10	40	60	150	100
Non-watershed	110	125	40	25	115	135	50	22	25	30	120	120
Jharkhand												
Watershed	144	155	45	24	160	166	55	42	50	60	200	120
Non-watershed	125	130	60	36	140	145	60	54	30	50	100	100
Telangana												
Watershed	110	80	30	45	145	160	60	85	85	103	90.0	70.0
Non-watershed	80	60	45	30	95	90	75	80	25	40	80	90
Karnataka												
Watershed	125	95	65	42	160	185	70	85	90	110	185	165

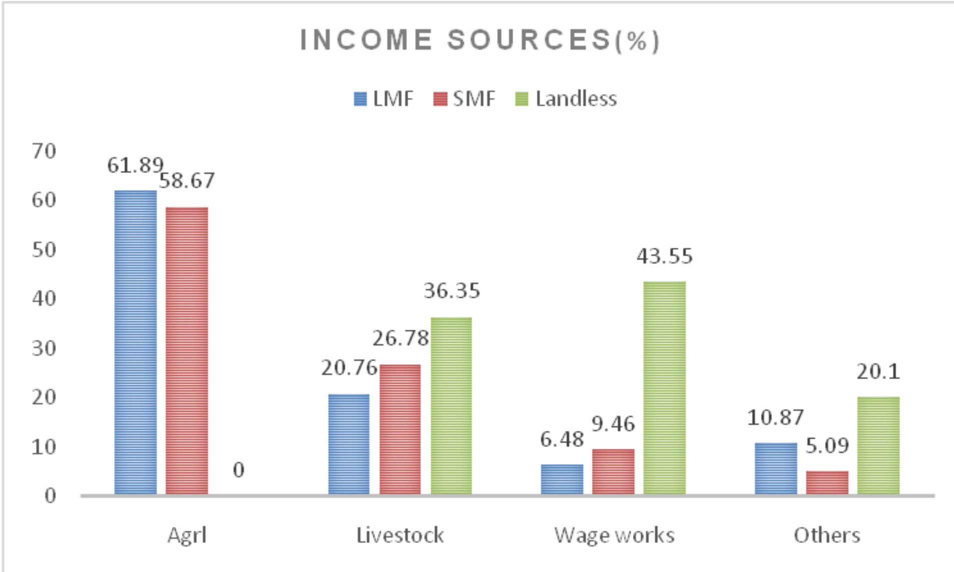
Non-watershed	95	105	50	65	85	90	90	75	25	40	140	135
Average of four states												
Watershed	131*	124**	44*	32*	155**	170**	53*	56**	64*	83*8	156*	114*
Non-watershed	106*	107**	49*	39*	107**	113 **	69**	59**	27**	40*	208**	99*

Note: 10% Level of Significance; ** 5% Level of significance

d) Share of different sources of Income in watershed villages

Major sources of income in the sample villages were agriculture, livestock and labour. Though there were other sources like services, their share was marginal. Income from these three major sources was included to arrive at the aggregate income at the household level. It is not uncommon that the share of income from agriculture was maximum for the two category farmers. However we could see from the figure below that the income from agriculture in watershed villages was more for LMF with 61.89 percent than the SMF with 58.67 percent despite the income diversification strategies of SMF. However, livestock also contributed significantly (26.78%) to the income for SMF. Livestock has become a significant source of livelihood for landless households also, in watershed villages with 36.35 percent of their total income.

Figure 2: Share of Different Sources of Income in Watershed Villages (%)



e) **Physical Availability of Major Foods per Household**

Availability refers to the physical availability of food stocks in desired quantities. Using food grains as a proxy for food (in a context where food grains account for a large share of food intake), availability of food grain at macro level is given by domestic production of feed, seed and wastage plus net imports plus draw-down of stocks at the macro level. Whereas, household level of availability of food grains depends on production and marketed surplus. The per capita availability of rice and wheat in the country was 84.8 kg/annum/capita during 2013-14. Similarly, for wheat it was 66.9/kg/annum/capita. The per capita requirement of cereals was 137 kgs/capita/annum. Compared to these figures, the per capita availability of rice was much higher in watershed villages with 185 and 148 kgs/per capita/annum respectively for LMF and SMF (Table 4). However, it was lower in watershed villages in case of wheat with 40 kg/annum/capita for LMF and SMF. The per capita availability of wheat was further lower for SMF in non-watershed villages with 25 kg/capita /annum. The per capita vegetable requirement as per ICMR norms in the country were 108 kgs/per capita /annum. The per capita availability of vegetables for the LMF and SMF households in watershed villages was 152 and 137 kgs/capita/annum respectively. These figures were much lower in non-watershed villages with 89 and 42 kg/annum /capita.

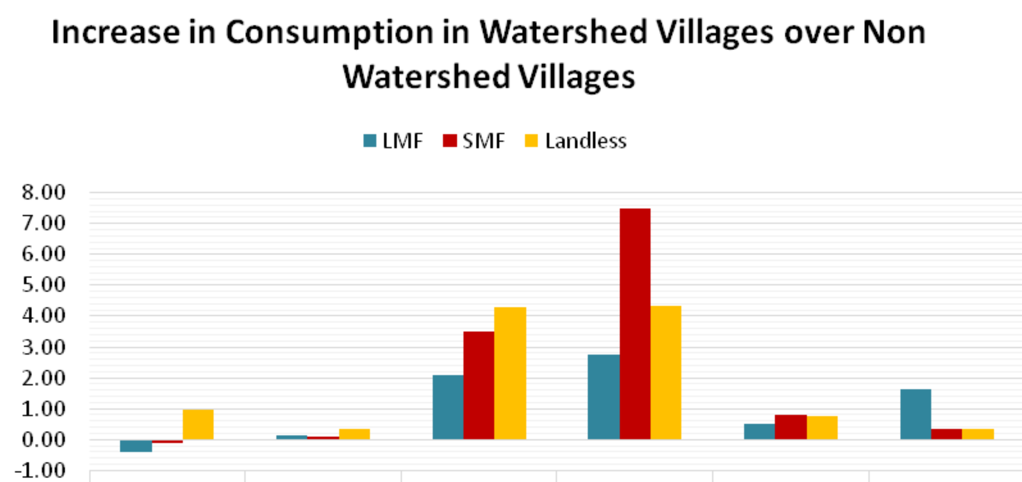
Table 4 : Physical Availability per household

Crops	**LMF**				**SMF**			
	Total producti	**Quantity Retained**	**Quantit y**	**Per Capita**	**Total productio**	**Quantity Retained**	**Quantity Markete**	**Per Capita**

	on (Quintal)	by HH own Consumption (Quintal)	Marketed (Quintal)	Availability (per annum-Quintal/Kgs)	n (Quintal)	by HH own Consumption (Quintal)	d (Quintal)	Availability (per annum-Quintal/ Kgs)
Watershed Villages								
Paddy	229.77	9.00	220.77	1.85	79.40	7.42	71.98	1.48
Vegetables	618.82	7.63	611.19	1.52	240.66	6.89	233.77	1.37
Wheat	10.00	2.00	8.00	0.40	10.00	2.00	8.00	0.40
Maize	57.24	0.58	56.66	0.13	56.13	-	56.13	-
Pulses	17.74	1.00	16.74	0.23	1.00	0.25	0.75	0.05
Cotton	23.61	-	23.61	-	14.76	-	14.76	-
Non-watershed Villages								
Paddy	173.19	6.41	166.78	1.28	57.20	4.75	52.45	0.95
Vegetables	267.98	4.45	263.53	0.89	70.89	2.1	68.79	0.42
Wheat	7.00	2.00	5.00	0.40	5.25	1.25	4.00	0.25
Maize	51.48	1.76	51.48	0.44	42.53	-	42.53	-
Pulses	19.68	0.68	19.00	0.17	-	-	-	-
Cotton	19.68	-	19.68	-	9.84	-	9.84	-

In general, theconsumption of the food items by all the households in the watershed villages was more compared to non-watershed villages, except for cereals in case of LMF and SMF of watershed villages. In watershed villages, the consumption of cereals was partly replaced with increased consumption of diverse food basket with pulses, vegetables, eggs and milk. Compared to the non-watershed villages, the landless households in watershed villages increased their consumption of pulses, vegetables and meat by 0.35 kgs, 4.3 kgs and 0.75 kgs per week respectively (Table 5). The consumption of vegetables, meat and milk of SMF in watershed households increased by 3.50 kgs, 0.80 kgs and 0.35 kgs respectively. However, inter household in equity in consumption was observed with landless households consuming less pulses, vegetables, and milk compared to the consumption of SMF and LMF in watershed villages (Table 6).

Table 5 : Increase in Consumption in Watershed Villages over Non-Watershed Villages (Per Week)



	Cereals (kgs)	Pulses (kgs)	Vegetables (kgs)	Eggs(no)	Meat (kgs)	Milk(lts)
LMF	-0.40	0.11	2.08	2.75	0.50	1.63
SMF	-0.13	0.07	3.50	7.50	0.80	0.35
Landless	0.96	0.35	4.30	4.32	0.75	0.33

Table 6: Household Consumption per Week in watershed Villages (average of four villages)

Category	Cereals (kgs)	Pulses (kgs)	Vegetables (kgs)	Eggs(no)	Meat (kgs)	Milk(lts)
LMF	13.77	1.13	9.70	10.50	1.37	3.67
SMF	12.99	0.86	10.22	14.25	1.65	1.65
Landless	13.15	0.46	6.75	12.50	2.50	0.96

Impact on the Nutritional Status of Beneficiaries

The findings above indicate an increase in the consumption of quality food items by all the four categories of households in the watershed villages. Therefore, it is imperative to examine to what extent this increase was translated to increase in the health status of the adults measured through BMI. Table 7 indicates that the mean BMI of women in LMF category in the age group of 15–59 in watershed villages was 22.4, whereas the same for non-watershed villages was 20.5. Also notable is the point that the mean BMI of women in the age group 15–59 was more for LMF with 22.4 followed by SMF and landless with 22.2 and 21.8 percent respectively, in watershed villages. Though the consumption of quality foods, high in plant and animal protein, by these women in watershed villages was more compared to non-watershed villages, it is a fact that it is not translated into a healthy BMI. Chronic energy deficiency is usually indicated by a BMI of less than 18.5. This was seen in all the categories of children between the age group of 5–15 years in non-watershed villages. Even the children of landless category in watershed villages also have low BMI with 16.1. Tables 8(a) and 8(b) demonstrate the percentage of children classified as undernourished by selected demographic characteristics. The proportion of children who are severely malnourished (more than –3 standard deviations below the median of the reference population), though notably higher in watershed villages, was less compared to non-watershed villages for all the age group of boys and girls. The percentage of girls with stunting and wasting of more than –3 standard deviations in the age group of 5 years (60 months) in watershed villages was 25.1 and 15.1, respectively. The same in non-watershed villages was 38.5 and 20.4 per cent, respectively. More noticeable is the fact that even in the watershed villages, the percentage of girls with underweight was higher in the age group of 5 years compared to boys with 12.1 per cent and 26.1 per cent, respectively, at –3 and –2 standard deviations, which may have stronger repercussions as they grow up and give birth to the next generation.

Table 7 :Average Body Mass Index of the Households

Gender	LMF		SMF		Landless	
	WV	NWV	WV	NWV	WV	NWV
Men	22.5	21.2	21.9	20.4	21.1	19.3

(15 &59)						
Women (15 &59)	22.4	20.5	22.2	18.6	21.8	18.0
Children (5 – 15 Years)	19.3	16.9	18.3	13.0	16.1	12.5

Table 8A : Percentage of Children classified as Malnourished according to three Anthropometric Indices of Nutritional Status - Watershed Villages

Age in Months	Height for Age (%)- Boys			Height for Age (%)- Girls			Weight for Height %- Boys			Weight for Height %- Girls			Weight for Age % - Boys			Weight for Age % - Girls		
	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO
12	14.6	11.4	6.1	8.1	37.9	9.9	11.1	29.1	31.1	10.1	31.2	30.1	10.1	27.1	32.5	11.7	22.1	41.1
24	13.5	21.9	7.9	11.9	31.5	9.7	14.9	25.9	29.2	14.6	31.6	32.2	11.1	26.2	28.2	10.5	21.6	38.6
36	14.2	22.4	7.2	14.9	43.8	7.4	14.3	29.2	31.6	13.4	28.5	28.1	10.2	24.1	37.8	11.1	22.2	40.2
48	17.9	23.9	7.6	19.1	38.9	8.8	12.9	26.1	31.6	14.1	22.5	27.1	12.2	23.1	36.9	14.2	26.6	42.6
60	20.4	23.6	8.9	25.1	41.3	11.6	10.9	24.9	38.9	15.1	21.2	36.5	13.2	21.1	40.4	12.1	26.1	43.8

Table 8B :Percentage of Children classified as Malnourished according to three Anthropometric Indices of Nutritional Status - Non Watershed Villages

Age in Months	Height for Age (%)- Boys			Height for Age (%)- Girls			Weight for Height %- Boys			Weight for Height %- Girls			Weight for Age % - Boys			Weight for Age % - Girls		
	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO	-3 SD	-2 SD	SDO
12	21.4	23.4	4.4	24.1	39.1	8.1	19.9	29.2	24.5	18.3	41.6	23.9	14.5	31.1	27.7	13.9	24.5	32.7
24	33.1	25.2	5.1	27.7	38.2	8.4	19.6	31.6	22.8	18.8	42.2	30.2	14.8	32.5	28.8	14.1	25.7	29.8

36	33.4	27.2	5.7	28.5	45.1	8.1	19.1	33.9	25.5	16.7	43.6	27.7	14.9	33.8	33.5	14.4	27.4	36.9
48	26.1	29.1	5.9	31.1	48.1	7.9	21.2	34.2	19.9	17.9	45.1	26.4	16.5	34.1	30.4	14.9	30.1	37.2
60	27.1	21.1	4.1	38.5	41.1	6.9	23.1	32.6	24.5	20.4	31.8	31.5	15.3	31.7	39.4	15.1	33.1	33.0

Conclusion

The priority for the implementation of any watershed programme is to improve the land productivity through its land use pattern and livelihoods of its stakeholders. There was an increase in net sown area and diversified cropping pattern in the watershed villages. An increase in the number of days of employment was observed because of increase in agriculture and livestock livelihoods which has led to an increase in consumption of quality food items such as eggs, milk and meat. Diversified cropping pattern with vegetables led to an increase in the consumption of vegetables. However, this was not adequately translated into a healthy consumption pattern across all the sections in watershed villages as reflected by the less consumption of quality food items by landless households in watershed villages. The anthropometric indices of nutrition security i.e, stunting, wasting and underweight assessed for all the households both in watershed and non-watershed villages reflected a gloomy picture. Nutrition specific interventions need to be promoted within the production systems in watershed programmes.

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An integrated extension strategy for dairy development in Haryana

V B Dixit[9], Hema Tripathi[10] and A Duhan[11]

ABSTRACT

There is an increasing demand among the farmers for scientific knowledge on improved dairy technologies. However, due to lack of convergence among the different agencies involved in dairy promotion, these needs are not sufficiently met. The public extension system has failed to respond to the demands for knowledge support as it doesn't have adequate human and financial resources. Moreover, its bureaucratic nature of functioning and the huge load of administrative responsibilities on its field level workers have rendered the public extension services supply driven rather than demand driven. Without integrated extension strategy efforts by the varied public, private NGOs, farmers' associations, rural institutions and other agencies involved in dairy development, we would fail to reach a large number of dairy farmers in shortest possible time with the new and improved knowledge and skills of dairying. This situation calls for fresh look and taking into account the policies, strategies and resources of various departments to ensure the full contribution for sustainable dairy development. Therefore, convergence of different agencies working for dairy development is essential to cater to the needs of farmers and to enhance livestock productivity and production through integrated extension.

WHAT IS INTEGRATED EXTENSION STRATEGY?

Integrated extension strategy is the need of the hour and it can be achieved through sharing of knowledge, resources and experiences of different stakeholders of livestock development. All the stakeholder of livestock development may jointly address the problems of farmers for enhancing their production, productivity and income. The word convergence has been derived from Latin word '*convergere'* which means to incline together. According to advanced learner's dictionary, convergence suggests that when people get along with each other for long enough, their acts, thinking and even appearance will become alike. Thus, convergence is mainly sharing of ideas, resources, manpower, knowledge and experiences of different entities which have different backgrounds for a common purpose i.e. dairy development resulting into synergistic effects of their combined efforts for ultimately enhancing the income of farmers.

WHY INTEGRATED EXTENSION STRATEGY?

Systems and institutions co-exist addressing the needs of farming community so as to derive synergistic advantages of both. There are pluralistic extension organizations working in the

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state. A lot of manpower is being utilized in this process. There is duplication of efforts with multiplicity of agents in extension work without convergence or coordination, resulting in loss of efficiency. In order to reduce the redundancy, repetition and better utilization of scarce resources, integrated extension strategy and better linkage is required in Public Private Partnership mode.

Public organizations are strong in backward linkage. Private organizations are strong in forward linkage and NGOs are strong in social engineering and mobilization. Each and every organization has comparative advantages over the other. Single development agency may have limitations of resources. That is why convergence is needed: a clear integrated strategy for a planned multi-stakeholder involvement with mandated activities as per the expertise, to supplement and complement the efforts and to ensure effective involvement of community partnerships (Mukherjee and Maity, 2015).

NEED FOR CONVERGENCE IN LIVESTOCK SECTOR

The state department of animal husbandry (SDAH) is implementing several dairy development programmes by expending huge resources in order to enhance the income of the dairy farmers. In addition, other organisations like the Department of Dairy Development, the National Dairy Development Board (NDDB), dairy cooperatives, agricultural and veterinary universities, ICAR institutions, financial institutions, input companies and NGOs are also working with dairy farmers. But most of these agencies are working in isolation and the adoption of improved breeding, feeding and management by farmers is limited.

In the case of research, institutions such as CIRB, NDRI and LUVAS are converging with each other through network projects, NAIP projects and also on few occasions like animal husbandry officers' workshops and meetings for technology reviews.

In these cases, there is sharing of knowledge, manpower, resources, experiences, etc. However, there is not enough convergence between the research system with others such as field functionaries, input agencies/organisations and NGOs.

INTEGRATED EXTENSION STRATEGIES: SOME IDEAS

At present, NDRI and LUVAS organize animal husbandry officers' workshop annually but separately. It would be better if these institutions jointly organize these workshops with other research institutes for catering to the needs of stakeholders in a better way. They may also try to address the problems of farmers through workshops and campaigns building on the strengths of each organisation. NDRI is equipped with information on dairy farming, while LUVAS has been known to respond better to the health related queries of the animal husbandry officers and CIRB is better equipped to deal with information pertaining to buffalo production.

Similarly, all the research institutions like NDRI, CIRB and LUVAS have developed area-specific mineral mixture. The mixture should be collectively analysed through a joint working group to make pertinent recommendations to the dairy farmers. Thus, all the institutions should jointly organize technology review meetings to avoid duplication and devise best possible technologies to cater to the needs of the farmers. Training modules on extension convergence needs to be developed by ATMA, KVKs and other private agencies. CIRB, SDAH and NDRI may provide specialised input *i.e.* more emphasis on skill development. ATARI in collaboration with SAMETI may take this initiative forward.

For integrated extension strategy, it is extremely important that all the institutions and organizations working for dairy development are aware of their respective roles and functions. For example, to prepare literature on the prevention and treatment of mastitis in buffaloes, ICAR-CIRB and LUVAS being the veterinary research institutions can develop the technical content jointly. The field veterinary officers of the State Department of Animal Husbandry (SDAH) can customize the text by introducing appropriate words in local language. Banks may be involved in financing the printing of literature to farmers. SDAH and Milk cooperatives may be involved for distribution of this literature to dairy farmers. Milk cooperatives may also need to play an important role in the supply of inputs required for clean milk production. SDAH needs to step up their role in diagnosing and treating cows and buffaloes for mastitis. By collectively addressing this issue as suggested above, the cost of addressing the mastitis problem could be reduced and more cattle and buffaloes could be protected from this disease.

Another example on integrated approach may be in organising Kisan Melas which may be organised jointly by different institutions by pooling together their knowledge, expertise and experience. At present, NDRI, CIRB and LUVAS organize *melas* separately. For its publicity and funding assistance of input agencies/SDAH, HLDB and banks may be sought. Cooperatives at village level may be utilized to mobilize dairy farmers to visit the *melas*. In this way, such an event would have wider coverage.

With regard to trainings it can be stated that number of institutions like CIRB, LUVAS, KVK, HVTI and SDAH etc are organising trainings for different types of clientele in isolation. SDAH is organising regular trainings for their field veterinarians but without the expertise of LUVAS in health aspects and CIRB in production aspects. Thus besides duplication of efforts they are also compromising on the quality of training. Therefore to do it more professionally different agencies should jointly prepare a training calendar looking into the strengths of each other While developing such a training schedule, care should be taken in identifying relevant topics and matching these with appropriate institutions to impart training to the farmers and other stake holders. For example, CIRB should focus on improved animal/buffalo husbandry, NDRI on dairy processing and entrepreneurship while LUVAS on health aspects so that their efforts are complemented. Areas of trainings should be determined on the basis of training needs of the farmers. Agencies like ATMA may provide funding for this purpose.

All the agencies of dairy development like research institutions, development departments, NGOs financial institutions etc. are engaged in performing one or the other task .In this process it becomes imperative for these agencies to interact within and with differ rent agencies through some modes in the formal setting. Any agency working in isolation would not be helpful in enhancing the milk production of the state. These must move in a coordinated manner and for which their basic pre-requisite is their close interaction among themselves.

The effectiveness of these elements in increasing milk production is also influenced by the overall government policies, plans and programmes, agro climatic conditions of the areas as well as socio cultural milieu of the farmers. Thus all the sub systems interact with one another and work under the environment created by the government policies, agro climatic conditions and socio cultural milieu.

Since the farmers are the ultimate people who are responsible for adoption of recommended technology ,increasing the milk production and thereby dairy development of the state Thus the model envisages that these agencies interact within and between in an open environment and influence farmers. Ultimately, most important modes of interaction may be identified and those used more frequently may be used for convergence.

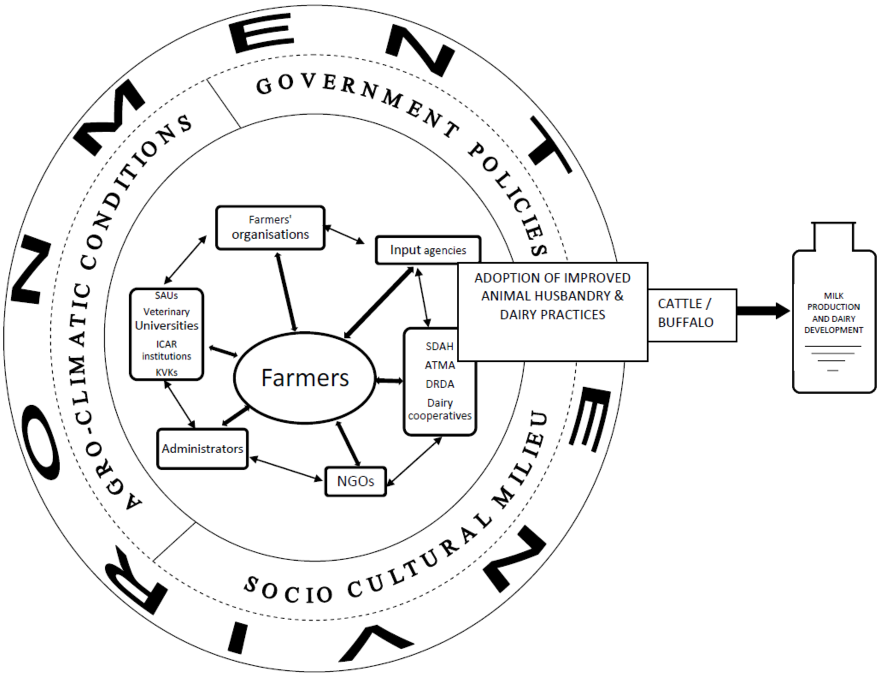

Figure 1: Dairy development system in Haryana

ROLES AND EXPECTATIONS OF STAKEHOLDERS FROM EACH OTHER

In Haryana, there are different stakeholders responsible for generating improved technologies through research. This new technology related to animal husbandry is passed on to the members of information dissemination system. The farmers are supposed to utilize this knowledge as suggested by animal scientists. The administrators and planners of different institutions like university, ICAR institutes and SDAH are responsible for framing the policies, guidelines etc. The dairy personnel are responsible for milk procurement through milk cooperatives and value addition. The input agencies/organisations are vital for supply of feeds, medicines etc. Thus, all the agencies/organisations of dairy sector are engaged in performing one or the other essential tasks. Hence, it is imperative for these agencies/organisations to seek each other’s expertise for the betterment of farmers. Therefore, they need to understand and appreciate each other’s roles and functions so that planning, implementation and evaluation of dairy development programmes can be effectively carried out .

LOCAL NEEDS, PROBLEMS AND OTHER ISSUES

The participatory planning process jointly by different research institutions of dairy development like NDRI, CIRB, LUVAS, development departments like state department of animal husbandry, dairy cooperatives, input agencies etc. may identify local needs and problems. For example to meet local needs of fodder, ATMA may be approached for financial support.

IDENTIFICATION OF SCHEMES AND ACTIVITIES

Annual plan and activities of stakeholders of dairy development like ATMA, DRDA, RKVY may be studied and discussed at the district level consultation to address the identified needs. Since the introduction of appropriate livestock technologies is envisaged as an integral part of convergence planning for dairy development. Therefore, it is an opportunity to the technical institutions to reorient their R & D activities and make them relevant to field problems. ATMA may also allocate funds for convergence at the district level. Quantum of funds may be decided by the group.

ACTIVITY MAPPING

Consultation/workshops with stakeholders at various levels to be undertaken. They may enable the related agencies departments to prepare new activity mapping and time frame for collective actions as per the outcomes/suggestion emerged in the workshop.
To effectively address the issue of convergence, a daylong meeting was held at CIRB to deliberate and delineate the roles and expectations of stakeholder agencies working for Animal Husbandry & Dairy development towards strengthening extension services on convergence mode. Participants represented various research & development institutions like CIRB, LUVAS, CCS HAU, Director ATARI (Zone-I), development departments like Animal Husbandry, HLDB, DRDA, ATMA, Dairy Cooperatives, Financial institutions like banks and private agencies. A few progressive farmers also actively participated and expressed their views. Major recommendations emerged are given as under:

RECOMMENDATIONS

1. There are various agencies, both in public and private sectors, providing extension services in animal husbandry and dairy development areas. Convergence of extension efforts at the district level and below on supplementary and complementary mode is recommended, taking into consideration, issues like core competencies, comparative advantages, programmatic coverage to the advantages of both, as also financial support benefiting each other. Such an arrangement if worked out on matrix mode would facilitate effective use of resources, avoid overlaps and achieve desired impact. Existing extension delivery mechanism in animal husbandry and dairy development sectors may be strengthened by enhancing interdepartmental interfaces, stakeholder workshops, adopting commonly agreed training strategies and collaboration in developing joint actions in field programmes. Training Modules on Extension Convergence need to be developed and operated at the district level by ATMAs, KVKs and other private agencies. CIRB, SDAH, NDRI may provide specialized input in the process *viz*. more emphasis on skill development.
2. ATARI (Zone-1) in collaboration with SAMETI may take this initiative forward. These training modules would facilitate improving the convergence competencies of field functionaries of the concerned development departments, ATMA functionaries at the districts and block levels, SMSs of KVKs, para-vets and NGO field forces. These modules when developed and agreed up on, may be up loaded on the websites of the respective agencies for wider use by the stakeholders.
3. District level plans developed under various schemes like District Profile of KVKs, Strategic Research and Extension Plan of ATMA, Comprehensive-District Agriculture Plan of RKVY,

Potential Linked credit Plan of NABARD, District Irrigation Plan of PMKSY, etc need to be analyzed to assess the Animal Husbandry & Dairy Development priorities reflected in them and resultant extension strategies required to achieve those priorities. Departments may sensitize each other about their programmes.

4. There appears a great possibility of promoting Animal Husbandry programmes through DRDA support. ATMA, Hissar may examine the DRDA provisions and support that could be availed from DRDA, Hissar in strengthening AH&D production and extension services.
5. Issue of financial support for fodder seed production to meet the seed shortage was discussed. ATMA Hissar, would be approached this purpose. PD, ATMA assured positive action in the matter.
6. Sharing of infrastructural facilities like community radio of CCSHAU and ICT facilities of different departments may be looked into by different stakeholders involved in animal husbandry and dairy development so as to cater to extension needs of the farmers in a better way. Better linkages between KVKs of CCSHAU and PVKs of LUVAS is the need of the hour.
7. Convergence can bring in shared values and responsibilities on supplementary and complimentary mode. Therefore, joint actions for serving dairy farmers may be undertaken promoting multi stakeholders' involvement around targeted programmes to obtain wider impact. MOU based arrangements may be considered to strengthen the convergence and integrated approach in extension with ultimate aim of dairy development.

Community Based Tank Management in AP and Telangana states

Dr. R. Ratnakar, Former Team leader, External M&E, and
Dr. Joseph Plakkoottam, Former M&E Expert, PMU

Water is a prime natural resource, a basic human need and a precious national asset. Water as a resource is indivisible; rainfall, river waters, surface ponds, tanks and lakes and ground water are part of a single unit, which needs a holistic and efficient management to ensure their long-term quality and availability. Historically minor irrigation structures have an important place in Indian agriculture and rural life.

The AP TS CBTMP, supported by the World Bank, envisaged renovation and rehabilitation of about 3000 tanks in 499 mandals spread over 21 districts of combined Andhra Pradesh, except Guntur and Hyderabad. The project tanks cover a command area of approximately 6.25 lakh acres (2.5 lakh hectares). The project was to be completed in three phases over a period of five years. The project period was extended twice up to nine years (up to July 2016). As part of effort to promote community participation, Andhra Pradesh Telangana State Community Based Tank Management Project (AP TS CBTMP) was initiated to focus attention on revival, restoration and rehabilitation of minor irrigation tanks with community based approach.

The main objective of the project is to improve agricultural productivity of tank based producers and enable Water User Associations (WUAs) to manage tank system effectively.

The main components of the project are:

A. Strengthening community based institutions to assume responsibility for tank system improvement and management;
B. Tank systems improvement, and Participatory Groundwater Management
C. Agricultural livelihoods support services; and
D. Project Management

External Monitoring and Evaluation (EME): As per PIP the External Monitoring Agency is expected to undertake (i) baseline survey; (ii) monthly monitoring of implementation and outputs; (iii) two impact/ outcome assessments of the project (MTR and final); (iv) social and environment management audits; (v) systematic monitoring of project impact through repeated monitoring of the same set of tanks, WUAs and households (panel data analysis) from the beginning to end of the project.

End Project Impact on productivity enhancement and Management of tank system by WUAs (2016)

Water Productivity: Productivity is a ratio between a unit of output and a unit of input. Here, the term water productivity is used exclusively to denote the amount or value of product over volume or value of water depleted or diverted. The value of the product might be expressed in different terms such as biomass, grain, or money. For example, the so-called 'crop per drop' approach focuses on the amount of product per unit of water. Water productivity means the economic yield in terms of rupees per hectare-meter of water.

Tank Water Productivity (Surface water): Water productivity is a focused subject in the AP TS CBTMP and a lot of efforts have been made to assess it. Over the project period, there has been significant improvement in water productivity in project tank ayacut. Improvement in irrigation efficiency and water use efficiency played a complementary and supplementary role in enhancing tank water productivity in the Project. An increase of 38 per cent in tank water productivity was evident during Project Impact Assessment (Rs. 39,606/ ha-m) survey, which improved from Rs.28708/ha-mtr. over Midterm (baseline) value. Water productivity improvement was a clear reflection of improved irrigation efficiency by reducing application and conveyance losses to field coupled with improvement in productivity of crop yields.

Irrigation Efficiency: Improved irrigation canals are quite evident among project tanks. Tank command area irrigated was 54 per cent during baseline (2007-08) and has improved to 82.0 percent showing an increase of 28.0 per cent over baseline.

Tank systems Improvement: Improvement in irrigation efficiency by reducing losses and increased application efficiency is the key factor resulted in enhanced tank water productivity.

Water productivity improvement was a clear reflection of improved irrigation efficiency by reducing application and conveyance losses to field coupled with improvement in productivity of crop yields. The irrigated area is increasing in a straight line manner as the External M&E surveys were conducted in progressive time interval. The rate of increase is 10.79 ha from base line survey and it is significant at 5% level. The compound growth rate of irrigated area is 0.142.

Water Productivity (Groundwater): AP TS CBTMP has integrated Participatory Groundwater Management (PGM as an essential component of tank systems improvement.

The objective of this sub-component is to enable groundwater users in those tank systems that are subject to groundwater stress, to improve the management of their groundwater resources, and thereby enhance their agricultural productivity and livelihoods.

PGM was implemented in 314 project tanks falling in critical and over-exploited groundwater assessment units of the state, for effective groundwater management. PGM farmers are able adopt the best groundwater management practices based on Crop Water Budgeting, resulted in enhanced value of put per unit groundwater usage.

APCBTMP was declared as the 2nd ranked finalist for 'Water for Life' UN-Water Best Practices Award 2014 edition, announced at the UNU Headquarters, Tokyo on 21 March 2014 the eve of the World Water Day.

Value of Crop output per unit of groundwater use is the key factor to understand the effectiveness of the participatory groundwater management in the select project tanks. Progress of income per unit of groundwater use was arrived based on the survey/study by the External Monitoring and Evaluation Team during project period at different time intervals is graphically presented**.** This key performance indicator was compared by calculating at constant prices to avoid erroneous comparison. An increase of Rs. 23,336 of value of crop output per unit (ha.m) of groundwater among groundwater groups was noticed from baseline (MTR study) of Rs 59,920/- to Rs 83,256/-, which is a notable increase of 38.9% per cent against the end project target of 25 per cent.

Conjunctive Use: "Conjunctive use refers to efforts planned at the scheme and basin levels to optimize productivity, equity and environmental sustainability by simultaneously managing surface and groundwater resources." (ARD 2006)

AP TS CBTMP: conjunctive use: The conjunctive use of surface and ground water resulted in higher crop productivity. The ground water from wells and bore wells under Tank Command area was utilized for initial field preparation, nursery raising of paddy and for supplementary irrigation of maize and ground nut. All the borewells in the project tank influence area are being recharged and used to cultivate crops like maize, sugarcane, chillies, vegetables, pulses and also paddy.

Cropping Pattern and Crop Diversification: There has been gradual decrease in paddy cultivated area with a corresponding increase in cultivation area of other crops, which is desirable for crop diversification. During baseline survey the percentage of paddy in selected tanks was 85.5 and now during FEPIS it was 74.6 per cent during *kharif*. Similarly, during *rabi* it was 71.2 per cent and during FEPIS it was 66.2 per cent overall the paddy was 69.7 per cent against 83 per cent during baseline. Next to paddy area, maize occupied considerable area during *kharif* season and *rabi* season in certain districts of the AP & TS states

A special mention to be made regarding pulses viz., redgram, greengram etc. were 0.2 and 2.1 per cent at baseline increased to 3.58 and 2.65 per cent of total area with an increase of 3.38 and 0.5 per cent during FEPIS. Overall pulses area increased from 2.3 per cent at base line increased to 6.23 per cent at the end of project period. As a result of this change in cropping pattern and crop diversification the non-paddy area increased from 17 per cent at baseline to 30.26 per cent in FEPIS. Paddy followed by paddy, Cotton and redgram.

Cropping Intensity: Selection of short duration low water requiring crops in sequence cropping, provided an opportunity for enhancement of cropping intensity. Interventions on improved cultivation practices, the cropping intensity increased from 103.3 per cent (Baseline-2007-08) to 137.8 per cent during 2015. Crops like maize, groundnut, tomato, chillies, and vegetables were included in sequence cropping in majority of the tanks as a second crop under conjunctive use of irrigation.

Crop Productivity: Crop productivity enhancement is the project development objective through introduction and demonstration of improved production technologies in tank ayacut area, in addition to increasing ayacut area through tank system development and maintenance. There was a marked increase in yields of major crops monitored for the project purpose viz., maize, groundnut and tomato followed by rice and tomato (vegetable) crops. It was observed that there was an of 36.3 per cent in paddy productivity from 44.33 q/ha at baseline period to 60.42 q/ha. Similarly in maize, the productivity increased from 32.8 q/ha to 56.5 q/ha by 72.3 per cent over baseline period. Groundnut yields also have shown remarkable improvement (112.5%) as compared to the yields recorded during baseline survey. Tomato yield also improved from base line period value of 280 q/ha to 392 q/ha at FEPIS registering 40 per cent increase.

Adoption of Improved Cultivation practices: The achievement in terms of cultural practices adoption was 60per cent followed by 64 per cent under INM, 58 per cent on IPM and 48.8 per cent on soil testing. On overall basis, the improvement in adoption of improved cultivation practices by the farmers of selected project tanks increased by 28.6 per cent over baseline period.

Adoption of water saving technologies: The baseline data indicated that the adoption of micro irrigation (sprinkler and drip) was quite low in selected tanks at the time of inception of the project. However, the pace of adoption of these water saving technologies started getting momentum gradually. The FEPIS survey found drip system used by 4 per cent and sprinklers by 5 per cent farmers. Alternate wetting in paddy, mostly during *rabi* season was adopted by 70 per cent farmers. Among all the technologies, ridge and furrow technology was adopted by around 21 per cent maize farmers.

Fish Productivity: The productivity of fish in project tanks increased from 1.25 q per ha. of effective water spread area (EWSA) at baseline survey to 5.3 q per ha of EWSA. The increase in fish productivity was 4.24 times from base line. There was an increase in fish productivity of 202 per cent over pre project.

Strengthening Community based Institutions (WUAs): Majority of water user associations were successful because of undisputed and devoted leadership among farmers; proper discipline among the members of the association for managing the water, maintaining the tank system and following the norms of the WUA; training to farmers on group functioning, water management, agriculture productivity; subsidies and incentives to farmers as volunteers ; good rapport between farmers and officials; and above all reliable water supplies even for tail end farmers. It was manifested in the gram sabha meetings (95%), cash book maintenance (89%), water charges collection (84%), fisheries lease share amount collection (91%), satisfaction of WUA members over O & M by WUA (82%).

Water Management by WUAs: The topmost priority of the WUA is the proper management of the tank water. Before adoption of PIM, the state government used to take care of management of water bodies by appointing lascars. However, this was not found in all tanks. With regard to mode of water distribution, Regulated (only day time) with rotation is major system with 72 % of the WUAs practicing the system followed by continuous with rotation system practiced by 28 % WUAs.

Socio Economic Development: Socio-economic parameters of the sample households were assessed starting from baseline to FEPIS at different periods of time. There is an increasing trend at 5.18%, 12.39% and 16.93% for tail end, middle and head reach household categories in possessing the important farm implements like tractors, weeders, threshers and harvesters. This could be attributed to the project impact. This was analysed based on the percent of households engaged in agriculture at different surveyed periods i.e., from baseline to FEPIS period. The % change over baseline to FEPIS in project area was 15.4% and the same in control was 12.4%. The incremental change was only 3%. During initial years the project has not shown any impact in generating additional net income and subsequently increased at increasing rate. Generally, impact of any development project will be visualized only after 2 or 3 years of implementation.

ECT COST
Particulars May-08 May-09 May-10 May-11 May-12 May-13 May-14 May-15 May-16 Total
A. Institutional Strengthening

Post Project Sustainability: The Way Forward: *The following suggestions would lead to greater project impact resulting post project Sustainability and improved implementation of future projects.* Federate the tank WUAs at Mandal and District level. Facilitate Linking the Federations, WUAs and lead farmers with the technical and social organizations such as, SERP, NABARD, Farm Universities, local research stations, input industries, development departments and expert NGOs. Federated and strengthened WUAs would result in post project sustainability.

Mission Kakatiya in Telangana State: an Innovative model

The objective of Mission Kakatiya is to enhance the development of agriculture based income for small and marginal farmers, by accelerating the development of minor irrigation infrastructure, strengthening community based irrigation management and adopting a comprehensive programme for rest.

The major benefits of the Restoration of Tanks

• irrigated area expansion by covering gap

• technology impacts through adoption of resource conservation-cum-production technologies when the project is fully implemented.

• diversification to cover irrigated area under high-value and low water intensified crops such as chillies, maize and vegetables.

• development of fisheries, improvement of livestock.

• reduction in waterlogged area.

• increase in groundwater levels and water quality there by getting the lands beyond command area under bore well irrigation.

• power savings due to the reduced need for well irrigation that is currently used to supplement the insufficient tank water.

A study by ICRISAT

- Moisture retention capacity has increased in farms.
- When local farmers used silt lifted from the water bodies, moisture went up by 4 to 7 days according to a pilot study by ICRISAT recently.

- addition of tank silt by 50 to 375 tractors loads per/ha. Improved available water content by 0.002 to 0.032 g. in the soil.
- An increase inclay was noticed from 20 to 40 per cent in the route zone. Decrease in course and fine sand was also noticed while there was no change in Ph., Ec and organic carbon. change was observed in available nitrogen, potassium, phosperous and a moderate reduction in sulpher. The silt addition also expected to reduce the chemicals by 30%, reduce in no. of wettings.
- Higher plant population, higher plant height resulted increase in net income of the farmer.
- Saving on fertilizers and pesticides from Rs. 2005 to 3750 per/ha. In cotton

Towards Wise Water Use

Sharing by all water users (surface and ground water) should be encouraged which will lead to social regulation

Provide pipes for proper water conveyance, avoiding wastage and encouraging sharing and equity

Build into the project cost of pipes and other micro-irrigation devices/equipment

Community consensus on any new groundwater extraction for drinking water or sharing only

Promote wise water use

Promote energy efficient pumping systems and practices

CONCLUSION: The impact of End project has been assessed by comparing the post-project situation with the pre-project situation as well as by comparing control. Institution development through vigorous capacity building has been a contributing factor for the success of PIM. AP TS CBTMP strengthened these efforts in the project area. Rise in farm income, ultimately the enhancement of livelihoods of direct and indirect stake holders of these irrigation projects has been achieved. This can be attributed to the change in cropping pattern and enhanced secondary groundwater recharge, happened due to rehabilitation of minor irrigation tanks in the Projects.

DISTRICT-WISE DEMAND AND SUPPLY OF FODDER (CROP RESIDUES) PRODUCTION IN KARNATAKA – A GAP ANALYSIS

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ABSTRACT

The study was undertaken to assess the present demand and supply of fodder production in different districts of Karnataka and also to identify the districts with high vulnerability for fodder shortage based on their rainfall pattern. For the study, the secondary data was collected from the Animal Husbandry and Veterinary Department, Bengaluru and

Natural disaster monitoring center, Government of Karnataka. The results revealed that Kolar, Mandya, Bidar, Yadgir, Chickmagalur, Dakshina Kannada, Udupi and Uttara Kannada were considered as highly vulnerable districts whereas Bengaluru urban, Ramanagara, Chickballapur, Tumkur, Belgaum, Gulbarga, Dharwad, Bagalkote and Shivamogga come under moderate vulnerability category towards fodder shortfall. The remaining districts like Bengaluru rural, Chitradurga, Mysore, Bellary, Chamrajnagar, Davanagere, Bijapur, Raichur, Gadag, Haveri, Koppal, Hassan and Kodagu have less vulnerability of fodder deficit and also act as surplus districts to fulfill the fodder requirement of other deficit districts of Karnataka. So the government has to take a necessary action towards it and improve the fodder production status in Karnataka by proper procurement, transportation, conservation and distribution of excess fodder to the deficit districts, organizing fodder banks to supply the seeds and root slips at reasonable rate in adequate quantity to the farmers.

Key Words: Fodder, Demand, Supply, Gap, Karnataka.

INTRODUCTION

Crop economy is considered as a dominant sector contributing about three fourth of total agricultural income. Although animal husbandry and dairying acts as a continuous supplementary to crop production, they play a major role in the agricultural economy (Kannan, 2012). It is argued that the recent high growth in agricultural sector is mainly contributed by a respectable growth from the livestock sector. Livestock sector plays a multifaceted role by its significant contribution to agricultural economy. The livestock sector provides livelihood support, employment generation opportunities, asset creation, recurring income and social and financial security to millions of households (Shah *et al.*2011). India has one of the largest livestock populations in the world and one of its prominent characteristics is that almost its entire feed requirement is met from crop residues and byproducts like grasses, weeds and tree leaves gathered from cultivated and uncultivated lands; and grazing on common lands and harvested fields (Dikshit and Birthal, 2010). Land allocation to cultivation of green fodder crops is limited and has hardly ever exceeded 5 per cent of the gross cropped area (Government of India, 2009). Due to ever increasing pressure of human population, arable land is mainly used for food and cash crops, thus there is little chance of having good quality arable land available for fodder production (Nayak *et al* 2010). The major problem being faced by this sector is shortage of quality fodder. Birthal and Jha (2005) have found feed scarcity as the main limiting factor in improving livestock productivity. In fact, traditionally crop and livestock sectors are interrelated to each other. The interactions between these two sectors are so complex that it would be difficult to separate out the contributions from each sector. The crop sector mainly supplies fodder to livestock, while livestock provides manure and draught power to crop sector.

With the increase in per capita income and urbanization, the consumption of livestock products will continue to rise in the foreseeable future. Consequently, the demand for feed and fodder for fulfilling the requirement of livestock population will also increase. According to Dikshit and Birthal (2010), India's livestock sector requires 855 MT of green fodder, 526 MT of dry fodder and 56 MT of concentrates by the year 2020. Fodder availability needs to be ensured if livestock is to be sustained at farm level (Biradar and Kumar, 2013). The regional deficits are more important than the national deficit, especially for fodder, which is not economical to transport over long distances. Feed and fodder account for significant proportion of cost in production of livestock products. Fodders are bulky in nature and difficult to transport from one place to another place due to its high cost of transportation which is uneconomical to the farmers. Generally, they are treated as non-tradable commodity in any economic analysis. The fodder crops are known to be cheaper source of nutrients as compared to concentrates and hence useful in bringing down the cost of feeding and reduce the need for purchase of feeds/ concentrates from the market. As the Indian farmers depend on monsoons, frequent crop failures occur due to low rainfall and natural calamities. The present study was undertaken to assess the present demand and supply of fodder production in different districts of Karnataka and also it identifies the districts with high vulnerability for fodder shortage with respect to their rainfall pattern and the percentage gap between the demand and supply of green fodder during 2016.

METHODS AND METHODOLOGY

For the purpose of the present study, district-wise data on livestock population was collected for different species viz., cattle, buffalo, sheep and goat, for the census period 2012. The data on district wise crop production in Karnataka during 2014-15 was collected from the Animal Husbandry and Veterinary Department, Bengaluru. In this study, the word "fodder" refers to crop residues as in India, farmers will not grow the fodder separately for feeding the animals. So to feed the livestock, crop residues were used as green fodder. With this data, the present fodder requirement for the livestock population was estimated using feed chart by National Institute of Animal Nutrition and Physiology, Indian Council of Agricultural Research recommendation as 5 kgs/day/animal for Cattle & Buffalo and 1 kg/day/animal for sheep and goat on dry matter basis. The percentage of gap between demand and supply of fodder for different districts in Karnataka was estimated using the following formula and the similar methodology was applied by Nayak *et al* (2010).

Gap percentage = (Production/Requirement) -1

Based on the calculated gap percentage, the districts of Karnataka were classified into three groups as High negative gap percentage (>-10%), low gap percentage (-10% to +10%) and high positive gap percentage (>10%). The cumulative rainfall pattern of different districts of Karnataka (January 1995 to November 2016) was collected from Natural disaster monitoring center, Government of Karnataka. The average of cumulative rainfall from 1995 to 2015 for each district was calculated. The districts of Karnataka were divided into two groups as less rainfall group and high rainfall group by comparing the present rainfall pattern with the average rainfall for the respective district. If the cumulative rainfall during 2016 is more than the average rainfall of particular district, then it will fall under high rainfall group and if it is less than the average, then it will come under less rainfall group. Based on this rainfall pattern among different districts of Karnataka and the percentage of gap between the demand and supply, the districts were classified into six categories and presented in Table 1.

Table 1: Classification of districts based on gap% and its rainfall pattern

<table>
<tr><th>S.No.</th><th>Category</th><th>Content</th><th></th></tr>
<tr><td>1</td><td>Category 1</td><td>High negative gap% (>-10%) & less rainfall</td><td rowspan="2">Highly vulnerable</td></tr>
<tr><td>2</td><td>Category 2</td><td>High negative gap% (>-10%) & more rainfall</td></tr>
<tr><td>3</td><td>Category 3</td><td>Low % gap (-10% to +10%) & less rainfall</td><td rowspan="2">Moderate vulnerable</td></tr>
<tr><td>4</td><td>Category 4</td><td>Low % gap (-10% to +10%) & more rainfall</td></tr>
<tr><td>5</td><td>Category 5</td><td>High positive gap% (>10%) & less rainfall</td><td rowspan="2">Less vulnerable</td></tr>
<tr><td>6</td><td>Category 6</td><td>High positive gap% (>10%) & more rainfall</td></tr>
</table>

RESULTS AND DISCUSSION

The percentage deviation of cumulative rainfall 2016 from its average rainfall in different districts of Karnataka was presented in the Table 2. The data revealed that all the districts of Karnataka come under “less rainfall areas” except Gulbarga and Bidar when compared with the average rainfall. Though Bidar and Gulbarga come under “More rainfall areas”, the rainfall in these areas are irregular and spontaneous.

Table 2: District-wise Cumulative rainfall 2016 and its comparison with average rainfall in Karnataka

S.No	DISTRICTS	Cumulative Rainfall (1stJan - 15th Nov2016)	Average rainfall (1995 to 2015)	% deviation	Status*
South Interior Karnataka					

1	Bengaluru U	649	941	-31.03	L
2	Bengaluru R	663	855	-22.46	L
3	Ramanagara	524	897	-41.58	L
4	Kolar	521	823	-36.70	L
5	Chickballapur	509	755	-32.58	L
6	Tumkur	479	772	-37.95	L
7	Chitradurga	305	645	-52.71	L
8	Davanagere	455	673	-32.39	L
9	Chamarajnagar	382	773	-50.58	L
10	Mysore	421	807	-47.83	L
11	Mandya	441	772	-42.88	L
North Interior Karnataka					
1	Belgaum	605	783	-22.73	L
2	Bellary	380	624	-39.10	L
3	Bidar	1077	871	23.65	M
4	Yadgir	599	724	-17.27	L
5	Gulbarga	824	738	11.65	M
6	Bijapur	451	599	-24.71	L
7	Dharwad	479	724	-33.84	L
8	Raichur	459	651	-29.49	L
9	Bagalkote	369	579	-36.27	L
10	Gadag	353	624	-43.43	L
11	Haveri	442	760	-41.84	L
12	Koppal	393	618	-36.41	L
Malnad					
1	Hassan	737	1065	-30.80	L
2	Shivamogga	1394	1794	-22.30	L
3	Chickmagalur	1165	1826	-36.20	L
4	Kodagu	1769	2509	-29.49	L
Coastal					
1	D. Kannada	2895	3707	21.90	L
2	Udupi	3381	4005	15.58	L
3	U. Kannada	2184	2798	21.94	L

* L - Less than the average rainfall; M- More than the average rainfall

The present study on demand and supply of fodder production in different districts of Karnataka was presented in the Table 3 and Fig 2. The district –wise vulnerability for fodder shortage in Karnataka was depicted in the Fig 1. From the table 3, it was revealed that the production of crop residues was in hand to mouth condition in the districts like Bengaluru urban, Ramanagara, Chickballapur, Tumkur, Belgaum, Gulbarga, Dharwad, Bagalkote and Shivamogga to fulfill the fodder requirement of livestock population in the respective districts, whereas the surplus crop residues production was seen in Bengaluru rural, Chitradurga, Mysore, Bellary, Chamrajnagar, Davanagere, Bijapur, Raichur, Gadag, Haveri, Koppal, Hassan and Kodagu and also it can be provided to deficit districts if it is properly pooled and managed. The crop residues production was deficit to meet out its requirement for livestock population in Kolar, Mandya, Bidar, Yadgir, Chickmagalur, Dakshina Kannada, Udupi and Uttara Kannada. The percentage of vulnerability for fodder shortage was high in Kolar, Bidar, Dakshina Kannada, Udupi and Uttara Kannada. This can be attributed to the high livestock population and higher preference towards cash crops by farmers. Paddy, maize, sorghum, Ragi and groundnut were the major crops grown in Karnataka.

Table 3:District-wise status and vulnerability for fodder shortage in Karnataka

DISTRICTS	Fodder Production status (tonnes)			Gap (%)	Major crops
	Production	Requirement	Status		
South Interior Karnataka					
Bengaluru U	285810	309228.7	-23418.8	-7.60	Ragi
Bengaluru R	509652.7	409389.5	100263.2	24.50	Ragi and Maize
Ramanagara	621947	629900.9	-7953.95	-1.30	Ragi
Kolar	314790	695661.9	-380872	-54.70	Ragi
Chickballapur	703201.6	743554.6	-40353	-5.40	Ragi and Maize
Tumkur	1670112	1799138	-129026	-7.20	Ragi
Chitradurga	1368084	1209983	158101	13.10	Ragi, groundnut, Maize
Davanagere	2937361	1089970	1847390	169.50	Paddy and maize
Chamarajnagar	682076.6	601655.8	80420.8	13.40	Maize
Mysore	1452989	1226960	226029.2	18.40	Paddy, Ragi, Maize
Mandya	993458.3	1154989	-161531	-14.00	Paddy and Ragi
North Interior Karnataka					
Belgaum	2803640	3062893	-259254	-8.50	Maize, Sorghum, paddy
Bellary	1962601	1231948	730652.6	59.30	Maize, Sorghum, paddy
Bidar	178925.7	752208.1	-573282	-76.20	Sorghum
Yadgir	677863.1	970444.5	-292581	-30.10	Paddy and sorghum
Gulbarga	1179185	1202626	-23441	-1.90	Sorghum
Bijapur	1274018	995087.1	278931.3	28.00	Sorghum and maize
Dharwad	581250.2	548446.1	32804.13	6.00	Sorghum and maize
Raichur	1448980	1244339	204640.4	16.40	Paddy and sorghum
Bagalkote	1283013	1324740	-41727.3	-3.10	Sorghum and maize
Gadag	801955.1	505021.3	296933.8	58.80	Sorghum and maize
Haveri	1684348	838715.3	845633.1	100.80	Maize, paddy &

Koppal	1321891	874142.2	447748.5	51.20	sorghum
Malnad					
Hassan	1890084	1459529	430554.7	29.50	Ragi and Maize
Shivamogga	1358038	1344945	13092.92	1.00	Paddy and maize
Chickmagalur	655019.1	795557.7	-140539	-17.70	Maize, Ragi & paddy
Kodagu	222176.3	191152.7	31023.61	16.20	Paddy
Coastal					
D. Kannada	257859.5	478868.3	-221009	-46.20	Paddy
Udupi	273751.1	478600.8	-204850	-42.80	Paddy
U. Kannada	376147.8	780223.6	-404076	-51.80	Paddy

The districts of Karnataka were classified into six categories based on its percentage of gap between the demand and supply of fodder and rainfall pattern which was presented in the Table 2. The results revealed that Mandya, Kolar, Yadgir Chickmagalur, Dakshina Kannada Uttara Kannada and Udupi were the districts that comes under the category "high negative gap% and less rainfall as the district has high livestock population which increases its fodder requirement to feed them but the actual rainfall was very less than the average rainfall that directly affects the production. Bidar was the only district which comes under the category of high negative gap% and more rainfall. Eventhough Bidar has received higher rainfall than average rainfall (23 %), its negative gap percentage was high due to its rainfall pattern which was not regular and stable throughout the year and also due to the high livestock population with less fodder production sometimes even land remains barren. Thus, the districts coming under the above two categories were considered as highly vulnerable districts for fodder shortage with respect to their rainfall pattern during the year. The districts like Dharwad, Tumkur, Bagalkote, Chickballapur Bengaluru Urban, Belgaum, Ramanagara and Shivamogga comes under the less gap percentage and less rainfall category. Though the rainfall in Dharwad and Shivamogga was less, the production of fodder was sufficient to fulfill the requirement of livestock population if it is properly pooled and managed whereas in case of other districts in this category, the production was slightly less to fulfill the requirement due to the less rainfall in these areas. Gulbarga was the only district with more rainfall and less gap percentage. Thus the districts under these two categories were considered as moderately vulnerable districts because a slight change in fodder production aspects or rainfall pattern may lead these districts to high vulnerability for fodder shortage in both quality and quantity manners.

Table 4: Vulnerability of fodder shortage and rainfall status in different districts of Karnataka 2016

Category	Less Rainfall	More rainfall
High negative gap % (High Vulnerable) (>-10%)	Mandya, Kolar, Yadgir Chickmagalur, D.Kannada U.Kannada and Udupi	Bidar
Low gap % (Moderate Vulnerable) (-10% to +10%)	Dharwad, Tumkur, Bagalkote,Chickballapur Bengaluru U, Belgaum, Ramanagara, Shivamogga	Gulbarga
High positive gap % (Less Vulnerable) (>10%)	Chitradurga, Mysore, Gadag, Haveri, Koppal Raichur, Chamarajnagar, Bellary, Davanagere Bijapur, Bengaluru R, Hassan and Kodagu	--------

Though the districts like Chitradurga, Mysore, Gadag, Haveri, Koppal, Raichur, Chamarajnagar, Bellary, Davanagere, Bijapur, Bengaluru R, Hassan and Kodagu has less rainfall but their production level not only fulfills the requirement of the particular district but also can be considered as surplus districts which can supply the excess fodder to the deficit areas. Thus, these districts falls under the category "high positive gap percentage and less rainfall". Though these districts were considered as surplus districts but still the farmers after harvesting the grains they burn the crop residues. Therefore the crop residues are not available for feeding the animals. There was no district in Karnataka which falls under the category of high rainfall and also high positive gap percentage. The districts discussed above were considered as less vulnerable for fodder shortage and also as surplus districts to fulfill the fodder requirement of other deficit districts.

CONCLUSION

The study conducted on assessing the present demand and supply of fodder with respect to rainfall revealed that Kolar, Mandya, Bidar, Yadgir, Chickmagalur, Dakshina

Kannada, Udupi and Uttara Kannada were considered as highly vulnerable districts whereas Bengaluru urban, Ramanagara, Chickballapur, Tumkur, Belgaum, Gulbarga, Dharwad, Bagalkote and Shivamogga were come under moderate vulnerability category towards fodder shortfall. The remaining districts like Bengaluru rural, Chitradurga, Mysore, Bellary, Chamrajnagar, Davanagere, Bijapur, Raichur, Gadag, Haveri, Koppal, Hassan and Kodagu has less vulnerability of fodder deficit and also act as surplus districts to fulfill the fodder requirement of other deficit districts of Karnataka. So the government has to take a necessary action towards it and improve the fodder production status in Karnataka through following measures like management of available fodder, concerted efforts should be made to encourage the farmers to cultivate green fodder crops, training periodically on silage making, processing of crop residues, nutritional enrichment of fodders and azolla cultivation and in proper procurement, transportation, conservation and distribution of excess fodder to the deficit districts, organizing fodder banks to supply the seeds and root slips at reasonable rate in adequate quantity to the farmers.

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EFFECT OF ORGANIC AND INORGANIC SOURCE OF NUTRIENTS ON YIELD ATTRUBUTES AND YIELD OF GROUNDNUT (*Arachis hypogaea* L.)

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ABSTRACT

Field experiments were carried out to study the effect of different sources of organic manures and inorganic fertilizers on yield attributes and yield of groundnut at Krishi Vigyan Kendra, Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam during *Rabi* 2014 and 2015. The experiments were laid out in split-plot design consisting of twelve treatments with 3 replications. The main plot consisted of Farm yard manure @ 12.5 t ha^{-1}(M1), Vermicompost @ 5.0 t ha^{-1} (M2), Fish pond silt @ 5.0 t ha^{-1} (M3) and Composted poultry manure @ 5.0 t ha^{-1} (M4) and sub plot consisted of 100 per cent recommended dose of fertilizers NPK (S1), 75 per cent recommended dose of NPK (S2) and 50 per cent of recommended dose of NPK (S3). Data on yield parameters *viz*., Number of pods plant^{-1}, Number of kernels pod^{-1}, 100 kernel weight (g), pod yield and haulm yield of groundnut (kg ha^{-1}) were collected for different treatments. Results revealed that application of vermicompost @ 5.0 t ha^{-1} (M_2) recorded significantly higher number of pods plant^{-1} (24 and 25 nos.), higher groundnut pod yield (2488 and 2549 kg ha^{-1}) and higher haulm yield (4170 and 4279 kg ha^{-1}) as compared to other organic manure treatment in both the season. Similar trend was observed in the case of number of kernel pod^{-1} also, whereas, the 100 kernel weight was not significant due to the application of different organic manure. In addition, application of recommended dose of 100 per cent NPK (S_1) significantly recorded higher number of pods plant^{-1} (22.9 and 24 nos.), higher groundnut pod yield

(2436 and 2490 kg ha^{-1}) and higher haulm yield (4092 and 4190 kg ha^{-1}) over 75 and 50 per cent of NPK levels in both the years. However, the interaction between organic manures and fertilizer levels were not significant on number of kernel pod^{-1}, 100 kernel weight, pod yield and haulm yield of groundnut but highly significant on number of pods plant^{-1}. The study showed that groundnut crop responded well in terms of yield attributes, pod yield and haulm yield by the application of vermicompost @ 5.0 t ha^{-1} and 75 per cent recommended dose of NPK fertilizers.

Keywords: Groundnut, vermicompost, fish pond silt, composted poultry manure, yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a unique and important oilseed crop of Tamil Nadu. In Tamil Nadu, groundnut is cultivated in 3.39 lakh ha with a production of 7.85 lakh tonnes and productivity of 2751 kg ha^{-1} (2012-13). The groundnut kernel is used mainly for edible oil and contains nearly half of the essential vitamins and one-third of the essential minerals. Hence, groundnut played an important role in nutritional security to the resource poor farmers. In addition, the haulms provided excellent fodder for livestock, cake obtained after oil extraction was used in animal feed and overall the crop acted as good source of biological nitrogen fixation (Nautiyal *et al,* 2011). In recent years, crop cultivation requires the use of chemical fertilizer, but it is expensive for people who have not capacity to buy fertilizer. Therefore, the current trend is to explore the possibilities of supplementing organic manures like farm yard manure, vermicompost, poultry manure etc. Indigenously available organic sources of nutrients have enhanced the efficiency and reduced the requirements of chemical fertilizers (Bhat *et al*., 2007). Hence, it is necessary to integrate different sources of nutrients to meet the crop requirement. Sustainable yields in groundnut can be achieved through the conjunctive use of organic and inorganic fertilizers (Singh *et al*., 1990). Such integrated approach with special emphasis on combined application of inorganic fertilizers with organic manures would sound well in oilseed crops like groundnut grown under aberrated climatic conditions. Therefore, an experiment was conducted to study the effect of integrated use of organic and inorganic sources of nutrients on yield of groundnut in Kancheepuram district of Tamil Nadu.

MATERIALS AND METHODS

Field experiments were carried out to study the effect of different sources of organic and inorganic nutrients on yield attributed and yield of groundnut at Krishi Vigyan Kendra, Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam located at North Eastern zone of Tamil Nadu at lies between 11° 00' to 12° 00' North latitudes and 77° 28' to 78° 50' East longitudes during *Rabi* 2014 and 2015. The soil of the experimental site was moderately well drained, sandy clay loam in texture and chemical analysis showed low in available nitrogen (199.5 kg ha^{-1}), medium in available phosphorus (19.8 kg ha^{-1}) and high in available potassium (461.3 kg ha^{-1}), 0.55 per cent of organic carbon and 7.8 pH of the soil. The experiments were laid out in split-plot design consisting of twelve treatments (four main and three sub plots) with 3 replications. The main plot consisted of Farm yard manure @ 12.5 t ha^{-1}(M1), Vermicompost @ 5.0 t ha^{-1} (M2), Fish pond silt @ 5.0 t ha^{-1} (M3) and Composted poultry manure @ 5.0 t ha^{-1} (M4) and sub plot consisted of 100 per cent (25:50:75 kg NPK ha^{-1}) recommended dose of fertilizers (S1), 75 per cent recommended dose of fertilizers (S2) and 50 per cent of recommended dose of fertilizers (S3).

The groundnut variety *TMV-13* was used for treatment. Beds and channel were formed, layout was taken and organic manures were applied to each plot in accordance with the treatments assigned, incorporated manually and levelled. The seeds were sown in a plot size of 6.0 m x 5.0 m spaced with 30 x 10 cm for each treatment during *Rabi* 2014 and 2015. Full dose of phosphorus and potassium along with half dose of nitrogen in all the treatments was applied as basal. Remaining dose of nitrogen was applied at 30 days after sowing at the time of weeding as per the treatments. All other recommended cultural practices and prophylactic plant protection measures were followed to raise healthy crop. Observations were recorded in 10 randomly taken and tagged plants from each replication on Number of pods $plant^{-1}$, Number of kernels pod^{-1}, 100 kernel weight (g), pod yield and haulm yield of groundnut (kg ha^{-1}) of different treatments. The harvested pods yield from each net plot cleaned separately as per the moisture content and expressed in kg ha^{-1}. The haulm yield of groundnut was recorded from the net plot area after enough sun drying and expressed in kg ha^{-1}. The data on various parameters were statistically analyzed in split plot design as suggested by Gomez and Gomez (2010). Wherever the treatment difference was significant, critical differences were worked out at five per cent probability level.

RESULTS AND DISCUSSION

Yield attributes of Groundnut

The number of pods plant^{-1} and number of kernel pod^{-1} were positively influenced by the application of organic manures and different levels of NPK fertilizer, whereas 100 kernel weight of groundnut was not significantly influenced by the application of organic manures and different levels of NPK fertilizer during *Rabi* 2015 and 2015 (Table 1 and 2).

Among different organic manure application, vermicompost application @ 5.0 t ha^{-1} (M_2) significantly recorded higher number of pods plant^{-1} (24 and 25 nos.) in both the years. The composted poultry manure application @ 5.0 t ha^{-1} (M_4) was the next best treatment followed by the application of FYM @ 12.5 t ha^{-1} (M_1) during both the years. Similar trend was observed in the case of number of kernel pod^{-1} also, whereas, the 100 kernel weight was not significant due to the application of different organic manure. With regard to different NPK fertilizer levels tried, higher number of pods plant^{-1} (22.9 and 24 nos.) was observed with the application of 100 per cent recommended dose of NPK fertilizers (S_1). It was followed by the application of 75 per cent recommended dose of NPK fertilizers (S_2). These two were comparable with each other. Application of 50 per cent recommended dose of NPK fertilizers (S_3) registered lowest number of pods plant^{-1}. Similar trend was observed for number of kernel pod^{-1} also. Different levels of recommended dose of NPK fertilizers did not show any significant improvement on the 100 kernel weight during both the years.

Interaction effect between organic manures and NPK fertilizers levels was highly significant on number of pods plant^{-1} in both the years. Combined application of vermicompost @ 5.0 t ha^{-1} along with 75 per cent of recommended dose of NPK (M_2 S_2) registered higher number of pods plant^{-1} (26.3 and 27.4 nos) in both the years. It was on par with application of vermicompost along with 100 per cent of recommended dose of NPK fertilizers (M_2 S_1) in both the years. The interaction effect on number of kernel pod^{-1} and 100 kernel weight of groundnut was not at all significant in both the years.

Pod yield of Groundnut

Groundnut pod yield was significantly influenced due to the application of organic manures and different levels of NPK fertilizers during both the years. Among organic manures application, vermicompost application @ 5.0 t ha^{-1} (M_2) recorded significantly higher groundnut pod yield of 2488 and 2549 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was followed by the application of composted poultry manure treatment @ 5.0 t ha^{-1} (M_4), which recorded on yield of 2379 and 2417 kg ha^{-1}.

The lowest groundnut pod yield of 2344 and 2391 kg ha^{-1} was observed with fish pond silt @ 5.0 t ha^{-1} (M_3) during *Rabi* 2014 and 2015, respectively (Table 3 and 4).

Regarding fertilizer levels, application of recommended dose of 100 per cent NPK fertilizers (S_1) significantly recorded higher groundnut pod yield of 2436 and 2490 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was on par with the application of 75 per cent of NPK fertilizers (S_2), which recorded on yield of 2421 and 2463 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. Application of 50% recommended dose of NPK fertilizers recorded the lowest groundnut pod yield of 2323 and 2370 kg ha^{-1} in both the years. The interaction effect between organic manures and NPK fertilizer levels was non-significant on groundnut pod yield in both the years.

Haulm yield of Groundnut

Groundnut haulm yield was significantly influenced by the application of organic manures and different levels of NPK fertilizers in the both the years (Table 3 and 4). Application of vermicompost @ 5.0 t ha^{-1}(M_2) recorded significantly higher groundnut haulm yield of 4170 and 4279 kg ha^{-1} in during *Rabi* 2014 and 2015, respectively. It was followed by the application of composted poultry manure @ 5.0 t ha^{-1} (3996 and 4092 kg ha^{-1}). The fish pond silt (M_3) recorded conspicuously the lowest groundnut haulm yield. Among the different fertilizer levels tried, application of 100 per cent recommended dose of NPK fertilizers (S_1) recorded significantly higher groundnut haulm yield of 4092 and 4190 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was on par with the application of 75% recommended dose of NPK fertilizers (S_2) in both the years. The lowest groundnut haulm yield was observed with the application of 50 per cent recommended dose of NPK fertilizers (S_3). Interaction effect between organic manures and fertilizer levels did not exhibit any significant variations on the haulm yield of groundnut in both the years.

Number of groundnut pods plant^{-1}, pod yield and haulm yield was positively influenced by the application of organic manures and different levels of NPK fertilizer during both the years. Combined application of vermicompost and 75 per cent of recommended dose of fertilizers recorded significantly higher yield compared to lower level of NPK fertilizers. The yield improvement could be attributed to continuous availability of nutrients, growth promoting effect of vermicompost and ultimately leads more photosynthetic activities, cell division and cell elongation, enhanced carbohydrate as well as metabolic process and improvement of soil structure by increasing the soil water holding capacity, good aeration, which encourages better root growth and nutrient uptake. These results were corroborated with the findings of Ramasamy and Umapathi, (2010). The beneficial effect of vermicompost on yield and yield attributes might be attributed to its ability of sustain availability of nutrients throughout the growing season. The increased balanced C:N ratio might have increased the synthesis of carbohydrates with ultimate improvement in yield and yield attributes. These findings corroborate with those of Mathivanan *et al*. (2012), Kondappa *et al.* (2009) and Yadav and Yadav (2010).

- Poultry manure is excellent organic manure, since it contains high amount of nitrogen, phosphorus, potassium and other essential nutrients. Poultry manure improves the number of pods per plant, pod yield and haulm yield in groundnut as reported by Subrahmaniyan *et al*. (1999). Groundnut being a leguminous crop, capable of fixing atmospheric nitrogen and application of fertilizers including gypsum with organic manures enhanced the productivity of groundnut. Veeramani *et al.* (2012) observed similar findings.

In agricultural land soil fertility depletion is an important draw back due to continuous cultivation with inorganic nutrients. In order to increase the soil fertility, inorganic fertilizers are being widely utilized in cultivable lands. Even though they promote the growth of crops, their toxic effect is the negative impact by means of their over utilization of fertilizers. To overcome these factors, the combined application of organic manure especially vermicompost, poultry manures and farm yard manure along with NPK fertilizers is recommended. The study showed that the yield attributes, pod yield and haulm yield parameters of groundnut were enhanced by different sources of organic manures and levels of NPK fertilizers. Among the organic manure treatments, application of vermicompost performed better than the other sources through improved number of pods plant^{-1}, number of kernel pod^{-1}, pod yield and haulm yield of groundnut crop. It could be concluded that the groundnut crop responded well in terms of yield attributes, pod yield and haulm yield by the application of vermicompost @ 5.0 t ha^{-1} and 75% recommended dose of NPK fertilizers.

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ABSTRACT

Field experiments were carried out to study the effect of different sources of organic manures and inorganic fertilizers on yield attributes and yield of groundnut at Krishi Vigyan Kendra, Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam during *Rabi* 2014 and 2015. The experiments were laid out in split-plot design consisting of twelve treatments with 3 replications. The main plot consisted of Farm yard manure @ 12.5 t ha^{-1}(M1), Vermicompost @ 5.0 t ha^{-1} (M2), Fish pond silt @ 5.0 t ha^{-1} (M3) and Composted poultry manure @ 5.0 t ha^{-1} (M4) and sub plot consisted of 100 per cent recommended dose of fertilizers NPK (S1), 75 per cent recommended dose of NPK (S2) and 50 per cent of recommended dose of NPK (S3). Data on yield parameters *viz*., Number of pods plant^{-1}, Number of kernels pod^{-1}, 100 kernel weight (g), pod yield and haulm yield of groundnut (kg ha^{-1}) were collected for different treatments. Results revealed that application of vermicompost @ 5.0 t ha^{-1} (M_2) recorded significantly higher number of pods plant^{-1} (24 and 25 nos.), higher groundnut pod yield (2488 and 2549 kg ha^{-1}) and higher haulm yield (4170 and 4279 kg ha^{-1}) as compared to other organic manure treatment in both the season. Similar trend was observed in the case of number of kernel pod^{-1} also, whereas, the 100 kernel weight was not significant due to the application of different organic manure. In addition, application of recommended dose of 100 per cent NPK (S_1) significantly recorded higher number of pods plant^{-1} (22.9 and 24 nos.), higher groundnut pod yield (2436 and 2490 kg ha^{-1}) and higher haulm yield (4092 and 4190 kg ha^{-1}) over 75 and 50 per cent of NPK levels in both the years. However, the interaction between organic manures and fertilizer levels were not significant on number of kernel pod^{-1}, 100 kernel weight, pod yield and haulm yield of groundnut but highly significant on number of pods plant^{-1}. The study showed that groundnut crop responded well in terms of yield attributes, pod yield and haulm yield by the application of vermicompost @ 5.0 t ha^{-1} and 75 per cent recommended dose of NPK fertilizers.

Keywords: Groundnut, vermicompost, fish pond silt, composted poultry manure, yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a unique and important oilseed crop of Tamil Nadu. In Tamil Nadu, groundnut is cultivated in 3.39 lakh ha with a production of 7.85 lakh tonnes and productivity of 2751 kg ha^{-1} (2012-13). The groundnut kernel is used mainly for edible oil and contains nearly half of the essential vitamins and one-third of the essential minerals. Hence, groundnut played an important role in nutritional security to the resource poor farmers. In addition, the haulms provided excellent fodder for livestock, cake obtained after oil extraction was used in animal feed and overall the crop acted as good source of biological nitrogen fixation (Nautiyal *et al*, 2011). In recent years, crop cultivation requires the use of chemical fertilizer, but it is expensive for people who have not capacity to buy fertilizer. Therefore, the current trend is to explore the possibilities of supplementing organic manures like farm yard manure, vermicompost, poultry manure etc. Indigenously available organic sources of nutrients have enhanced the efficiency and reduced the requirements of chemical fertilizers (Bhat *et al*., 2007). Hence, it is necessary to integrate different sources of nutrients to meet the crop requirement. Sustainable yields in groundnut can be achieved through the conjunctive use of organic and inorganic fertilizers (Singh *et al*., 1990). Such integrated approach with special emphasis on combined application of inorganic fertilizers with organic manures would sound well in oilseed crops like groundnut grown under aberrated climatic conditions. Therefore, an experiment was conducted to study the effect of integrated use of organic and inorganic sources of nutrients on yield of groundnut in Kancheepuram district of Tamil Nadu.

MATERIALS AND METHODS

Field experiments were carried out to study the effect of different sources of organic and inorganic nutrients on yield attributed and yield of groundnut at Krishi Vigyan Kendra, Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam located at North Eastern zone of Tamil Nadu at lies between 11° 00' to 12° 00' North latitudes and 77° 28' to 78° 50' East longitudes during *Rabi* 2014 and 2015. The soil of the experimental site was moderately well drained, sandy clay loam in texture and chemical analysis showed low in available nitrogen (199.5 kg ha^{-1}), medium in available phosphorus (19.8 kg ha^{-1}) and high in available potassium (461.3 kg ha^{-1}), 0.55 per cent of organic carbon and 7.8 pH of the soil. The experiments were laid out in split-plot design consisting of twelve treatments (four main and three sub plots) with 3 replications. The main plot consisted of Farm yard manure @ 12.5

t ha^{-1}(M1), Vermicompost @ 5.0 t ha^{-1} (M2), Fish pond silt @ 5.0 t ha^{-1} (M3) and Composted poultry manure @ 5.0 t ha^{-1} (M4) and sub plot consisted of 100 per cent (25:50:75 kg NPK ha^{-1}) recommended dose of fertilizers (S1), 75 per cent recommended dose of fertilizers (S2) and 50 per cent of recommended dose of fertilizers (S3).

The groundnut variety *TMV-13* was used for treatment. Beds and channel were formed, layout was taken and organic manures were applied to each plot in accordance with the treatments assigned, incorporated manually and levelled. The seeds were sown in a plot size of 6.0 m x 5.0 m spaced with 30 x 10 cm for each treatment during *Rabi* 2014 and 2015. Full dose of phosphorus and potassium along with half dose of nitrogen in all the treatments was applied as basal. Remaining dose of nitrogen was applied at 30 days after sowing at the time of weeding as per the treatments. All other recommended cultural practices and prophylactic plant protection measures were followed to raise healthy crop. Observations were recorded in 10 randomly taken and tagged plants from each replication on Number of pods $plant^{-1}$, Number of kernels pod^{-1}, 100 kernel weight (g), pod yield and haulm yield of groundnut (kg ha^{-1}) of different treatments. The harvested pods yield from each net plot cleaned separately as per the moisture content and expressed in kg ha^{-1}. The haulm yield of groundnut was recorded from the net plot area after enough sun drying and expressed in kg ha^{-1}. The data on various parameters were statistically analyzed in split plot design as suggested by Gomez and Gomez (2010). Wherever the treatment difference was significant, critical differences were worked out at five per cent probability level.

RESULTS AND DISCUSSION

Yield attributes of Groundnut

The number of pods $plant^{-1}$ and number of kernel pod^{-1} were positively influenced by the application of organic manures and different levels of NPK fertilizer, whereas 100 kernel weight of groundnut was not significantly influenced by the application of organic manures and different levels of NPK fertilizer during *Rabi* 2015 and 2015 (Table 1 and 2).

Among different organic manure application, vermicompost application @ 5.0 t ha^{-1} (M_2) significantly recorded higher number of pods $plant^{-1}$ (24 and 25 nos.) in both the years. The composted poultry manure application @ 5.0 t ha^{-1} (M_4) was the next best treatment followed by the application of FYM @ 12.5 t ha^{-1} (M_1) during both the years.

Similar trend was observed in the case of number of kernel pod^{-1} also, whereas, the 100 kernel weight was not significant due to the application of different organic manure. With regard to different NPK fertilizer levels tried, higher number of pods plant^{-1} (22.9 and 24 nos.) was observed with the application of 100 per cent recommended dose of NPK fertilizers (S_1). It was followed by the application of 75 per cent recommended dose of NPK fertilizers (S_2). These two were comparable with each other. Application of 50 per cent recommended dose of NPK fertilizers (S_3) registered lowest number of pods plant^{-1}. Similar trend was observed for number of kernel pod^{-1} also. Different levels of recommended dose of NPK fertilizers did not show any significant improvement on the 100 kernel weight during both the years.

Interaction effect between organic manures and NPK fertilizers levels was highly significant on number of pods plant^{-1} in both the years. Combined application of vermicompost @ 5.0 t ha^{-1} along with 75 per cent of recommended dose of NPK (M_2 S_2) registered higher number of pods plant^{-1} (26.3 and 27.4 nos) in both the years. It was on par with application of vermicompost along with 100 per cent of recommended dose of NPK fertilizers (M_2 S_1) in both the years. The interaction effect on number of kernel pod^{-1} and 100 kernel weight of groundnut was not at all significant in both the years.

Pod yield of Groundnut

Groundnut pod yield was significantly influenced due to the application of organic manures and different levels of NPK fertilizers during both the years. Among organic manures application, vermicompost application @ 5.0 t ha^{-1} (M_2) recorded significantly higher groundnut pod yield of 2488 and 2549 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was followed by the application of composted poultry manure treatment @ 5.0 t ha^{-1} (M_4), which recorded on yield of 2379 and 2417 kg ha^{-1}. The lowest groundnut pod yield of 2344 and 2391 kg ha^{-1} was observed with fish pond silt @ 5.0 t ha^{-1} (M_3) during *Rabi* 2014 and 2015, respectively (Table 3 and 4).

Regarding fertilizer levels, application of recommended dose of 100 per cent NPK fertilizers (S_1) significantly recorded higher groundnut pod yield of 2436 and 2490 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was on par with the application of 75 per cent of NPK fertilizers (S_2), which recorded on yield of 2421 and 2463 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. Application of 50% recommended dose of NPK fertilizers recorded the lowest groundnut pod yield of 2323 and 2370 kg ha^{-1} in both the years. The interaction effect between organic manures and NPK fertilizer levels was non-significant on groundnut pod yield in both the years.

Haulm yield of Groundnut

Groundnut haulm yield was significantly influenced by the application of organic manures and different levels of NPK fertilizers in the both the years (Table 3 and 4). Application of vermicompost @ 5.0 t ha^{-1}(M_2) recorded significantly higher groundnut haulm yield of 4170 and 4279 kg ha^{-1} in during *Rabi* 2014 and 2015, respectively. It was followed by the application of composted poultry manure @ 5.0 t ha^{-1} (3996 and 4092 kg ha^{-1}). The fish pond silt (M_3) recorded conspicuously the lowest groundnut haulm yield. Among the different fertilizer levels tried, application of 100 per cent recommended dose of NPK fertilizers (S_1) recorded significantly higher groundnut haulm yield of 4092 and 4190 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was on par with the application of 75% recommended dose of NPK fertilizers (S_2) in both the years. The lowest groundnut haulm yield was observed with the application of 50 per cent recommended dose of NPK fertilizers (S_3). Interaction effect between organic manures and fertilizer levels did not exhibit any significant variations on the haulm yield of groundnut in both the years.

Number of groundnut pods plant^{-1}, pod yield and haulm yield was positively influenced by the application of organic manures and different levels of NPK fertilizer during both the years. Combined application of vermicompost and 75 per cent of recommended dose of fertilizers recorded significantly higher yield compared to lower level of NPK fertilizers. The yield improvement could be attributed to continuous availability of nutrients, growth promoting effect of vermicompost and ultimately leads more photosynthetic activities, cell division and cell elongation, enhanced carbohydrate as well as metabolic process and improvement of soil structure by increasing the soil water holding capacity, good aeration, which encourages better root growth and nutrient uptake. These results were corroborated with the findings of Ramasamy and Umapathi, (2010). The beneficial effect of vermicompost on yield and yield attributes might be attributed to its ability of sustain availability of nutrients throughout the growing season. The increased balanced C:N ratio might have increased the synthesis of carbohydrates with ultimate improvement in yield and yield attributes. These findings corroborate with those of Mathivanan *et al*. (2012), Kondappa *et al.* (2009) and Yadav and Yadav (2010).

Poultry manure is excellent organic manure, since it contains high amount of nitrogen, phosphorus, potassium and other essential nutrients. Poultry manure improves the number of pods per plant, pod yield and haulm yield in groundnut as reported by Subrahmaniyan *et al*. (1999). Groundnut being a leguminous crop, capable of fixing atmospheric nitrogen and application of fertilizers including gypsum with organic manures enhanced the productivity of groundnut. Veeramani *et al.* (2012) observed similar findings.

In agricultural land soil fertility depletion is an important draw back due to continuous cultivation with inorganic nutrients. In order to increase the soil fertility, inorganic fertilizers are being widely utilized in cultivable lands. Even though they promote the growth of crops, their toxic effect is the negative impact by means of their over utilization of fertilizers. To overcome these factors, the combined application of organic manure especially vermicompost, poultry manures and farm yard manure along with NPK fertilizers is recommended. The study showed that the yield attributes, pod yield and haulm yield parameters of groundnut were enhanced by different sources of organic manures and levels of NPK fertilizers. Among the organic manure treatments, application of vermicompost performed better than the other sources through improved number of pods plant^{-1}, number of kernel pod^{-1}, pod yield and haulm yield of groundnut crop. It could be concluded that the groundnut crop responded well in terms of yield attributes, pod yield and haulm yield by the application of vermicompost @ 5.0 t ha^{-1} and 75% recommended dose of NPK fertilizers.

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Table 1. Effect of treatments on yield attributes of groundnut during *Rabi* 2014

Treatments	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	22.0	21.2	19.4	**20.8**	1.61	1.60	1.50	**1.57**	44.1	44.0	44.0	**44.0**
M_2	23.6	26.3	22.4	**24.0**	1.64	1.69	1.62	**1.64**	44.2	44.6	44.2	**44.3**
M_3	22.2	20.6	19.2	**20.6**	1.54	1.52	1.50	**1.52**	43.9	43.8	43.7	**43.8**
M_4	24.2	23.1	21.0	**22.7**	1.60	1.60	1.58	**1.59**	44.0	43.8	43.8	**43.8**
Mean	**22.9**	**22.8**	**20.5**		**1.59**	**1.60**	**1.55**		**44.0**	**44.0**	**43.9**	

	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	M	S	M at S	S at M	M	S	M at S	S at M	M	S	M at S	S at M
SEd	0.1	0.2	0.3	0.4	0.01	0.01	0.03	0.03	0.5	0.3	0.8	0.7
CD(P=0.05)	0.2	0.4	0.7	0.8	0.03	0.03	NS	NS	NS	NS	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}

M_2 - Vermicompost @ 5.0 t ha^{-1}

M_3 - Fish pond silt @ 5.0 t ha^{-1}

M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK

S_2 - 75 per cent recommended NPK

S_3 - 50 per cent recommended NPK

Table 2. Effect of treatments on yield attributes of groundnut nut during *Rabi* 2015

Treatments	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	23.2	22.5	20.2	**21.9**	1.62	1.56	1.50	**1.56**	44.2	44.1	44.0	**44.1**
M_2	24.2	27.4	23.5	**25.0**	1.61	1.68	1.60	**1.63**	44.2	44.6	44.2	**44.3**
M_3	23.1	21.7	20.1	**21.6**	1.55	1.50	1.50	**1.51**	44.0	43.9	43.9	**43.9**
M_4	25.6	24.8	22.2	**24.2**	1.61	1.60	1.58	**1.59**	44.2	44.0	44.0	**44.0**
Mean	**24.0**	**24.1**	**21.4**		**1.59**	**1.58**	**1.54**		**44.1**	**44.1**	**44.0**	

	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	M	S	M at S	S at M	M	S	M at S	S at M	M	S	M at S	S at M
SEd	0.3	0.2	0.4	0.4	0.01	0.02	0.03	0.04	0.7	0.3	0.9	0.7
CD(P=0.05)	0.8	0.4	1.1	0.9	0.04	0.04	NS	NS	NS	NS	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}

M_2 - Vermicompost @ 5.0 t ha^{-1}

M_3 - Fish pond silt @ 5.0 t ha^{-1}

M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK

S_2 - 75 per cent recommended NPK

S_3 - 50 per cent recommended NPK

Table 3. Effect of treatments on pod and haulm yield of groundnut during *Rabi* 2014

Treatments	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	2411	2368	2306	**2362**	4096	3915	3825	**3945**
M_2	2476	2595	2392	**2488**	4152	4350	4007	**4170**
M_3	2405	2340	2286	**2344**	3984	3923	3813	**3907**
M_4	2451	2381	2306	**2379**	4136	3946	3905	**3996**
Mean	**2436**	**2421**	**2323**		**4092**	**4033**	**3887**	

	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	M	S	M at S	S at M	M	S	M at S	S at M
SEd	40	22	54	43	85	44	112	89
CD(P=0.05)	99	46	NS	NS	NS	94	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}
M_2 - Vermicompost @ 5.0 t ha^{-1}
M_3 - Fish pond silt @ 5.0 t ha^{-1}
M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK
S_2 - 75 per cent recommended NPK
S_3 - 50 per cent recommended NPK

Table 4. Effect of treatments on pod and haulm yield of groundnut during *Rabi* 2015

Treatments	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	2460	2405	2361	**2409**	4157	4126	3910	**4064**
M_2	2565	2644	2439	**2549**	4251	4468	4117	**4279**
M_3	2451	2385	2337	**2391**	4098	4012	3922	**4011**
M_4	2486	2419	2345	**2417**	4253	4026	3998	**4092**
Mean	**2490**	**2463**	**2370**		**4190**	**4158**	**3987**	

	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	M	S	M at S	S at M	M	S	M at S	S at M
SEd	21	22	42	44	33	51	90	102
CD(P=0.05)	52	47	NS	NS	81	108	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}
M_2 - Vermicompost @ 5.0 t ha^{-1}
M_3 - Fish pond silt @ 5.0 t ha^{-1}
M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK
S_2 - 75 per cent recommended NPK
S_3 - 50 per cent recommended NPK

Effect of water soluble fertilizers through drip irrigation on growth and yield of African Marigold.

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Abstract: Afield study was conducted during Rabi,2015 at Agricultural farm, College of Agricultural Engineering, Madakasira, Andhra Pradesh to study the Effect of water soluble fertilizers through drip irrigation on growth and yield of American Marigold. The experiment consists of 6 treatments viz.,**T_1 – Control (no fertilizers), T_2 – 100% RDF through conventional (Urea, SSP, MOP) fertilizers, T_3 – 100%Nitrogen through drip and P, K through soil application, T_4 – 100% RDF through Water soluble fertilizers, T_5 – 75% RDF through Water soluble fertilizers,T_6 – 50% RDF through Water soluble fertilizers. Growth parameters like plant height, no.of branches, no of flower buds per plant and yield attributes like no of flowers per plant, size of the flowers, no of flowers per kilogram, yield were maximum with 100% RDF through Water soluble fertilizers.**

Key words: Marigold, Water soluble fertilizers, Growth parameters, Yield

Introduction: Marigold is a one of the major flower crop in India. Depending on environment, planting of marigold can be done in three seasons i.e. rainy, winter and summer and seeds are sown accordingly. Hence, flowers of marigold can be obtained throughout the year. It is put to many uses like cut flowers, garden displays, garlands, bouquets and for worship. The aromatic oil extracted from Tagetes minute which is being traded as "Tagetes oil" is a fly repellent. Marigold carotenoids are the major source of pigment for poultry industry as a feed additive to intensify the yellow color of egg yolks and broiler. The area under floriculture in Maharashtra during 2010-11 was is 15000 ha, out of which marigold contributes 29 % share with an area of 4350 hectares. While the production of floriculture is 64,400 million tones out of which marigold contributes 33,488 million tones which is account to about (52 %). Marigold only need enough water to dampen the soil .The base of the plant should receive the water, and the plant should not be watered from over the head. Drip irrigation in marigold increases in yield up to 20 – 30 percent saves water compare to flood irrigation. Keeping this in view, an experiment was conducted to know the effect of different water soluble fertilizers at different applications on growth and yield of marigold.

Materials and methods:

The present investigation was conducted during *Rabi* seasons of 2015 at Agricultural farm, College of Agricultural Engineering, Madakasira, Andhra Pradesh. The experiment was laid out in Complete Randomized Design with six treatments replicated thrice. The soil was sandy loam in texture with pH 7.4, low in organic carbon(0.54%) and available nitrogen (176 Kg ha^{-1}), high in available phosphorus (32 Kg P_2O_5 ha^{-1}) and available potassium (325 Kg K_2O ha^{-1}) . The gross plot size was 6.0 m x 7.5 m. The recommended dose of fertilizers is 80:80:80 (NPK) kg/ha. Recommended **water soluble fertilizers for this experiment were Urea, Urea Phosphate and Murate of Potash.**

The treatments comprised of six fertilizer treatments *viz*.,. **T_1 – Control (no fertilizers), T_2 – 100% RDF through conventional (Urea, SSP, MOP) fertilizers, T_3 – 100%Nitrogen through drip and P, K through soil application, T_4 – 100% RDF through Water soluble fertilizers, T_5 – 75% RDF through Water soluble fertilizers,T_6 – 50% RDF through Water soluble fertilizers.** The test variety was INCA II . The seedlings grown in portrays under shade net with the age of 20 days were selected for present study.

RESULTS AND DISCUSSION:

The growth parameters viz., plant height, **no.of branches/plant, no of buds /plant** were maximum with the treatment 100% RDF through water soluble fertilizers (T_4), which was significantly superior to other treatments followed by 75% RDF through water soluble fertilizers (T_5) , **100% Nitrogen through drip and P , K through Soil application** (T_3) . This might be due to higher level of nutrients absorption in the presence of adequate quantity of nutrients .

The lowest plant height, **no.of branches/plant, no of buds /plant** was registered with treatment Control (T_1) which was comparable with 100 % RDF through conventional fertilizers

(T_2) , 50% RDF through water soluble fertilizers (T_6) at 100 days after transplanting as shown in the table 1.

The duration to 50 per cent flowering differed significantly with different nutrient levels. The longest duration to 50 per cent flowering was observed with Control (T_1), which was on par with 50% RDF through water soluble fertilizers (T_6), 100 % RDF through conventional fertilizers (T_2). Prolonged flowering might be due to insufficient quantity of nutrients available to the crop. The shortest duration to 50 per cent flowering was noticed with 100% RDF through water soluble fertilizers (T_4) , which was significantly higher than with 75% RDF through water soluble fertilizers (T_5) and **100% Nitrogen through drip and P , K through Soil application** (T_3) with significant disparity between them,

The no of flowers/plant, flower size, no of flowers /kg, flower yield were maximum with the nutrient level of 100% RDF through water soluble fertilizers (T_4) .The next best flower yield recorded in75% RDF through water soluble fertilizers (T_5), 100% water nitrogen through drip P,K soil application (T_3), with significant disparity between them. Higher level of biomass accrual and efficient translocation of photosynthates to the reproductive parts due to supply of adequate nutrient levels might be responsible for the production of elevated level of yield structure. The lowest yield was recorded in control (T_1) which was on par with 50% RDF through water soluble fertilizers (T_6) and 100 % RDF through conventional fertilizer(T_2), at harvest due to non-availability of sufficient quantity of assimilates to sink.

From this study, it was revealed that the performance of marigold with highest yield and good returns could be realized with **100% RDF through Water soluble fertilizers** at Madakasira in sandy loams.

Table 1: Effect of water soluble fertilizers through drip irrigation on growth and yield of American Marigold.

Treatments	Plant height (Cm)	Number of branches	Number of flower buds	Days to 50% flowering	Number of flowers/ plant	Maximum flower size(Cm)	Minimum flower size(Cm)	Number of flowers/ Kg	Yield (Kg/ha)
T_1-Control	48.3	13.1	39.8	52.4	9.7	3.4	2.2	67.6	6828
T_2-100 % RDF through conventional fertilizer	53.7	14.4	42.4	48.9	11.4	4.2	2.6	74.2	7834
T_3-100% water nitrogen through drip P, K soil application	60.7	16.4	47.1	46.3	14.9	5.6	3.2	85.3	9642
T_4-100% RDF through water soluble fertilizers	74.3	20.1	57.3	40.8	19.2	7.4	4.4	109.1	13000
T_5-75% RDF through water soluble	67.5	18.2	52.3	43.7	16.8	6.8	3.9	96.7	11009

fertilizers									
T_6-50% RDF through water soluble fertilizers	51.5	13.8	40.7	51.2	10.6	3.8	2.4	69.4	7034
SE m ±	1.97	0.53	1.56	1.74	0.46	0.17	0.10	2.80	314
CD (p=0.05)	5.8	1.5	6.8	5.1	1.37	0.52	0.3	8.3	927

Extension Approaches for Sustainable Agricultural Development

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India is predominantly an agrarian country where 70 per cent of the population is directly or indirectly involved in agriculture and allied sectors. People depend on agriculture for their livelihood. Agriculture stands on the very complex interaction between biological, climatic and geographical factors in addition to human activities. The information under such a complicated system is unpredictable, unstable, subjective, site specific and reliant on empirical decision given the inhered variability of biological phenomena.

Our economy is predominantly an agrarian economy where agriculture sector provides employment to 65 per cent of the population. Agriculture alone contributes 24 per cent of our total GDP. Our economy is based on agriculture but the condition of both farmers and farming is really serious. Agriculture and allied sectors are providing employment and livelihood to many of the rural households. The green revolution of sixties – seventies has changed the face of Indian agriculture but now it seems that the new approaches are required to meet present day challenges to compete in the global market. Our farmers are still using labour intensive agriculture production technique and there is lack of attitude for diversification in agriculture.

Most of our farmers are unaware of recent technologies and global demand. With the increasing load of population and stagnated agriculture production this sector is headed for collapse. In the recent past astronomical rise in the cost of cultivation, indebtedness and cases of farmers suicides compound with dwindling land-water resources, depleting nutrient base and production capacity of soil, escalating ecological degradation and ravaging climate change pose a serious threat to national economic growth and livelihood security. With no new technological breakthrough in terms of high yielding varieties of major food grain crops in recent years poor soil management and poor harvest management infrastructures are at farm level. In such complex scenario agriculture depict major challenges. There are 60 per cent farmers holding land less than a hectare, 50 per cent fall in the rate of additional land brought under irrigation, 40 per cent farmers in support of other

Technology for sustainable development

To meet the present day challenges in agriculture due to climate change and global competitiveness there is an urgent need to reform agriculture system. Most suitable package of practice has to be presented before the farmers to make necessary and important changes in agricultural pattern of the different agro climatic zones to achieve sustainable agriculture production and growth. Scientific approach is required at the level of actual user to meet the challenge. A long term research is required to modify present agricultural pattern where alternate cropping pattern and practices, crop rotation and substitute varieties have to be studied for resource conservation and ecofriendly technology, watershed development, conservation and organic agriculture, integrated management of biotic and a biotic stresses, maximum profit by improving quality production and strong standing in global market. Agriculture research system must place emphasis on generation of required technology along with strong linkage between research-extension system.

Technological advance for sustainable development

In recent years the growth of information and communication technology will help to provide the most suitable and required package of practices on different aspects of sustainable agricultural development. Improving livelihood of the farmers is a great challenge before the policy planners, scientists, developmental agencies and extension workers. Livelihood strategy is represented by the challenges and pressure to provide equitable distribution to all. It has been observed that beneficiaries do not know the government welfare schemes and beneficial technologies. This lack of information and scientific knowledge is a great hindrance in adoption of technologies. By designing portal' many farmer friendly technologies can be disseminated thus providing technological advancements for sustainable livelihood to the farmers and sustainable growth in this sector. Agricultural production technologies require urgent and important modification for scientific crop production, considering climate change, market demand and degrading resources etc. ·

Effective management of water land, resources, natural resources, conservation of natural resources and better management of surface and ground water use of technologies like rain water harvesting and fog harvesting under watershed development programme. · Use of eco-friendly technology for ecological protection and quality production. · Diversification in agriculture – diverting labour to activities like food processing, apiculture, mushroom cultivation etc and increasing off-farm income both agriculture and non agriculture. Use of non-conventional and renewable sources of energy, promote solar energy, integrate renewable energy technologies like biomass, wind etc Technological advances in suitable package of practices for specific areas viz., dry land agriculture, rain fed agriculture, hill agriculture etc.

Innovative extension approaches

Extension approaches have to be redefined for sustainable growth and livelihood security of the farmers for which a conceptual framework has to be developed in response to recognizing and considering different livelihood assets viz human, social, physical, natural and financial resources. Innovative extension approach must be worked on how to make agriculture more profitable to provide livelihood security to farmers. The technology dissemination process in agriculture for enhancing production for sustainable livelihood is a great challenge today. Innovative extension approaches are to be adopted and the relevant information is to be provided in the most suitable package of practices that can be handled in the most efficient manner. The new extension approaches for livelihood security of the farmers are required to address the problems in agricultural and enhancing their scientific knowledge, skill,

Extension approaches for agricultural development

Package of covering risks like insurance for enhancing productivity, promotional skills and alternate market linkage with quality consciousness are important to support them. Majority of our farmers are owning land less than a hectare and their source of income is not regular. Approximately 50 per cent of the agricultural labour households are landless and have no assets. They are living under conditions of extreme poverty. Strong linkage with market, financial institutions and banking sector will help to improve living conditions of financially weaker sections of the farming community and help them to get out of clutches of poverty. For effective implementation it requires better network infrastructure, mainly telecommunication, power backup, proper literacy and broadcasting technologies. With the development of new software products and instruments remarkable growth has been seen in the use of internet, mobile, video-conferencing and audio-visual aids. By using these technologies approaching target groups is much facilitated and becomes easier. However knowledge of handling these gadget is basically required at the other end. So use of IT application in agriculture will bring remarkable change in the attitude and knowledge level of user. Basic requirement is to provide most appropriate information in such a capsule that can be easily understood and used by them. This approach will strengthen the extension system for better dissemination of technology

Strong Extension system network

The role of extension in agricultural system cannot be ignored. Strong extension system is the key to the desired change to meet the present day challenges in agriculture. Basically the end product of the extension system is to work with farmers within a climate and economic environment by providing suitable technologies to widen their horizon, enriching knowledge and upgrade abilities to improve better handling of natural farm resources and production technologies to achieve production goal. Extension system is needed to make it more participatory and farmer driven with new knowledge and skill for transmitting most appropriate technical, management and marketing skill to improve profitability in agriculture. Extension has an important role to play in empowering farmers and other partners to overcome the emerging challenges and concern thus developing a synergistic pathway for enhancing productivity along with quality of agricultural produce in order to sustain production base and ecological and livelihood security. The extension system needs to disseminate a broad array of information related to production and protection of the field crop required by an aware and intelligent decision maker in an integrated manner for safe delivery from field to the consumer concerning all the aspects of conservation agriculture production technologies, post harvest management, processing and value addition. Such knowledge based decision should be incorporated in reshaping of extension approaches. In present scenario a transformation is required from technology driven extension system to market driven system where farmer or farmer groups are able to market high value products, maintain quality control, fulfil market demands thus economic variables become theme to the program planning process.

Conclusion

A new farming system approach and implementation should be based on the most efficient utilization of resources not only to fulfil the growing demands for the food and nutritional security but also for the livelihood security of the farmers. Agriculture sector needs to strengthen with suitable package of practices through improved agricultural technologies, effective use of technology, diversification in high tech agriculture for sustainable agriculture development and global competitiveness. · For addressing complex agricultural scenario and making it more profitable the innovative extension approaches comprising latest information and communication technology and suitable infrastructure to upgrade their scientific knowledge, skill and abilities in facilitating farmer to be an intelligent decision maker and better manager. · Effective implementation of programs and policies of agricultural development by integrating management, community participation, monitoring of quality along

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GIs, Agrobiodiversity and Farmers Income

Summary

Agricultural products in the market are identified mostly based on their quality, taste, method of production and prices. In the competitive world with identical products, origin labeling has emerged as a medium for market access. India has rich biodiversity and the agricultural products registered under Geographical Indications (GI) also indicate the rich biodiversity. GI registration enables producers to use geographic origin signifying uniqueness owing to geo-climatic factors. Given the potential of GIs to enhance economic returns for the producer, certification with a distinguishable logo for GI emerges as an important link to bridge the information asymmetries between the producers and consumers. A governance mechanism wherein farmer producer organizations (FPOs) establish and implement Code of Practices (CoPs) to produce authentic quality products is a pre-requisite for successful GIs which serve as a powerful marketing tool. Imparting training to FPOs on standardizing and adhering to COPs will help farmers to carve a niche market for GI protected agricultural products and augment farmers’ income and strengthen their livelihoods.

Draft

GIs, Agrobiodiversity and Farmers Income

N.Lalitha[12], SoumyaVinayan[13]

1. Introduction

Market competition of agricultural products is mostly based on their quality, taste, method of production and prices. Globalization and the abundance of substitute products have led to efforts on the part of the producers to create a niche area for themselves based on the geographical origin of their products. A few celebrated examples are Darjeeling tea from India, Jasmine ricefrom Thailand, Nevada Oranges, Mexican red savanna habaneros, Columbian coffee and so on. India adopted to provide protection for well-known regional products through the suigeneris system of Geographical Indications (GIs) in 2003. GIs are an important intellectual economic asset of the region, which by their highlydistinguishable unique features that are due to their geographical origin, have an edge over similar products. Therefore, there is potential for realizing higher economic returns particularly for agricultural products, provided there are governance mechanisms to certify and market the products based on their uniqueness. The rich agro biodiversity of the country is evident in the number of products that have been registered under GI so far. Lack of economic returns appropriate to the efforts put in by the farmer is a primary reason for more farmers leaving agriculture.

As GIs are community based intellectual property assets, they are held by all producers in that region and by the corollary exclude those who are outside the region to claim ownership right on the product. Most importantly, the non-rivalry nature of the right on the product means that benefits due to GI for one producer does not diminish the same for another. The economic rationale for GIs is the correction of a market failure caused by asymmetric information between sellers and buyers and thus it prevents free riding on the reputation of the product.

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In this paper, taking the case of GI protected agricultural products, we argue the need for following specific farm practices, adopted and implemented by Farmer ProducerOrganisations (FPOs) that would distinguish the farmers'GI product from the rest and enable farmers to realize better economic returns for their product.The organization of the paper is as follows. Following this introduction, Section 2 discusses the usefulness of GI, diversity in GI agricultural products, their applicants and the type of market that majority of the products operate in. Section 3 discusses the usefulness of code of practices (CoP) and the relevance of the same to Indian agricultural GIs. Section 4 discusses the need to organize the producers of registered GI agricultural products under the FPOs. Section 5 lists the policy implications that emerge from the paper.

2.Importance of GI:

In the context of India, owing to rising per capita income and changes in life styles, the demand for nutritive and quality products has been accelerating. Importantly, for fruits, vegetables, pulses and livestock products, the income elasticity is positive and has become very high in India (Acharya SS, 2015)**.** Studies on willingness to pay for GI protected agricultural products carried out in the context of Thailand and India revealed that consumers were willing to pay 50 and 100 per cent more for Thailand and Indian agricultural products respectively because they were distinct and of good quality (Seetisarn*et al* 2011 and Vinayan 2015). Similar results were also found by studies conducted by Rose and Umesh (2012) and Datta (2010) on Indian agricultural products having GI registration.

Implicitly, if the consumers are assured of the authenticity and quality of the product, then they would be willing to pay a higher price which would have a direct impact on the income for the farmers**.** In India, from 2004 to December 2016,82 agricultural products have got the GIprotection. The efforts to bring in more agricultural products under GI fold by Government of India is in direct response to the attempt by the USA to file patent application for turmeric and rice varieties that have origins in India. Products protected so far include– food grains, spices, fruits, vegetables, flowers and betel leaves (Table 1) indicating the importance of agri-GI recognition to the state. There were 245 registered products in India as on December, 2016. Of these, agriculture (33.5%), handicrafts (31.5%) and textiles (29.5%) account for more than 94.5%

of the total registered products in India. Of the 82 agricultural products registered with GI, Maharashtra leads the rest of the states in the total number of registered products (23 out of 82) closely followed by Karnataka (16) and Kerala (11). Thus, these three states account for 61% of total agricultural products registered in the country. Assam and Uttar Pradesh (3.9% each), West Bengal (5.2%) and Tamil Nadu (6.5%) account for additional 20% of total agricultural products registered. Himachal Pradesh, Rajasthan, Arunachal Pradesh, Tripura, Sikkim, Mizoram, Manipur, (Punjab, Haryana, Himachal Pradesh and Jammu and Kashmir together hold the Basmati GI) and Uttarakhand have only one GI in the agricultural section.

33 fruits (41%), 13 spices (16%), 11 food grains (14%), 6 each beverages and vegetables (8%), 5 flowers (6.5%), 4 others (5.2%), 2 dry fruits, and 1 pulse variety constitute the agricultural GIs. Fruit GIs consist of different varieties of oranges (6), banana (6), mango (7), pineapple (2), grapes (2), lemon (2) and 1 each of coconut, strawberry, litchi, custard apple, pomegranate, fig, chikko and guava. The different constituents of spices are: chilly (5), cardamom (3), ginger (1), pepper (1) kokum (1), Tejpata (1), and turmeric (1).There are 10 rice varieties and 1 variety of wheat under the good grains. Of the 5 varieties of flowers, 4 are varieties of jasmine. Four tea varieties and two coffee varieties (GI for processing) constitute the beverages segment. Of the six vegetables that have got GI, two each are onion and eggplant varieties, and one each for tomato and beans.

Compared to the agricultural diversity of the country, the number of products protected in each of the category is very small as detailed in the above paragraph and Table 1. However, filing GI requires tremendous human resources to document the historical evidence of association of a crop/plant/product with the region. Moreover, it requires financial resources to form a producer group, register the same with the legal entity, establish market and so on. Unlike the European countries, in India, the expenses for the filing of the GI application are borne by the producer associations (Lalitha and Vinayan, forthcoming). Though the government and its various arms like horticulture department, agro corporations and commodity boards have taken the initiative to register the products (Table 2), the economic returns on such investment are not known. Farmer producer organisations (FPO) account for 30 per cent of the proprietors of the registered products.

The product profiles of agricultural GIs registered so far indicates the rich biodiversity of products across the country. These GI products can be categorized into three: 1. GIs that have strong association with the region through the land, soil, water and other climatic factors, a criterion which most agricultural GI products satisfy. Notable among these are the varieties of tea grown at Darjeeling, Nilgiri, Assam and Himachal Pradesh, cardamom from Sikkim, Appemidi mangoes from Karnataka, the Monsooned Malabar arabica and robusta coffee that derive their uniqueness from the climatic factor that plays a crucial factor in the processing of coffee and the list goes on; 2. GIs that have been protected based on natural factors and also based on the idea of protecting different varieties and those that are becoming extinct (even within the state). Implicitly, while the generic varieties of pineapple, oranges and bananas are grown in different parts of the country, yet a few varieties have been nurtured in specific areas. For instance, the Coorg and Nagpur oranges are distinct in their taste, color and appearance. Naga chilli is distinctly different from the byadagichilli. Naga chilly has the Guinness book of records for its high capsaicin content, byadagichilli has the least capsaicin content and sought for its high color quotient; (3) A few agricultural GIs have strong medicinal values associated with them and is specifically mentioned in their statement of case like the Memong orange. Memongnarang is grown only in Meghalaya. These oranges are not edible but are used as medicine and in medicinal preparation for small pox, jaundice, stomach and kidney diseases in human and livestock. Similarly the navara rice of Kerala is known for its medicinal values.

One of the important expectations of filing agricultural GI applications is to get better returns. The primary condition for this is that every producer with the GI registration is aware of the uniqueness of the product derived from its geo origin and is able to exploit the uniqueness. However, it is observed that while 33 per cent of the GI applications have been filed and obtained by the farmer societies and associations, the rest have been obtained by different types of government organizations (Table 2).

Implicitly, when the GI registration is done by the government, awareness regarding the same is not uniform across all the producers (Vinayan 2013, Lalitha2014).Products like tea and coffee that have got GI registrationthrough their respective boards,operatemostly in the organized markets through the auction routes. However, products that areperishables in nature like fruits, flowers, and vegetables mostly deal within the long chain of (commission agents-wholesalers, retailers)unorganized market and receive non-remunerative prices for their products. A primary survey conducted by Singh and Singla (2014) among vegetable growers in Karnataka reveal that farmers found sales through the organized retail channels had resulted in lower rejections and better price realizations for the farmers in general.

2.1 General marketing issues experienced in India:

Most studies on agricultural marketing point out that products traded through traditional channelssuffer due to inadequacies in sorting, grading, storage, regulation, and poor handling during loading, unloading and transport resulting in a significant productionloss. These studies also suggest that the producer's share in consumer's rupee is the highest when the producer engages directly with the consumers. In other words, longer the channel chosen to sell the product, lesser hasbeen the returns to the farmer as the farmer has to pay several links enroutethe market. Also, in products that undergo further processing like rice or tea, the producer's share in consumer'srupee would be limited. However, perishables and seasonal products like fruits or flowers where direct consumption also takes place, the possibility of realizing higher prices do exist, if the farmers are able to sell the product directly and collectively, highlighting their uniqueness and authenticity. Particularly for the GI recognizedagricultural productshigher economic returns are possible if the producers and other stake holders in the value chain are able to maintain traceability of the product to the producer/region to ensure authenticity through internal and external control system known as Code of Practices (CoP).

3. Importance of code of practices in GI agricultural products:

Code of practice (CoP) is a set of measurablevoluntary practices for the production of GI product which every producer should comply with. The different components of CoP in GI are specific definition of the product, delimitation of the area and the guarantee system. Mainly CoPs focus on the following elements that give the products their uniqueness: 1. The main physical, chemical and biological aspects of the product; 2. Ingredients and raw materials that can be used in the production process;3.Definition of the process that consist of production, conditioning, seasoning/maturing, packing and transportation; 4. Demonstration of the specific quality linked to the geographic region; 5. Definition of the production area; 6. Names of the product and labeling rules and 7. Verification/control systems (**Vandecandelaere et al 2010**). Inspection and certification of adherence to such controls are also carried out by accredited agencies to provide credibility to such processes.

Some of the well-known GI agri products that have set up these CoP include Columbian coffee, Coffee of Kintamani Bali, Argan oil of Morocco and Thailand'sHom Mali Rice (jasmine rice) to mention a few. In the Indian context, CoP is evident in the case of Darjeeling tea –where the production area is strictly demarcated and all the production from the designated GI gardens is marketed only through one channel. Hence, there is no difference in the price realized by the recognized tea gardens. In the case of Basmati rice, which got the GI registration recently in March 2016, the Basmati rice exporters association has taken efforts to compile the names and other details of all the basmati rice producers in the region and the traceability of the product is established up to *mandi* level. Establishing traceability up to mill level is in the process.[14] Here, Thailand's Jasmine rice sets a good example. Thai Hom Mali Rice Trade Association Thung Kula Rong-Hai received GI in 2008. By 2008/09, there were 1,131 Thai jasmine rice farmers, 13 exporters and 4 processors certified as GI operators for ThungKulaRong-Hai rice by the Department of Intellectual Property (DIP). Necessary external quality control systems have been established and are accredited by Thai Industrial Standards Institute (TISI) and the National Bureau of Agricultural Commodity and Food Standard (ACFS). As the Thai jasmine rice is a premium product particularly in the export market, the DIP insists that jasmine rice to be sold at a premium price with the GI designation displayed on the packaging. In addition, the rice must be packed at the site where it was cultivated and be traceable back to the field in order to assure the consumer of the authenticity of the origin of the product (Ngokkuen and Grote 2012). More often, the internal quality control systems are established and monitored by the farmer producer organizations (FPOs). In this context, mention should be made of the common logo for GI that is

[14] Interaction with the President of the All India Basmati Rice Exporters Association on 7th April, 2016.

prevalent in Europe and Thailand registered under GI legal framework(Vinayan 2014, Lalitha 2014). In contrast, even after a decade of enforcement of GI Act, in India, thereexists no common logo for GI products, which is one of the reasons for the limited awareness of importance of GI. Logos act as an important bridge in mitigating information asymmetry between sellers and buyers and this coupled with internet based residual traceability systems in place like Hortinet, grapeNet,MangoNet, Tracenet and Peanutnet would guide the farmers in their farming practices.

4. Role of Farmer Producer Organisations

Setting up CoP and enforcing require governance mechanisms and the governance works better when it is designed and implemented by the farmers themselves. As a first step, it is essential that the producers form themselves into an association and distinguish their products from the rest through a distinguishable logo. Mere formation of FPOs do not serve the purpose as is evident from many defunct FPOs in the country for a variety of reasons ranging from lack of training to clear strategies (Singh and Singh 2013). It is essential that training needs to be provided to farmers in a variety of aspects ranging from pooled procurement to packing and documentation. Handholding of FPOs for a specific period of time by experienced individuals or organizations are often required not only in identifying and strengthening the horizontal and vertical linkages but also in meeting the costs of branding and documentation.

In India, farmer societies have been responsible for getting GI registration in the case of (1) three varieties of rice and one variety of banana from Kerala, (2) majority of products in the case of Maharashtra (3) Allahabad red guava and (4) Madurai malli in the case of Tamil Nadu to name a few. If the farmer societies are able to form themselves into FPOs, it would work to their advantage. FPOs combine the best elements of a private company and cooperatives, and are run by the elected members of the farmers themselves.

The advantages of FPOs include: increasing economies of scale and lowering of transaction costs. Most FPOswork as multi-purpose organizations and provide a range of services. Most important of these are establishing internal monitoring mechanisms, facilitation of collective production activities, output marketing, market information and analysis, branding, certification, water and resources conservation measures (Trebin and Hassler 2012). These are very relevant for some of the existing GI registered products and the potential GI products. For instance, a study done in the year 2007-08 on Mysore malligae points out that due to lack of market information system the Mysore jasmine growers assessed the prices of jasmine by regular visit to the market, their past experience and demand (Bose 2010).Lack of appropriate growers association for Jasmine, makes it difficult for the small growers to approach the export market like Malaysia, Singapore and West Asia (Srivatsa 2010). Given the very limited shelf life of jasmine and the extremely high freight charges which is Rs. 650 for 500 gram, collective action from a FPO would benefit the producersconsiderably. Naga king chilies is considered as the world's hottest chili and has entered in Guinness book of world records beating the Mexican red savanna habaneros (Sharma 2013). As the study by Sharma indicates, producers particularly the marginal farmers, selltheir produce in the local channels through seed traders. Most farmers experienced high price fluctuation in market, followed by exploitation by intermediate agencies, and lack of warehouse facilities. Lack of warehouse facilities often lead to distress sales by the farmer. In the case of queen pineapples from Meghalaya (Bhagat 2012), majority of the producersbeing small farmers, sell their pre-harvest produce at a pre-determined price to the trader/middlemen, resulting in poor returns. Moreover, transport cost is high which can be attributed to poor road and transportation infrastructure in connecting villages to markets in the hilly terrain of West Garohills. In addition, farmers had limited capacity to change the trader. The trading partner had all the power and control of all the information and farmer had to adhere to their demand.

In contrast, in the case of Nam Dok Mai Khung Bang Kachao Mango of Thailand, the producers (FPOs) are also the traders of the produce. Hence, there has been no place for grey sales and the producers were able to realize the high value of the crop (Lalitha, 2016).

In all these cases, it emerges that FPOs, with appropriate training have a potential role to function particularly in the marketing stage by organizing the farmers collectively to set appropriate price with the trader and reverse the trend in their favor to get better remuneration. Though 33 per cent of the GI registered agriproducts have been filed by farmer societies, effective functioningof these FPOs in promoting the market for such products is to be ascertained through empirical research.

Particularly in the case of GI products as these are grown in specific areas, enforcing the code of practices across the producers is not an impossible task, though it would take a couple of years to establish credible systems with traceability.

5. Policy Implications

When agricultural products get GI recognition, the expectation of the producer is to reach widermarket and get better returns. Unfortunately, this has happened only in a few established products like Darjeeling tea but should be the case for all the unique products that have been filed so far. India has to start with a common logo for all GI registered products first and popularize the same, so that consumers relate the logo to quality and uniqueness of the product. It is suggested in this paper that forming FPOs and adopting code of practices would help the farmers to sustain quality and create an edge over other producers. FPOs need to be trained in a variety of spheres to handle procurement of inputs and importantly documentation. In this regard, the agricultural universities, marketing committees, research institutes and other governmental departments along with non-governmental organizations have an important role to play. This intervention is critical given the informal nature of production and the value chain of most agricultural products. As many of the agri products with GI designations are produced in a relatively small area, protecting and promoting the economic viability of the same would help farmers continue with farming. It is important for India to make use of GI as an important marketing tool.

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Table 1 Registered GI Agricultural Products of India

S. No	State	No. of Agricultural Products	Total No. of GI Products	% of Agricul-tural to total	Type of Products
1	Karnataka	16	35	45.7	Coorg Orange, Mysore Betel leaf, Nanjanagud banana, Mysore Jasmine, Udupi Jasmine, Hadagali Jasmine, Monsooned Malabar Arabica coffee, Monsooned Malabar RobustaCoffee,Coorg Green cardamom,DevenahalliPomello,Appemidi Mango, Kamalapur Red Banana, ByadagiChilli, UdupiMattuGullaBrinjal, Bangalore Blue Grapes, Bangalore RoseOnion
2	Kerala	11	23	47.8	Navara Rice, PalakkadanMatta Rice, Pokkali Rice, WayanadJeerakasala Rice, WayanadGandhakasala Rice, Kaipad Rice, Malabar Pepper, Alleppey Cardamom, Vazhakulam Pineapple, Central Travancore Jaggery, ChengalikodanNendranBanana
3	Maharashtra	23	29	79.3	Mahabaleshwar Strawberry, Nashik Grapes, Nashik valley wine, Kolhapur Jaggery, Nagpur Orange, AjaraGhansal rice, MangalwedhaJowar, Jalna sweet orange, Sindhudurg&Ratnagiri Kokum, WaghyaGhevada,NavapurTur dal,

					Vengurla cashew, Lasalgaon onion, Waigaon turmeric, Solapurpomogrenate, Sangli raisins, JalgaonBrinjal, Beed Custard Apple, Purandar Fig, BhiwapurChilli, Abemohar Rice, DahnuGholvadChikoo, Jalgaon Banana, MarathwadaKesar Mango
4	Tamil Nadu	5	25	20.0	Eathomozhy Coconut, Nilgiri tea, Virupakshi Hill Banana, Sirumalai Hill Banana, Madurai malli
5	West Bengal	4	10	40.0	LaxmanBhog mango, Khirsapati (Himsagar) Mango, Fazli Mango, Darjeeling tea
6	Uttar Pradesh	3	22	13.6	Allahabad Surkha, Mango Mallihabadi, KalanamakRice
7	Assam	3	4	75.0	Assam Tea, Assam KarbiAnglong Ginger, Tezpur Litchi
8	Gujarat	2	10	20.0	Bhalia Wheat, GirKesar mango
9	Odisha	2	14	14.3	GanjamKewraRooh&GanjamKewraFlower
10	Nagaland	2	2	100.0	Naga mircha, Naga tree tomato
11	Meghalaya	2	2	100.0	Khasi Mandarin, MemongNarang
12	Andhra Pradesh	1	12	8.3	Guntur SannamChilli
13	Himachal Pradesh	1	5	20.0	Kangra Tea
14	Arunachal Pradesh	1	1	100.0	Arunachal Orange
15	Tripura	1	1	100.0	Tripura Queen Pineapple
16	Sikkim	1	1	100.0	Sikkim Large Cardamom
17	Mizoram	1	1	100.0	Mizochilli
18	Manipur	1	4	25.0	Kachai lemon
19	Punjab, Haryana, Delhi, Himachal Pradesh, Uttarakhand, and parts of western Uttar Pradesh and Jammu & Kashmir	1	1	100.0	Basmati Rice
20	Uttarakhand	1	1	100.0	UttarakhandTejpata
	Total	**82**	**247**	**33.2**	

Note: The total number of GI products include products of other states that do not have agricultural GIs**.**
Source: Compiled from the GI registry http://ipindia.nic.in/girindia/

last updated on Dec.2016

Table 2.Proprietors of Agricultural GIs in India

Type of Proprietor	No. of Agricultural Products	% Share
Commodity Board	12	15
Central Government	12	15
FPO & University	2	2
State Government	13	16
Trust	2	2
University	8	10
Associations (Farmer/Producer/ Trader/Manufacturer)	28	34
Cooperative	5	6
Total	82	100

Source: Compiled from http://ipindia.nic.in/girindia/

Improvement in egg production of PD 3 chicken line with histopathological conditions of the jejunum up on supplementation of fermented yeast culture during and post summer season

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ABSTRACT

During summer, under high ambient temperature conditions, the thermoregulatory system of the body adjusts a variety of physiological mechanisms through a combination of heat exchange and evaporative heat loss to attain a balance between the heat produced within the body and the heat lost to the environment. In chickens sweat glands are absent making it more vulnerable for dissipation of heat and reducing stress. Leptin affects energy homeostasis by decreasing food intake and by up-regulating fatty acid oxidation. In chicken leptin and ghrelin are known as anorexigenic hormones. Effects of yeast products on production and their mode of action in monogastrics have been reported in poultry. It is reported that yeast products affect nutrient digestibility, growth and immune system. Fermented yeast culture contains viable cells, cell wall components, metabolites, and the media on which the yeast cells were grown. No study has been carried out on endocrinological and histopathological studies with supplementation of fermented yeast culture in chicken and their relation with egg production, especially during summer season. This study was carried out to determine pattern of leptin and ghrelin secretion among other oxidative markers in PD 3 chicken line (Dahlem Red) with histopathological conditions in the intestine, when subjected to natural heat stress during summer season. During summer the temperature ranged between 26^{o}C-36.9^{o}C and post summer season it ranged between 29^{o}C-32^{o}C. A hundred number of 16 week old Dahlem Red (PD-3) breed of chickens whose body weight ranged between 850-950g were selected and randomly allotted to two groups of fifty birds each. The experiment was continued from 16-32 weeks of age. After eight weeks (April-May) of summer season, experiment was continued till the birds attained 32 weeks of age. The two groups were Control and Treatment groups. The treatment group received 1.25g of fermented yeast culture (Saccharomyces *cerevisiae*) commercial product per kg feed. Blood samples were collected at weekly intervals, plasma was separated and analyzed for Leptin, Ghrelin hormones, plasma protein carbonyls, MDA, cholesterol and free fatty acids. Fortnightly body weight and feed intake of the birds were recorded. Egg production and egg weight were also recorded. Based on these observations, feed conversion ratio (FCR) was also calculated. Supplementation of fermented yeast culture decreased the concentration of plasma Leptin and Ghrelin ($P<0.01$), Cholesterol ($P<0.01$) and MDA ($P<0.01$) during summer season and feed intake of birds during post summer season. It was observed that the egg production increased from 26-31 weeks of age and FCR was significantly less ($P<0.05$) in the supplemented group. It was observed that fertility and hatchability of eggs was more for the supplemented group. In conclusion providing fermented yeast culture to the sexually maturing hens during peri and post summer period improved feed efficiency, egg production with no improvement in the morphology of the jejunum. However the severity of necrosis decreased from medium to mild stage in both the groups from pre to post laying period.

Key words: Summer, Layers, Fermented yeast culture, Leptin, Ghrelin, MDA, Cholesterol

Introduction

Hyperthermia is defined as an elevated body temperature due to failed thermoregulation.During hyperthermia, core body temperature increases due to an inability to dissipate heat(Fuquay, 1981).During the initial period of heat stress heat shock proteins assist in folding of the membrane proteins and stabilize membrane lipids for maintaining the homeostasis of the cell integrity. When the organism gets acclimatized to elevated temperature, it leads to decrease in the sensitivity towards stress and the response to the stress is delayed. One of the best described effects of oxidative stress-generated ROS on cells is the oxidation of membrane lipids. The susceptibility of lipids to oxidation is determined by its composition and degree of saturation. Depending on the severity of heat stress, the stress signals are activated and which in turn determine the response of the organism to stress. Chronic heat stress leads to depletion of antioxidant reserves. HS has been a great concern to the poultry producers, especially in the tropical regions of the world, during summer season. Chronic HS is categorized as cyclic chronic heat stress, which refers to a limited period of exposure to elevated temperature followed by comfortable temperature for the rest of the day. The consequences of heat stress on physiological functions are numerous, leading to impairment in reproductive and endocrine functions, disruption in structure and function of intestinal epithelium. Azad et al. (2013) observed that in chronic heat exposed chickens, ROS production increased and was found until d9 of HS and not thereafter, which means that chickens became acclimatized to the heat stress. In 18 h heat stressed chickens, plasma and mitochondrial malondialdehyde (MDA) was 2.1- and 2.7-fold higher (Mujahid et al., 2007) . Even though the role of appetite regulating hormones like Leptin, Ghrelin on feed intake, functions of liver is known (Song et al., 2012), their role on physiological and metabolic functions of chickens experiencing heat stress during summer season is lacking. In addition to being a primary organ for absorption and digestion of nutrients, the GIT also contains a diverse set of microbes, which aid in metabolic processes as well as host defense mechanisms. Impairment of small intestinal function can occur with or without morphological changes to the epithelium. Functional integrity of the intestine is dependent upon coordinated regulation of the mucus layer, tight junctions, epithelial cells, as well as the enteric immune system (Groschwitz and Hogan, 2009). Nutrient absorption optimization and post-absorptive metabolism changes have been observed in heat stress poultry (Garriga et al., 2006). Appetite regulating peptides such as ghrelin, cholecystokinin, and glucagon-like peptide 1 released from digestive tract act on the satiety centres in the hypothalamus, which ultimately results in reduced nutrient absorption from the intestine (de Lartigue et al., 2011). Since there is a strong relation between mentioned gut hormones, feed intake, and can be modulated by heat stress. This study was primarily taken up for evaluating the effect of supplementation of fermented yeast culture in maintaining morphology of the jejunum portion of the gut on the level of plasma hormones, production parameters under the influence of higher ambient temperature during and post summer season.

Materials and Methods

Study for the summer period was carried out from the last week of April-last week of June (eight weeks) in the poultry farm, Directorate of Poultry Research, situated in Rajendranagar, HYDERABAD. The month of April and May is characterized by *gradually rising* daily high temperatures, with daily high around 37°C throughout the month, exceeding 41°C or dropping below 34°C only one day in ten. Birds with uniform body weight ranging between 850-950g were taken for the present study. The birds were divided in to two groups, one served as control and the other served as treatment/supplemented group. Each group contained 50 birds with five birds in each replicate. The supplemented group was provided with fermented yeast culture (Saccharomyces *cerevisiae*) @ 1.25g/kg feed. The experiment was initiated when the birds were 16 weeks of age and by the end of summer, the age of the birds was 24 weeks. The experiment was carried out during post summer period also, which coincided with the laying period of the hens. The experiment continued till the birds attained 32 weeks of age. Fermented yeast culture @1.25g/kg was supplemented during and also during post summer period. Blood samples were collected at fortnight intervals, from pectoral vein during summer season only . The samples were centrifuged at 3000 rpm for 15 min and analysed for plasma hormones leptin and ghrelin and other parameters cholesterol and MDA. The hormones were estimated with the help of commercially available kits. Plasma MDA was analyzed using the standard method of MDA assay which was based on the reaction of MDA with thiobarbituric acid (TBA); forming an MDA-TBA2 adduct that absorbs strongly at 532 nm. Cholesterol was estimated with the help of commercially available kit purchased from BioAssay Systems, CA 94545,USA. Body weight was recorded at fortnight interval. Weekly feed intake was estimated. In the laying period during post summer period, eggs were collected daily and weight was recorded. The birds (5 nos. from each group) were sacrificed during first and last week of summer period and at the end of the laying period, jejunum portion of the digestive tract (from the pancreatic loop to Meckel's diverticulum) was separated, feed particles were removed gently by rinsing in normal saline solution. They were fixed immediately in 10% formalin for histopathological studies. Samples were processed, paraffin embedded and cut at 5u thickness. The sections were stained with hematoxylin-eosin. The slides were observed at 20 x magnification, under light microscope. Approval was taken from Institutional Animal Ethics committee for techniques involved in conducting the present study.

Results and Discussion

The temperature during summer period varied between 29^{o}C-39.6^{o}C.The circulatory level of plasma leptin, and ghrelin were significantly high ($P<0.01$) in the control when compared with the treatment group. In the treatment and control groups, within the group, the highest concentration of the hormones was observed on d21 (Table 1).

Higher concentration of anorexigenic hormones did not result in decrease in body weight or feed intake and difference between these parameters was not significant between the groups. Later by d49 or by the end of summer, the level of plasma leptin and ghrelin in the control group decreased, but, the difference between the level of respective hormones between the groups was still significant (P<0.05).

Table 1 Concentration of plasma leptin and ghrelin in control and supplemented group of PD 3 chicken line (Dehlam Red) during summer season

Days	Leptin (ng/ml)		Ghrelin (pg/ml)	
	CONTROL	TREATMENT	CONTROL	TREATMENT
7	1.67** ±0.12	1.23±0.09	60.23*±2.30	52.10±2.10
21	1.85**±0.15	1.26±0.09	80.57**±1.58	64.23±2.54
35	1.79**±0.11	1.10±0.08	65.70*±2.01	50.60±1.98
49	1.54*±0.09	1.23±0.12	58.23*±1.62	49.32±2.05

*P<0.05, **P<0.01, Values are exhibited as Mean ±SE, represented for 15d interval.

The hypothalamic and gastrointestinal tract peptides like ghrelin are involved in appetite regulation in laying hens exposed to heat stress (Song et al., 2012). It appeared that birds of control group were not acclimatized by the end of the summer period. Similar trend was observed with plasma malondialdehyde (MDA) levels (Table 2,P<0.01)). Plasma MDA levels indicate the oxidative state of the lipids. It is known that fermented yeast culture reduces MDA levels (Matur et al., 2011). Hence in the present study also, supplementation of fermented yeast culture, reduced plasma MDA level, indicating protective effect of supplementation on lipid peroxidation or in amelioration of oxidative stress. At the end of the experiment, level of plasma MDA compared between the groups was not significant indicating decrease in lipid peroxidation in the control group (Table 2). It is known that heat stress, increases plasma cholesterol level, in the present study also, the level of circulatory cholesterol was higher in the control group. The rise in the concentration of cholesterol was observed on d21 of the experiment and continued till the end of the study period. The concentration did not decrease by the end of summer period in the control group, where as in the treatment group, supplementation of fermented yeast culture decreased the level of plasma cholesterol (Table 2,P<0.01) when compared with the control group. Exposure to heat enhances ROS production and induces oxidative stress, which can lead to cytotoxicity (Bernabucci et al., 2002) and lipid peroxidation (Mujahid et al., 2007).

Table 2 Concentration of plasma cholesterol and MDA in control and supplemented groups of PD 3 chicken line (Dehlam Red) during summer season

	Cholesterol (mg/dl)		MDA (uM/ml)	
Days	CONTROL	TREATMENT	CONTROL	TREATMENT
7	212*±10.23	180± 9.24	140 **±8.54	68±3.21
21	220*± 9.56	155± 8.52	135**±7.89	65±1.58
35	230*± 8.45	140±10.23	91**±5.89	58±2.03
49	235*±10.45	135± 9.85	65±2.35	59±1.09

*P<0.05,**P<0.01, Values are exhibited as Mean ±SE, represented for 15d interval.

Hypercholesterolemia is caused by hyperactivity of the adrenal gland (Siegel, 1995). It is known that during heat stress, ambient temperature increases level of plasma cortisol, which is indicative of hyperactivity of adrenal gland. In the present study supplementation of fermented yeast culture, might have decreased hyper activity of adrenals, which in turn decreased plasma cholesterol during summer. Similar reports are available in layers and broilers (El-Husseiny et al., 2008). Antioxidant systems are important with regard to the scavenging of free radicals and their metabolic products, as well as in the maintenance of normal cellular physiology, via the restoration of various depleted antioxidants in stressed poultry (Halliwell and Gutteridge, 1989). Yeast culture or its products are also known to play an antioxidant role, preventing lipid peroxidation .Several studies reported that addition of yeast or yeast culture products to diets resulted with better feed efficiency (Tangendjaja and Yoon, 2002), increased egg weight (Yalcın et al., 2008) and improved internal egg quality (Miles and Bootwalla, 1991) in hens. Addition of yeast culture products to hen diets improved feed efficiency (Tangendjaja and Yoon, 2002). In the present study also, it was observed that supplementation improved feed efficiency significantly (4.13vs3.22, $P<0.05$). Others have reported that yeast products affect nutrient digestibility (Shin et al., 2005) and intestinal mucosal development (Zhang et al., 2005). The difference in the body weight and egg weight between the groups was not significant during post summer season. It was observed that supplementation decreased feed conversion ratio, but did not affect the morphology of the jejunum portion of the intestine. Inclusion of YC (2.5g/kg) in broilers decreased the villus height to crypt depth ratio (**VCR**) in jejunum but increased in duodenum(Gao et al., 2008).A mild to medium necrosis (Figure 1) was observed in the histological sections of the jejunum with fusion of villi. Later on occurrence of villi necrosis was decreased in both the groups with the decrease in ambient temperature. Intestinal villi had more desquamation, mostly located at the tip. Heat stress might have caused these effects, but supplementation of FYC did not improve the morphology of the jejunum as observed in the histological sections. The attainment of 50% egg production potential was earlier in the treatment group, and egg production was more from 26-31 weeks when compared with the control group (Table 3). The decrease in egg production potential as observed for the control group may be due to to the presence of mild necrotic condition in the jejunum, and in addition to it the absence of supplement might have led to less absorption of nutrients from the digestive tract. The result with respect to fertility and hatchability of the eggs was observed to be higher for the treatment group during post summer season (Table 4). The values of different plasma parameters when compared between control and treatment groups, it appeared that birds of control group were under chronic cyclic heat stress. At the end of study period, during summer season, from the results on different parameters, it appeared that birds of control group were not getting acclimatized to heat stress/high ambient temperature, the results with respect to egg production , fertility and hatchability parameters for post summer period were not at par with the supplemented group.

Table 3 Comparison of percentage of egg production Potential post summer season

WEEKS	CONTROL	TREATMENT
24	**36.5**	**34.8**
25	**43.7**	**45.8**
26	**47.6**	**50.6**
27	**47.1**	**52.1**
28	**48.6**	**53.7**
29	**50.7**	**55.5**
30	**54.1**	**58.2**
31	**52.9**	**55.1**

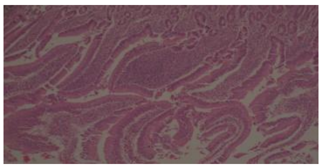
32	**54.0**	**56.7**

Attainment of 50% egg production potential earlier in treatment group
Egg production was more in the treatment group (26-32 weeks)

In conclusion it can be said that supplementation of fermented yeast culture to layers @1.25g/kg, increased egg production, fertility , hatchability parameters during the post summer season, by decreasing concentration of plasma hormones, MDA and cholesterol of PD 3 chicken line with mild to medium necrotic conditions in the jejunum during summer season. Supplementation did not bring about differential effect on the morphology or necrotic condition of the jejunum, when compared between the groups. Hence supplementation of fermented yeast culture may prove to be beneficial.

Table 4 Percentage of fertility and hatchability

28-29 weeks	Egg set (nos.)	Fertility	Hatchability
CONTROL	210	79	92
TREATMENT	252	86	98
30-31 weeks			
CONTROL	216	82	90.1
TREATMENT	230	88	98.5



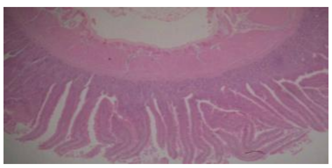


Figure 1 Mild to medium necrosis in jejunum portion of the gut; Fusion and thickening of villi. Observed at 20x magnification under light microscope

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Legume Fodders for Sustainable and Eco-friendly Livestock Production

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Abstract

Animal husbandry is an integral component of Indian agriculture supporting livelihood of more than two-thirds of the rural population. India's livestock sector is one of the largest in the world, which contribute 4.1% of the total national GDP and 27.25% of the agricultural GDP. Livestock derive major part of their energy requirement from agricultural byproducts and residues. Hardly 5% of the cropped area is utilized to grow fodder. India is deficit in dry fodder by 11% and green fodder by 35% and also the grazing lands too have been deteriorating quantitatively and qualitatively which were important sources of fodder for the livestock in India. Indian livestock sector was driven by the structural changes in agriculture and food consumption pattern. Importance of livestock as source of 'draught power' has declined considerably due to mechanization of agricultural operations. On the other hand, their importance as a source of quality food has increased. Sustained income and economic growth, a fast-growing urban population, changing lifestyles, improvements in transportation and storage practices and rise of supermarkets especially in cities and towns are fuelling rapid increases in consumption of animal food products. It was predicted that by the end of 2017 demand, for milk is expected to increase to 155 million tons and for meat, eggs and fish together to15.8 million tons. Consequently, the demand for feed and fodder for fulfilling the requirement of livestock population will also increase. Increasing livestock population leads to substantial climate change through the emissions of Green House Gases (GHGs) such as Carbon-di- oxide (CO2) and methane (CH4). Globally, livestock sector contributes 18 percent of global greenhouse gas emission. Increases in methane emission from livestock leads to environmental pollution and global warming. If methane emissions continue to rise in direct proportion to livestock number a 60% increase in global methane production is predicted by 2030. India produces 12.45% of the total enteric methane emissions of world. With the increase in per capita income and urbanization, the consumption of livestock products will continue to rise in the foreseeable future. Consequently, the demand for feed and fodder for fulfilling the requirement of livestock population will also increase. In this situation, legume fodders work handy as a cheap supplement and quality protein

source as well to reduce enteric methane emission. In this regard educating the farmers on cultivation of legume fodder which is economically and environmentally friendly for feeding their livestock is needed.

Key words: Economic, environment, legume fodder and livestock production

Introduction

Animal husbandry is an integral component of Indian agriculture supporting livelihood of more than two-thirds of the rural population. Animals provide nutrient-rich food products, draught power, dung as organic manure and domestic fuel, hides and skin, and are a regular source of cash income for rural households. India's livestock sector is one of the largest in the world. It has 57.8% of world's buffaloes, 15.06% cattle, 25.07% small ruminants, 2.18% camel, 1.3% equine, 1.2% pigs and 34.72% chicken and contributes 4.1% of the national GDP and 27.25% of the agricultural GDP (Islam *et al.,* 2016).

Animal husbandry in India is driven by the structural changes in agriculture and food consumption patterns, the utility of livestock has been undergoing a steady transformation. Importance of livestock as source of 'draught power' has declined considerably due to mechanization of agricultural operations and declining farm size. Sustained income and economic growth, a fast-growing urban population, changing lifestyles, improvements in transportation and storage practices and rise of supermarkets especially in cities and towns are fuelling rapid increases in consumption of animal food products (Birthal, 2012).

Demand for animal food products is responsive to income changes, and is expected to increase in future. Between 1991-92 and 2008-09, India's per capita income grew at an annual rate of 4.8% and urban population at a rate of 2.5%. By the end of 2017, demand for milk is expected to increase to 155 million tons and for meat, eggs and fish together to15.8 million tons (Birthal, 2012).

Livestock derive major part of their energy requirement from agricultural byproducts and residues. Hardly 5% of the cropped area is utilized to grow fodder. India is deficit in dry fodder by 11%, green fodder by 35% and concentrate feed by 57%. The common grazing lands too have been deteriorating quantitatively and qualitatively which are important sources of fodder for the livestock (Surapa, 2011).

Economical impact of some of the legume fodders in livestock production

Agasse (*Sesbania grandiflora*)

Sesbania grandiflora is a small, loosely branching tree that grows up to 8- 15 m tall and 25-30 cm in diameter and well adapted to hot, humid environments. It has an outstanding ability to tolerate water logging and is ideally suited to seasonally flooded environments. It is a fast-growing tree and do not require complex management and leaves and pods are valued for fodder. The leaves contain 36% crude protein and 9600 IU vitamin A in every 100 g and Sesbania is known to possess anthehelmintic, antibiotic, anticancerous, tonic, diuretic and laxative properties and also cure night blindness in cattle. The most effective method of feeding the fodder to ruminants is to supplement with it, up to 15-30% of the total diet. Because of its high protein content, *S. grandiflora* should not be solely fed to animals but should be combined with roughage that is low in protein and high in energy, such as rice or maize straw. Forage production of 4.5-9.1 ton/ha per year could be expected (Orwa *et al*., 2009)

- The chief economic value of the Sesbania is likely to be as a green manure and livestock forage (Gillett, 1963).
- *Sesbania grandiflora* can meet production shortages in times of extreme climatic conditions such as droughts. This are easy to grow, require little land, labour or capital, have numerous by-products (Steven *et al.,* 2014).

Impact of sesbania supplementation on Milk yield and Body weight

Increased growth rate of 7 g/day was observed with goats fed with dried *Sesbania grandiflora* as 30% supplement to straw over a period of 4 weeks (Robertson, 1988). Goats fed on a diet of *S. grandiflora* forage *ad lib* for a period of 8 weeks body weight gain of 17.1 g/head/day was observed by Singh *et al.* (1980). Gutteridge (1987) reported that when *S. grandiflora* fed as supplements to teff straw (30%) to both sheep and goats, the growth rates of sheep was increased by 35 g/head/day while those for goats was 4 g/head/day. Ash and Petaia (1992) conducted an experiment to evaluate the nutritive value of *Sesbania grandiflora*. The goats (Group 1) were fed on sesbania *ad libitum* with a basal diet of low quality grass. In group 2 goats were fed with grass alone. The body weight gain of 78.6 g/day in group 1 and 54.7 g/day in group 2 were observed. Pramila *et al.* (2015) conducted on - farm demonstrations to demonstrate the effect of supplementation of sesbania forage on milk yield in crossbred lactating cows. The average daily milk yields (lit/day) without feeding sesbania was 7.36±0.08 and with feeding sesbania 9.24±0.08. Total increase in milk yield was 1.88 lit/day. Lemma *et al.* (1988) reported that milk yield was higher in crossbred cows supplemented with sesbania (30%) by 0.85 kg/day. The supplementation of *Sesbania grandiflora* in bovines at 5 kg/head daily for 45 days. Milk yield was increased by 8 per cent. (Vijayakumar *et al*., 2000).

Lucerne (*Medicago sativa)*

Native of south- western Asia well adapted to warm temperature and cool sub – tropical regions. It is hardy and drought resistant, can withstand high temperature (40 ^{o}C to 45 ^{o}C) and an annual rainfall of 45-50cm is optimum but can also survive in low rainfall of 35cm. Lucerne is perennial herb, grow up to 0.6-1.6m tall. First cutting can be taken 45-90 days after sowing and cutting interval 30-40 days. Yield about 40 tones of green fodder per hectare (New South Wales Agriculture Facts., 2003).

Impact of Lucerne supplementation on Milk yield and Body weight

The diets containing lucerne elicited the greatest DMI and milk yield. (West *et al.,* 1997*)*. Kanthraju (2015) conducted on-farm demonstrations and reported that milk yield in crossbred lactating cows was increased (32.5%) on supplementation (5kg/day/cow) of wilted lucerne forage. Steinshamn (2010) compared the effect of White clover (*Trifolium repens*), Red clover (*Trofolium pratense*) and Lucerne (*Medicago sativa*) based diets on feed intake, milk production and milk quality. The results indicated that there was a tendency that lucerne fed cows had higher DMI (0.8 kg/day) and Milk yield (2.2 kg/day) compared to other diets. Lucerne hay supplemented (25% of DM requirement) along with maize silage or groundnut haulms resulted in optimum weight gain and reduced feed cost in Nellore ram lambs (Venkateswarlu *et al*., 2013). The inclusion of lucerne in dairy cows total mixed ration (TMR) can reduce the proportion of supplements in the form of cereals like maize, resulting in reduced feed costs (Dewhurst *et al.,* 2003).

Moringa (*Moringa oleifera)*

Moringa is native to the Indian subcontinent and has become naturalized in tropical and subtropical areas around the world. It is a multipurpose tropical tree, mainly used for food and has numerous industrial, medicinal and agricultural uses, including animal feeding as fodder. The tree is evergreen and fast growing with high capability to re-grow after pruning. The tree has the capacity to produce high quantities of fresh biomass per unit area even at high planting densities and give dry matter yield from 4.2 to 8.3 ton per hectare with a cutting frequency of 40 days interval (Wasif *et al*., 2014). The leaves are very nutritious and rich in crude protein (22 - 25%), vitamins A, B and C, and minerals (*Moyo et al., 2011).*

Impact of Moringa supplementation on Milk yield and Body weight

The inclusions of Moringa as a protein supplement to low quality diets improves DM intake and digestibility, increases milk production and affect milk composition in terms of milk fat and total solids (Nadir *et al*., 2005). An increase of 43% in milk yield was seen when cows were fed 15-17 kg (fresh matter) of Moringa leaves daily, mixed with their regular feed (Amaglo, 2010). DM intake and growth rate of goats fed on different ratio of dried moringa foliage and concentrate diets was higher than the sole conventional concentrate diet. Replacing moringa foliage supplementation at 75% with conventional concentrate could be used as a cheap protein supplement for goats (Nasrin *et al.*, 2015). Inclusion of *Moringa oleifera* meal as protein supplement in broiler diets at 25% inclusion level produces broilers of similar weight and growth rate compared to those fed under conventional commercial feeds (Gadzirayi *et al.*, 2012)**.** Supplementation of *M.oleifera* leaves to diet significantly reduced the adverse effects of aflatoxin in broilers (Umaya and Parvatham, 2012).

Berseem (*Trifolium alexandrinum)*

Indigenous to Egypt and introduced to India in 1904 and by 1916 it was recognized as a widely adaptable and valuable addition to the forage crops of India. First cutting can be taken 50-60 days after sowing and cutting interval of 35-40 days. Berseem is best fed mixed with some dry fodder, like jowar and it is very palatable and nutritious feed for all livestock and stimulates milk production in dairy cows and buffaloes.

Impact of berseem supplementation on Milk yield and Body weight

Increase in milk yield (0.7lt/day) and VFA levels were observed when berseem (25%) was fed along with wheat straw in HF cross bred cows (Sawal and kurar, 1998). Dry matter intake and milk yield were higher in buffaloes fed with Berseem fodder diet than those fed with Lucerne fodder diet (Sarwar *et al.,* 2005). Berseem forage to concentrate ratio of 75:25 was most appropriate for economical mutton production in Lohi lambs (Jabbar and Anjum, 2008).

Impact of some other legume supplementations on Milk yield and Body weight

Forage legumes, such as red clover offered fresh or ensiled can increase growth rates in ruminants due to higher nitrogen utilization efficiency and dry matter intakes. (Speijers *et al.,* 2004). In Tabasco sheep in Mexico, both DM intake and DM digestibility increased when gliricidia was used as a supplement, up to 30% of the diet, with grass hay. (Nochebuena and Donovan, 1986). Gliricidia at 25, 50 and 75 percentage supplementation with grass has higher level of improving growth and survival of lambs. Lambs growth rate was almost double by feeding gliricidia (Chadhokar, 1980). The inclusion of forage cowpea in the diet of the cows increases the average milk production per cow from about 0.25liter/day to 1.25litres/day (Grings, 2000). Increased growth rate of 5 g/kgBW/day with ram fed with dried *cowpea* as a 30% supplement over a period of 4 weeks was observed (Singh *et al.,* 2000). Mupenzi (2009) reported that supplementation of *stylosanthes scabra* (3kg/day) to the Ankole cows increases the milk yield by 54.4%. A shrub legumes such as *Acacia boliviana, Calliandra calothyrsus and Leucaena leucocephala* supplementation improves the milk yield (Maasdorp *et al*., 1999)

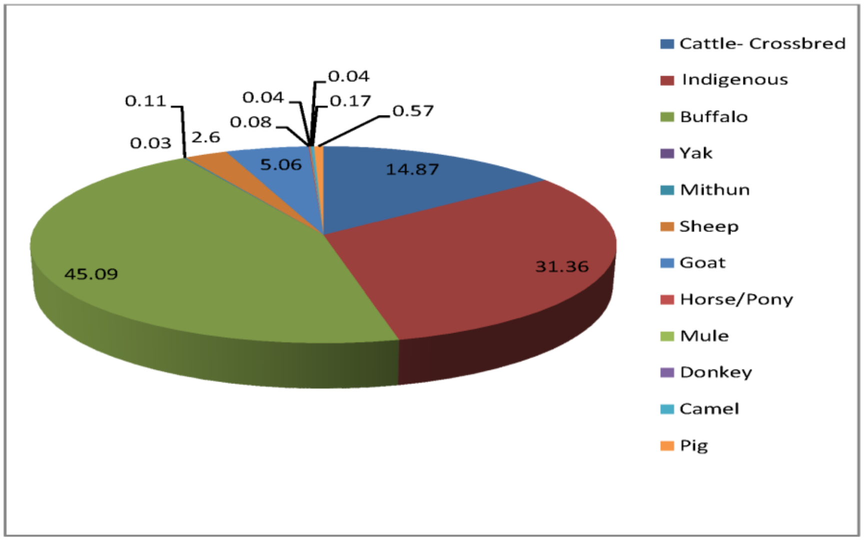
Environmental impact of some of the legume fodders on livestock production

Livestock contributes both directly and indirectly to climate change through the emissions of greenhouse gases such as carbon dioxide (9%) and methane (35%). Globally, livestock sector contributes 18% of greenhouse gas emission accounting for 9.3 Teragram/year (IPCC, 2013). Increases in methane emission from livestock leads to environmental pollution and global warming. If methane emissions continue to rise in direct proportion to livestock number a 60% increase in global methane production is predicted by 2030 (FAO, 2003). Methane production by enteric fermentation in the rumen accounts for the 2-12% loss of gross energy (Johnson, 1997). Changes in feeding regime could remodel the present scenario of methane emission from livestock and thus mitigate some of this increase (US-EPA, 2006).

Contribution of livestock to methane emission in India

India produces 12.45% of the total enteric methane emissions of world (20.56 million tons). Average methane emission from lactating animals in India is about 53.6g CH_4/kg milk (IPCC, 2013). India has approximately 512 million livestock and in the total livestock population, about 60% are cattle and buffaloes, which comparatively emit more enteric CH_4 than any other livestock species (Singhal, 2005).

Species wise contribution of Methane production in India (Veerasamy *et al., 2016)*



Enteric Methane production mechanism

Methane production in the rumen occurs as a consequence of the presence of a group of microorganisms called methanogens. These organisms play an important role in converting organic matter to methane. Proteins, starch and plant cell-wall polymers consumed by the animal are hydrolyzed to amino acids and simple sugars by the bacteria, protozoa and fungi. Primary and secondary digestive microorganisms further ferment the amino acids and sugars into volatile fatty acids, hydrogen, carbon dioxide and other end products. Methanogens then converts carbon dioxide to methane.

Methane mitigation by the use of legumes fodder

Inclusion of legume-based forages in the diet was associated with higher digestibility and faster rate of passage resulting in a shift toward high propionate in the rumen and reduced methane production. Legumes that contain secondary compounds such as condensed tannins (CT) it was possible to reduce methanogenesis. Some legumes with tannins contribute to the reduction in in-vitro CH_4 production.

Sesbania contain saponins, which increases partitioning factor (mg of truly degraded substrate/ml gas produced) and alter the microbial community towards proliferation of fibre-degrading bacteria and inhibition of methanogenic organisms, there by decreases methane production (Jayanegara *et al*., 2009). Tropical tree leaves containing saponins and tanins such as

Autocarpus integrifolia, *Jatropha curcus* and *Sesbania grandiflora* have the potential to suppress methanogenesis (Patra, 2010). Tannins and saponins reduce methane due to their inhibitory effect upon methanogens, protozoa and other hydrogen-producing microbes. (McCaughey *et al*., 1997). Enteric methane reduction of 32% was observed due to the addition of 30% Lucerne fodder (Malik and Singhal, 2008). Alfalfa varieties were rich in secondary metabolites such as malate and saponins that can reduce methane production (Klita *et al*., 1996). Cows grazing the alfalfa-grass pastures had greater dry matter intake and lower methane production was observed compared to their counterparts grazing grass-only pastures (McCaughey *et al*., 1997). Acacia fodder tree supplementation (25%) reduces methane release by 13% on an average (Carulla *et al.*, 2005). *Gliricidia sepium* and *Acacia mearnsii* fodder trees improve livestock productivity and helps to reduce methane emissions per unit of output (Steven *et al*., 2014). Shrub legumes such as *Calliandra calothyrsus* and *Leucaena leucocephala* contain tannins which can reduce methanogenesis (3 – 21% methane reduction). (Elizabeth, 2010).

Conclusion

With the increase in per capita income and urbanization, the consumption of livestock products will continue to rise in the foreseeable future. India has a large livestock population – a resource that provides livelihood opportunity and employment to over 70% of rural people. The shrinking land base and natural resource degradation restricts grazing and forage availability. Consequently, the demand for feed and fodder for fulfilling the requirement of livestock population will also increase. Increase in livestock population also contributes for more enteric methane emission. The percentage increase in enteric methane emission by Indian livestock was greater than world livestock (70.6% vs 54.3%) over the years 1961 to 2010. In this situation legume fodders work handy to supplement as a cheap and quality protein source as well as to reduce enteric methane emission by replacing the concentrates. In this regard educating the farmers on cultivation of legume fodder which is economically and environmentally friendly for feeding their livestock is need of the hour.

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Millets – A Way Forward in Doubling Small Farmers' Income through Processing and Value Addition

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Abstract

In the context of burgeoning human population, increase in demand for food grains and natural resources, shrinking land mass, conversion of cultivable land into non-agricultural purpose, change in ecological environment, less availability and high cost of labour etc., now the livelihood of the small and marginal farmers' is on stake. Rapid population growth in India is raising the demand for locally-grown foods, especially in the dry land regions. Related to this is the fact that, while the majority of poor people are still located in rural areas, an increasing share of the population is migrating to urban areas in search of nonfarm jobs. So one of the solution could be for this is adoption of cultivation of "climate smart" crops i.e. millets. In India, eight millets species (sorghum, finger millet, pearl millet, foxtail millet, barnyard millet, proso millet, kodo millet and little millet) are commonly cultivated under rain fed conditions. Its great merit is that it can be grown on poor sandy soil with low rainfall areas, drought-tolerant, resistance to pests and diseases, short growing season, and still give economic yields and are often considered to be a "poor man's cereal". Millets were found to have high nutritive value and comparable to that of major cereals such as wheat and rice, rich sources of phytochemicals

and micronutrients and are gluten free they are suitable for celiac patients. Millets must also be accepted as functional food and nutraceuticals because they provide dietary fibers, proteins, energy, minerals, vitamins, and antioxidants required for human health. Several potential health benefits such as preventing cancer and cardiovascular diseases, lowering blood pressure, risk of heart disease, cholesterol, and rate of fat absorption were reported for millets. Millets are less expensive compared to other cereals and is a staple for the poorer sections of population. In recent years, the demand for millets in India has risen, creating new opportunities for these crops in the marketplace. As incomes rise, diets are changing and the demand for health conscious foods is also increased.Millets are playing the important role in achieving the consumer needs. To make the farmer to get better income from these low cost crops basic strategy is to effectively link production of millets with processing, value addition and ultimately the market. This integration will ensure better profit for farmers and it not only doubles their income but also take care of nutritional security among the consumers.

Introduction:

After decades of neglect, small millets are figuring in the National AgriculturalDevelopment Agenda. Millets are tasty grains that have a mildly sweet, nut-like flavor , versatile, climatic resilient, widely grown crops around the semiarid tropics around world and used for human food and stalks for their livestock fodder. They are important crops cultivated in the semi-arid tropics of Asia and Africa (especially in India, Nigeria, and Niger), contributing 97% of total millet production in developing countries. Sorghum and Pearl Millet are referred as major millets and Small millets are finger millet, Kodo Millet, little Millet, Foxtail Millet, Proso Millet and Barnyard Millet. Millets are well known for rich sources of protein, dietary fiber, energy and minerals like Ca, Mg, Zn, Fe, etc. when compared to rice. India is one of the diversity centers of millet crops and is primary orsecondary centre of diversity for several millet crops. Millets which are a treasure trove of health-promotivephytochemicals, have invited lot of attentionfor their potential role as functional foods. These millets have diversified high food value but the consumption of millets has declined for want of standardized processing techniques to compete with fine cereals. Plausible reasons for declined consumption of millets is due to lack of technical-know-how among the farmers and processors about the processing methods with respect to their own old methods of processing inconvenience in its product preparation.Associated cultural issues in adoption and diversification of millets and lack of awareness among the people about nutritive value of millet and a general opinion that millets are poor men crop. In this regard, interventions through diversification of millets processing technologies are attempted to remove the inconveniences in and develop, fine tune and standardize millets product technologies.

Health Benefits of Millets:

According FAO report that there are over 50,000 edible plant species are known to human kind, but in the history few thousands of these plant species were consumed by our ancestors with dietary diversification. Today whole planet is depending on only four foods (rice, wheat, maize and potato) for the energy requirements. This monotony of our diet leads us to many non-communicable diseases. Thus the key element in maintaining overall physical well-being is directly proportional to nutritional wellbeing showing as sustainable force for health, development and maximization of human genetic potential (Saleh et al., 2013). Therefore there is an every need to reintroduce many of the cereals, millets in our daily diets. In the food industry, cereal grains and plant nutrients are largely used as a major source of dietary nutrients worldwide .The richness in calcium, dietary fiber, polyphenol and protein content in millets make them unique among the cereals. Generally, millets show significant amounts of amino acids (methionine and cysteine) and also have high fat content than maize, rice, and sorghum.

Millets are nutritionally comparable to major cereals and serve as good source of protein, micronutrients and phytochemicals. Processing methods like soaking, malting, decortications, and cooking affect the anti-oxidant content and activity. While sorghum and most of the millets contains about 10% protein, 3.5% lipids, finger millet contains 12-16% protein and 2-5% lipids. Sorghum and millets are very good sources of micronutrients such as vitamins and minerals. Major portion of sorghum protein is prolamin (kaffirin) which has a unique feature of lowering digestibility upon cooking whereas, the millets have a better amino acid profile. It has been reported that sorghum proteins upon cooking are significantly less digestible than other cereal proteins, which might be a health benefit for certain dietary groups. On the other hand millets contain fewer cross-linked prolamins, which may be an additional factor contributing to higher digestibility of the millet proteins.

Gluten intolerant persons (celiac) allergic to gliadin, a prolamin specific to wheat and some other common grains comprise a large segment of population. Sorghum and millets are gluten free, hence may be useful dietary cereals. Being non-glutinous, millets are safe for people suffering from gluten allergy and celiac disease. They are non-acid forming, and hence easy to digest.Recently, an interest in both sorghum and millet in high-end food products, snack foods, gluten free foods and in health food markets has begun in regions of the world that have traditionally not used these grains in human food systems. Sorghum and millets complement well with lysine-rich vegetable (leguminous) and animal proteins and form nutritionally balanced composites of high biological value. Because of these benefits millets, millets can be used in functional foods and as neutraceuticals. Hence, they are also called as ‘nutri cereals’.

Millets are now back to plate

In the present situation, working people are not getting enough time to prepare food for these people, breakfast cereal technology has evolved from the simple procedure of grain milling for cereal/coarse cereal products that requires cooking to the manufacturing of highly sophisticated ready-to-eat and ready-to-cook products. Modern children are being sufferer especially in obesity as well as assailant of environment and geriatric diseases. While efforts are being made worldwide towards achieving self-sufficiency in food, conserving the environment, and solving health problems. For this reason millet is attracting the world's attention as a key crop to overcome population explosion and food crisis. Hence, the pressing need to improve livelihoods and well-being through improved use of biodiversity has been augmently envisaged. Thus focus in India is to be on small-grain cereals, notably millets. Eating millet will recover the diversity in staple food. There should be a systematic and holistic approach to study millet from various aspects such as environmental conservation, coping with food crisis, sustainable agriculture, traditional food culture, food and health, history, culture, cultivation, preparation, marketing, consumer acceptance, etc., are needed to bring back our traditional diet to avoid modern illness and biodiversity.

Given the above background of health benefits of millets and changing the trends of young generation becominghealth consciousness and it is necessary to promote healthy foods like millet based products to meet the demand of today’s customers. However,processing of millets is need of the hour for two main reasons. First is to increase the purchasing power of consumers and secondly to provide the customers a tasty and healthy value added millet product. It needs to address the changing consumer aspirations, the emerging needs of the society, empower the farmers, and leverage upon the strengths of the available pool of talented young population, especially in rural areas, with entrepreneurial drive to bring in a self-sustaining economy that links agriculture with the food and agribusiness industry. This calls for the right strategies and mechanisms for fostering innovative self-sustaining entrepreneurial business activities.

Entrepreneurship through value addition

In a sense, it is crucial to find and develop good profitable uses of coarse cereals/millet. Millet is much cheaper, but they are not popular and unprocessed and thereforeless convenient to use. As a result, markets for locally grown millet are retreating; incentivesfor local production are weakening. Thus, in the rural areas especially where the dry area belt is more, processing facilities are particularlyvital to the future of local millet farming. Thus, millets are so compelling to agree there needs toeducate consumers on the health benefits and to encourage increased consumption. To do this, ajoint effort is needed by many inter-disciplinary partners likepost harvest, health department, food engineers, and nutrition professionals, includingindustry, government, and health promotion organizations is required. As part of this effort, weneed support from nutrition educators in industry, academia, and government to develop clearand consistent messages in consumer language to communicate the positive health benefits ofmillet products.

Entrepreneurship development is one of the highly needed area in millet promotion. In village conditions farmers follow the traditional way of both growing the millets and they grow for subsistence level and they are not aware about the value added products which can be prepared from millets. In order to keep up the momentum and the sustainability of commercialization process, entrepreneurship development for the stakeholders is necessitated. To motivate the farmers to develop an enterprise in millets ICAR-IIMR in partnership with ITC backstopped the participating farmers with improved cultivars and buy-back assurance. IIMR has also signed Memorandum of Understanding with 15 entrepreneurs of which MoU with multinational Britannia Industries Ltd to create the opportunities for entrepreneurs to popularize their product as well as to acquire more benefit for their products.

Summary

There is a lot of scope for value added products of millets especially in peri-urban and urban areas that will help in diversifying the use of millet based products. Enhancing the demand is the key for success of the enterprise. In order to leverage on the huge entrepreneurial opportunity in millet sector, a 360° approach needs to be taken to ensure that the next wave of growth in the millet processing sector is achieved through nurturing enterprises, linked to innovations.It is necessary to create a platform for entrepreneurs with the market through facilitating buy-back of marketable surplus. The entrepreneurship approach thus provides end to end solutions and forward integration is enabled for food processing and commercialization by the entrepreneurs.

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Nutrition security challenges and strategies to improve the nutrition security status in India

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Abstract

India is the second most populous country in the world. It currently accounts for more than 17% of the global population with 456 million poor peoples. Food and nutrition security is possible through availability, accessibility, and absorption. So, nutrition security is possible through not only the quantity of food items, mainly quality food products (mainly diversified food items like, minor millets, pulses, fruits , vegetables, milk and intake of animal protein). Good health depends on good nutrition. In India, providing nutritional security to all peoples is the main problem. But, Nutritional security should be achieved through reducing the "nutrition gap", it is between what foods are consumed and what foods are needed for good nutrition. To reduces the nutritional security issues, promoting awareness, knowledge and building the attitude among the farmers and promoting strategies related to nutritional aspects through agricultural and health extension initiatives. Because, local production seems to be an important factor influencing its food consumption. This paper deals about important strategies to improve the nutrition security in India such as promotion of industrial fortified products, promotion of homestead gardening practices, enhancement of diversified agricultural production, empowerment of rural women, strengthening the links between the agriculture -nutrition and health sectors, providing nutrition education, ground water improvement, climate change mitigation in agriculture for sustainable production, development of infrastructures in marginalized areas.

Key words: Agriculture, Malnutrition, Health, Nutritional security

Introduction

Nutrition security is possible through not only the quantity of food items, mainly quality (mainly diversified food items like minor millets, pulses, fruits , vegetables and intake of animal protein) food products. Good health depends on good nutrition. Malnutrition is the most serious health problem and the single biggest contributor to child deaths. The Malnutrition leads to blindness, mental retardation and early death. The strategic framework of FAO's first goal is reducing the number of hungry and ensuring adequate nutrition for all between the periods of 2010-2019. With respect to India, It currently accounts for more than 17% of the global population and 456 million poor, or 41.6% living on less than $1.25 a day (Chen and Ravallion 2008). According to Food and Agriculture Organization (FAO), Food security has three components, viz., availability, access, and absorption (nutrition). It suggests that the nutritional security is the only solution to solve the malnutrition and health issues. So, in order to tackle widespread problems of nutrition, it might be necessary to move scaling up "nutrition-specific" interventions (i.e., those that address the immediate determinants of nutrition) and devote "new and aggressive focus on coupling effective nutrition-specific intervention with nutrition sensitive interventions" that address the underlying causes of under nutrition.

Nutrition insecurity

Nutritional insecurity is the problem through "nutrition gap", it is between what foods are consumed and what foods are needed for good nutrition. The under nutrition is the result of not having enough to eat the quality of diets, such as lack of protein and of micronutrients, including iron, iodine, zinc and vitamin A. Micronutrient malnutrition (or "hidden hunger") affects people and can lead to poor physical growth and development, lowered mental capacity, reduced productivity, impaired immune systems and other health problems (FAO, 2010). Even if there is availability as well as access to food, there is no guarantee of adequate absorption or nutrition, especially since; nutrition depends on many other factors such as the condition of pregnant women, breast feeding, health factors, hygiene, drinking water, sanitation, etc. And so, access to health care and sanitation facilities is among the key determinants of nutrition security.

Problems of Nutrition security in India

It is now well recognized that India's economic growth is good. But the problem of persistent and widespread under nutrition, poverty and rising inequalities also increasing in absolute quantities (Drèze and Sen, 2013). The economic growth and its importance, cannot alone deliver nutritional security. It requires specific interventions to address nutritional problems through “nutrition-sensitive” food and agriculture protection for promoting food and nutrition security. Economic access to food by about a one fourth of the population living below the poverty line is problematic. The level of malnutrition especially among women and children remains unacceptably high. About 44% of children under the age of 5 are underweight, around half of pregnant women are anemic condition.

Good health depends on good nutrition. Good nutrition, in turn, depends on agriculture to provide the foods – cereals, pulses, vegetables, fruit, meat, fish, milk and dairy products – for a balanced diet that meets our needs for energy, protein, vitamins and minerals. Nutrition is the bridge between agriculture and health. The important problems in agricultural sectors are the following: (i) ill effects of globalization challenges in agricultural sector, volatility in prices; (ii) shrinking farm size; (iii) dry land farming challenges; and (iv) environmental stress. And so, the six deficits in agriculture are: (i) investment, credit, and infrastructure deficit; (ii) research and extension (technology) deficit; (iii) market deficit; (iv) diversification deficit; (v) institutions deficit; and (vi) education/skill deficit. Deficiencies in agriculture and rural infrastructure are the biggest problems for agricultural development.

Nutritional security should be achieved through much more attention needs to be given, not only to the quantity, but also to the quality of foods available and consumed, especially among low-income rural households, where monotonous diets high in starchy staples and low in micronutrients are the norm, and where adequate amounts of micronutrient-rich foods, such as meat, dairy products, legumes, vegetables and fruit, are generally unavailable.

Social disparities in Nutrition security

Social disparities are main indicators of poverty and vulnerability. So, the incidence of malnutrition also increased due to the concern indicators. The SC/ST and Muslims suffer from poverty and vulnerability to a greater extent as compared to OBCs and other castes. The incidence of malnutrition (chronic energy deficiency) among women is the highest for SCs/STs, followed by OBCs and Muslims. The malnutrition among women for OBCs is much lower than other castes (Jose and Navaneetham, 2010).

Strategies to improve the nutrition security in India

Food-based strategies

Industrial fortified products promotion is one of the comprehensive strategies to improve the nutritional status such as iodized salt and fortified flour – and home fortification of meals using micronutrient powders and lipid-based spreads, plays an important role in food-based nutrition interventions. More sustainable approaches like bio fortification, i.e. increasing the vitamin A, iron and zinc content of staple food crops through plant breeding and improved agronomic practices. For example, improved varieties of orange-fleshed sweet potato and golden rice are very rich in beta carotene (FAO, 2011a). And so, well-designed food-based combined interventions with appropriate, use of supplements, supported by health and nutrition education – can improve the diets of vulnerable populations in a sustainable manner.

Homestead gardening practices

Sustainable enhancement of household "nutritional self-sufficiency" through the establishment of homestead gardens. It supports significantly higher intake of fresh vegetables, dark green leafy vegetables, eggs and milk. It has led to a decline in the prevalence of anemia in women and in children aged from six months to five years (Arimond *et al*., 2011).

Diversifying agricultural production

A more sustainable approach for subsistence farming households is diversification of their food production through the introduction of horticultural crops, fish and livestock that are suited to local agro-ecological conditions and it can fill the micronutrient deficiencies in the local diet. The nutritional quality of the diet improves as a greater diversity of food items and food groups is consumed. So, the key strategy in nutrition-sensitive agricultural development is the "food-based" approach, which is aimed at increasing the availability and consumption of the diverse range of foods necessary for a healthy diet. Therefore, food-based interventions promote dietary diversification by increasing the availability of, access to and consumption of foods with a high content and bioavailability of nutrients throughout the year. Those foods include nutrient-rich animal-source foods, such as dairy products, poultry and fish, which address multiple nutrient deficiencies, as well as pulses, vegetables and fruit.

Nutrition-sensitive diversification through crops, aquaculture and livestock increases the production of nutrient-rich foods for direct consumption as well as income generation with enhanced nutritional quality. And so, the post-harvest technologies that reduce food losses and conserve nutrients. In India, it is possible in a wide range of farming systems, agro-ecological zones.

Empowering rural women

Rural women are the strongest link between agriculture and nutrition. There is a strong positive association between rural women's empowerment and nutritional security. Women with higher status have better nutritional status themselves, are better cared for, and provide higher quality care to their families. So, at field level, both nutrition and gender inequities need to be addressed through the design and development of women specific of agricultural development programmes for improvement of nutritional status and their health conditions. The improved nutritional status of women also supports better child health and survival. If women and men had equal status, the prevalence of underweight children would decline by almost 30 percent (Jose and Navaneetham 2010).

Strengthening links between the agriculture, nutrition and health sectors

Interventions aimed at improving diets and raising levels of nutrition should combine public health, nutrition education and dietary strategies. Agriculturalists need to work with nutritionists to identify deficits in local diets and micronutrient intakes. Food-based interventions will be more effective when accompanied by community health programmes.

Providing nutrition education

Interventions should include a strong nutrition education programme to change the behavior of women , poor peoples and socially vulnerable groups of the peoples. In this regards, to ensure and increase the food consumptions and food distribution patterns, the social protection programmes of MGNREGA, National food security bill and food transfer through (PDS) and supplementary nutritional programmes plays very important role in the nutritional security perspectives.

Increasing ground water level

India is a net agricultural exporter but food availability is threatened by the effects of declining water resources. There is a huge pressure on groundwater resources in India and this is felt even more during periods of drought; hence, large investments are needed in "groundwater banking" (Shah et al. 2009). It is interesting to observe that Gujarat has invested in more than 100,000 check dams through the involvement of nongovernment organizations since the year 2000, and has been instrumental in recharging water tables. This has given rich dividends to Gujarat, which has registered the highest rates of growth in agriculture (above 9% per annum) among all states of India supportive to the decentralized food availability and nutritional security (Shah et al. 2009).

Climate change mitigation

One of the emerging issues in food and nutritional security is climate change and its impact on agriculture. The vast majority of India's population depends on climate-sensitive sectors like agriculture, forestry, and fishery for their livelihood. The adverse impact of climate change in the form of declining rainfall and rising temperatures, and thus, increased severity of drought and flooding, is bound to threaten food security and livelihoods in the economy. (FAO, 2005). So, various climate change mitigation practices like conservation agriculture, climate smart agriculture, etc should be promoted for sustainable food and nutritional security in India.

Development of infrastructures in marginalized areas

In particular, women's access to clean drinking water, toilet facilities, and clean cooking fuel influences their health outcomes, which are critical to child health and nutrition. The impact is measured in terms of both the health effects and the time they spend in coping with the lack of these facilities. Over 53% of women in India do not have access to toilet facilities, 55% do not have drinking water in their premises, and only 29% have access to clean fuel. Meanwhile,35.6% of women suffer from chronic energy deficiency, indicated by a body mass index below 18.5 (Jose and Navaneetham 2010). So, development of infrastructural aspects in this area is the need of the hour in India.

Constraints

Among the poor, the most vulnerable are those whose nutritional needs are higher and social status is lowest, mainly young children, pregnant and lactating women, the sick and the elderly (UNSCN, 2010a). An estimated 40 per cent of the India's undernourished people are women (ECOSOC, 2007). Rural women are particularly vulnerable because they receive less health care and are subject to greater risks, owing to repeated pregnancies and delivery of children (FAO, 2011b).

In the Green Revolution time, India's cereal production has increased but the poverty rate declined slowly (World Bank, 2007b). However, growth in staple crop production and levels of income has not triggered matching reductions in the incidence of chronic hunger and malnutrition. The number of chronically undernourished – people unable to meet their minimum food energy requirements (FAO, 2009d). The rapid urbanization in India is accompanied by a "double burden" of malnutrition and health hazards (UNICEF, 2012). On the other hand, the prevalence of overweight and obesity, and associated chronic diseases such as diabetes, is increasing among those slum dwellers who over-consume low-cost, high-energy and nutrient-poor foods (FAO, 2006b). In India, the causes of persistent hunger and malnutrition are complex. It results in a combination of inadequacies in food access and availability, dietary knowledge, health, sanitation and care. People in low-income, food-insecure, resource-poor, socially excluded and economically marginalized households, in both rural and urban areas, are malnourished because they do not have enough resources to produce, or enough income to buy, sufficient amounts of all the foods they need.

Conclusion

Nutritional security should be achieved through not only the quantity food items mainly quality food products. Important strategies to improve the nutrition security in India are promotion of Industrial fortified products, promotion of homestead gardening practices, enhancement of diversified agricultural production , empowerment of rural women, strengthening the links between the agriculture -nutrition and health sectors, providing nutrition education, ground water improvement climate change mitigation in agriculture for sustainable production, development of infrastructures in marginalized areas. Finally, India has many policies to control the food insecurity and malnutrition. The problem is with both design and implementation of the programmes. India has many policies and programmes. However, food insecurity and malnutrition continue to be high. The problem is with both design and implementation of the programmes. Social mobilization, community participation and decentralized approach are necessary for better implementation of policies and programmes.

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ORGANIC FARMING FOR SUSTAINABLE AGRICULTURE WITH FOCUS ON AGRICULTURAL EXTENSION STRATEGIES FOR MOTIVATING FARMERS TOWARDS ORGANIC FARMING

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Introduction

Agriculture, the leading economy of the nation, is taking part in a momentous responsibility in the overall socio-economic fabric of the country accounting for 17.9% of the GDP in 2015 and about 50% of the workforce (Mahapatra *et al.*, 2016). It must meet the challenges of feeding the growing population while simultaneously minimizing its environmental ill impacts. Energy intensive conventional agriculture boosts the productivity in terms of jeopardizing the natural resources vis-à-vis overall ecological balances. Hence, there is need to focus on more environment friendly and sustainable approach to increase the agricultural production. One such alternative approach is organic agriculture that uses bio-fertilizer, bio-pesticides, green manure, compost etc. which do not harm environment and provides sustainable yields. Thus, the major aim of organic agriculture is to augment ecological processes that foster plant nutrition yet conserve soil and water resources. Therefore, besides targeting the productivity of the crops alone, efficiency vis-à-vis resource input of different organic agriculture production systems and their comparative study with conventional farming systems and technology generation is the need at this hour.

Statistics:

As per the statistics compiled by the IFOAM and FiBL (Anonymous, 2016) world over 43.7 million ha land (1% of total agricultural land) is being managed organically by 2 million producers in 172 countries. Besides this, there is another 37.6 million ha being certified for wild harvest collection. Global sales for organic products have reached 80 billion US$ with US and Europe being the largest consumers. As on March 2016, India has brought 57.0 lakh ha area under organic certification process, which includes 14.8 lakh ha cultivated agricultural land and 42.2 lakh ha of wild harvest collection area in forests.

During 2015-16, India exported 2.64 lakh MT of organic products belonging to 135 commodities valuing at US$ 285 million (approximately INR 1900 crore). The major share of exports was oilseeds, cereals and millets and processed foods with a combined share of around 91%. In the oilseeds category, soybean with exports of 1.26 lakh tons during 2015-16

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had a share of about 95% among total oilseeds. In cereals and millets category, rice, maize, wheat and coarse millets are being exported. In the rice category, the quantity of basmati rice exported was around 10300 tons. Domestic market is also growing at an annual growth rate of 15-25%. As per the survey conducted by ICCOA, Bangalore, domestic market during the year 2012-13 was worth INR 600 crore which has now grown to more than 1000 crore during 2014-15 9 (ICCOA, 2014). Among all the states, Madhya Pradesh has covered largest area under organic certification followed by Himachal Pradesh and Rajasthan respectively.

Organic agriculture and productivity

Since the advent of organic farming in the recent years there had been concerns on the production potential of the system. But the results of long term experiments released during the last 10 years from world over have eliminated all fears. Under irrigated conditions organic farming may be yielding 5- 12% less than their conventional counterparts but under rainfed and water deficit conditions organic system yields 7 to 15% more. Six years experimenting, comparing two models of organic management with only chemical input and chemical + organic under 4 crop husbandry systems at ICRISAT (Rupela, 2006) revealed that organic systems were at par with integrated and higher then chemical fertilizers in all the years from second year onwards. Reviewing 154 growing seasons' worth of data (Halwell, 2006) on various crops grown on rain-fed and irrigated land in the United States, it was found that organic corn yields were 94 percent of conventional yields, organic wheat yields were 97 percent, and organic soybean yields were 94 percent. Organic tomatoes showed no yield difference. More importantly, in the world's poorer nations where most of the world's hungry live, the yield gaps completely disappear. Research findings released from UAS, Dharwad, Karnataka under Network Project on Organic Farming (ICAR) reported that under rainfed systems organic management yields much higher productivity then conventional (UAS Dharwad, 2011).

Organic agriculture and profitability

Recently a study was conducted in Maharashtra to study the impact of organic farming on economics of sugarcane cultivation in Maharashtra (Kshirsagar, 2007). The study was based on primary data collected from two districts covering 142 farmers, 72 growing Organic Sugarcane (OS) and 70 growing Inorganic Sugarcane (IS). The study finds that organic cultivation enhances human labour employment by 16.90 per cent and its cost of cultivation was lower by 14.24 per cent than conventional farming. Although the yield from organic was 6.79 per cent lower than the conventional crop, it was more than compensated by the lower cost and price premium received and yield stability observed on organic farms. The organic farming gives 15.63 per cent higher profits and profits were also more stable on organic farms than the conventional farms.

Tej Pratap and Vaidya (2009) in a nationwide survey of organic farmers suggest that "The cost-benefit analysis indicates favourable economics of organic farming in India. Farmers in 5 out of 7 states are better placed, so far as organic farming is concerned. The returns are higher in Himachal Pradesh, Uttaranchal, Karnataka, Maharashtra and Rajasthan. In Karnataka organic farmers had 4-35% higher returns than inorganic farmers. In Kerala the differentials ranged between 4-37% in favour of inorganic farmers. In Maharashtra the difference in net profit was more than 100% in case of organic soybean. Organic cotton farmers were enjoying comfortable profit margin. The profit differential in Rajasthan ranged from 12-59% in favour of organic farmers. In Tamil Nadu organic farmers were better placed with two crops, while inorganic farmers were at slight advantage in other two crops. Comparative economic analysis with four cropping systems at UAS, Dharwad also indicates the promising potential of organic farming systems (Babalad, 2016).

Organic agriculture and soil health

Long term experiments comparing productivity and soil health parameters at ICRISAT have demonstrated that organic practices produced yields comparable to conventional plots, without receiving any chemical fertilizer; they actually showed increase in the concentration of N and P compared with conventional. In another similar study conducted under Network Project on Organic Farming of ICAR, (Gill and Prasad, 2009) showed Improvements of different magnitudes in respect of soil organic carbon, available-P, available-K, bulk density, and microbial count under organic systems as compared to chemical farm. Ramesh *et al*., 2010) reported that the bulk density of soil is less in organic farms which indicates better soil aggregation and soil physical conditions

Pest management in organic farming

The impact of pests, diseases and weeds on food supply is high that they reduce production by at least one-third despite using pesticides worth about $38 billion. In the past 50 years, pesticides use has increased tenfold, while crop losses from pest damage have doubled. Detrimental upshot of indiscriminate use of agro-chemicals to manage pests is well evident in crop ecosystem. As a result of growing concerns about health and environmental problems associated with pesticides, there are accelerated efforts from scientists for organic production. The focus in crop production is now gradually shifting towards on food quality and environment safety. In organic production the insect pests and diseases can be managed by using biological viz., plant extracts, micro-organisms or minerals and cultural pest control techniques like crop rotation, mixed cropping, ground covers, field fallowing and other vegetation, encouraging biodiversity to boost soil organic matter levels and to provide shelter and food for natural enemies of crop pests and diseases although approved organic pesticides may also be used when necessary. Their aim is to support the diversity and activity of natural enemies (Kristiansen, 2006). Thus, not only the quality of produce that will come through organic mode, but also will be free from toxins and pollutants which can be supplemented with higher resource use efficiency of crops for sustainable agriculture.

Extension strategies to encourage farmers towards organic farming

In India, 70% of the cultivated area is under areas receiving low rainfall. (Yadav *et al*., 2016) reported that under rainfed, water stressed conditions and in marginal land areas it is 7-15% higher yielder. Hence, organic farming it India has tremendous scope to increase its area under dryland farming. Even though India has vast potential for organic production and marketing, its achievement on production, certification and export is low due to various reasons. Lack of sufficient education on production with specific standards, lack of easy accessible information on organic methods, market facilities for interested farmers, lack of good consumer information on organic farming and organic food, high distribution cost, lack of effective demonstration of research results among farmers and advisors are some among the problems. To tackle the problems we need to focus on suitable strategies to encourage farming community towards organic farming.

1.Capacity building

Trainings and demonstrations should be organized for knowledge and skill up gradation. Trainings should be imparted to farmers on organic farming with various topics like soil fertility management, principles and practices of organic farming, organic input production technologies, use of natural resources and ITK, documentation in organic farming and certification, post harvest techniques.

2.Supply of inputs in time and quantity

The availability of bio-fertilisers and bio pesticides was also a problem for farmers. Intial supply of these inputs will encourage farmers to initiate organic farming. The inputs namely bio-fertilizers (Azolla, Azospirillum, Phosphobacteria), Bio-pesticides (Pseudomonas & Trichoderma), green manure (Sunhemp, Dhaincha, Calotropis) can be supplied ti the farmers.

3. Spread of Awareness:

Exhibitions, mass media programmes and exposure visits were organized to create awareness on larger scale. Through this exhibitions, awareness on organic products and market channels can be created that can divert their interest to organic farming. Similarly mass media like TV, radio and news papers can be utilized for wider reach. Publications in the form of folders, booklets and manuals can be bought out on organic production practices and need based information to the farmers.

4.Increasing self reliance

Most of the organic inputs were produced locally reducing dependence on external inputs. Training on the most widely used inputs like farmyard manure, vermicompost, panchagavya, neem based insect repellents can reduce cost of cultivation. This may attract small and marginal farmers towards organic farming. This practice not only reduces input cost but also fetch more price for organically grown produce.

5.Linking producers and consumers

To create awareness among consumers, exhibitions can be organized where farmer come in direct contact with the consumers. This will facilitate the farmers to know the consumer demand and provide direct linkage to consumers.

6. Wide publicity about Success stories:

Krishi Vigyan Kendra, Karur have developed various extension strategies to attract farmers towards organic farming. They have trained around 3402 farmers on organic farming.14 exposure visits to the nearby successful organic farmer fields and conducted 21 exhibitions. An impact study was conducted at karur village indiacted that 85% of the respondent were adopted organic farming practices.

The Government of Orissa has pooled resourced from the State Plan and various central schemes like, Horticulture Mission in North East (HMNE), Macro Management in Agriculture (MMA) and RashtriyaKrishiVikasYojna (RKVY). As on date, Sikkim, with only 0.2 % of the geographical area of the country, has accounted for more than 12% of the total organic area in the country (76,000 ha out of 6,20,000 ha). From the year 2016-17, the Government of Sikkim is implementing the Centrally Sponsored Scheme, "Mission Organic Value Chain Development for the North Eastern Region (MOVCD-NER)". The scheme aims at developing certified organic production in a value chain mode to link growers with consumers through an integrated and concentrated approach with end-to-end facilities for production, processing, storage and marketing (Anbalagan, 2016).

Conclusion:

Organic farming is a science based intensive cropping system based on efficient management of resources, soil health, sun energy harvesting and judicious use of natural resources. Under irrigated and intensive cultivation conditions, organic farming may be 5-12% less yielder but under rainfed, water stressed conditions and in marginal land areas it is 7-15% higher yielder. Organic farming in its modern version, equipped with local resources, strengthened with modern science and supported with mechanization is ready to take challenges in the field of environment preservation; resource optimization, comparable productivity and soil health build up. Besides, the adoption of organic farming in group and desire of the organic farmers to enter into direct trade as entrepreneurs is also contributing to social, physical and financial capital build up.

India has the potential to become a major organic producing country given the international demand for our farm products, different agro-climatic regions for the cultivation of a number of crops, the size of the domestic market and above all the long tradition of environment friendly farming and living. Therefore strong national organic policy is main need of the current position which will give an important place to organic farming addressing the current issues and obstacles. . An action plan for the organic sector should be developed based on the analysis of the state of the sector, participatory consultations, a need evaluation and proper sequencing of the actions.

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PUBLIC-PRIVATE PARTNERSHIP FOR AGRICULTURAL DEVELOPMENT – A VISION FOR DEVELOPING COUNTRIES

Dr. Sahana.S[1] and Ms. Vasanthi. C[2]

Agriculture is known to be an important sector in many developing countries, including India. The requisites for advancement in improved farming are not completely met out by the Public sector/government. For such requirement, Public Private Partnership stands out as an alternative solution. The term 'Public Private Partnership' emphasizes the relationship between public and private sectors in providing services. The concept of Public Private Partnership not only involves the participation of private sector but also reforms the role of government in order to meet the social obligations. Through Public Private Partnership, the targets for public achievement and sectorial reforms can be achieved. An apt Public Private Partnership model promotes distribution of tasks, risks and obligations optimally among private and public partners. The models of PPP vary from short-term simple to long-term complex type. The various models are Management contracts, Turnkey, Affermage, Revenue Sharing model, etc. Such models are often farmer friendly and efficient. Agricultural Research is the area of thrust which can be very well emphasized through engaging private sector in it. The public extension service is under tremendous pressure due to limited resources. Hence, Public Private Partnership in agricultural extension is recommendable to accommodate all the stakeholders in agriculture. Many times, by the collaborative research project, partnership directly results in flexible financing arrangements. Some of the successful examples from developing countries GraminSuvidha Kendra for farmers' empowerment in Maharashtra, e-Haat bazaar in Nepal guide farmers by providing market linkages, WWW.ruralinfobd.com, Bangladesh provides efficient content and information services to the farmers can be utilized for successful implementation of Public Private Partnership initiatives. Most of the developing countries are unable to spend money on developmental activities and thus PPP play a major role in enhancing the productivity and profitability of agriculture.

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PUBLIC-PRIVATE PARTNERSHIP FOR AGRICULTURAL DEVELOPMENT – A VISION FOR DEVELOPING COUNTRIES

Dr. Sahana.S[1], Ms. Vasanthi. C[2], Dr. S Sridhara[3]

The integrated approach helps in getting better result compared to the individual approach. Nowadays, the needs of people had been increasing. One sector could not able to meet the requirements of the people. In such case, for effective and quality delivery of the services, partnerships of different sectors are required.

The latest buzz word in the present situation is Public Private Partnership (PPP). This PPP has revolutionised the public sector for effective delivery of the goods. Complete privatization may act as a barrier to free flow of public goods. This encourages to go for PPP. In case of PPP, the government decides the public goods to be delivered then the private sector is invited to provide the goods and realise the user charges from the final consumers.

Public Private Partnership emerged in the later part of 1980s in Britain. The Tatcher Government introduced private finance initiatives, whereby public goods were financed with private capital and the private sector was also involved only to the extent of funding the public goods as long term lenders to the Government. In developed countries Public Private Partnership has reached a much matured level where by the most of the risk is transferred to the private sector. But in developing countries although Public Private Partnership is extensively used to provide public goods, the risk sharing is more skewed towards the government.

Concept of Public Private Partnership

Public Private Partnership describes a government service or private business venture which is funded and operated through a partnership of government or one or more private sector companies.

Public Private Partnership as any research collaboration between private and public sector entities in which partners jointly plan,execute activities with a view to accomplishing agreed-upon objectives while sharing the cost, risk and benefits incurred in the process.

So, in general, we can describe Public Private Partnership as a mode of implementing government programmes/schemes in partnership with private sector.

The Public Private Partnership serves the government in different ways like,

1. It helps in providing the facility which is much needed without financing directly.

2. The major portion of the risk is shared by the private sector by handling government bureaucracy.
3. With the unit partnership with private sector, the existing projects could be renovated to make independent of government fund or can take up profit making projects.
4. Effective managerial skill of private sector can be used by government sector.

Need for Public Private Partnership.

1. **Growing Popularity.**

   For effective delivery of infrastructure facilities like transportation, education, health care, etc., Public Private Partnership is most preferred in developing countries as it is more successful there.

2. **Limitations of government.**

   Due to population pressure, rural-urban migration has increased urbanisation and socio-economic development have increased the demand for infrastructure. Sometimes pressure on maintaining and operating the existing infrastructure has been increased.

3. **Need of new financial and institutional mechanisms.**

   Increased demand for the infrastructure with the existing resources forces the government and policy makers to explore for the other source of finance. Thus private sector could be attracted through mutually beneficial agreement.

4. **Benefits and Strengths.**

   The efficient use of resources, availability of modern technology, better project design and implementation and improved operation combine to deliver efficiency. Public Private Partnership also fastens the implementation, reduces life cycle cost and optimises risk.

5. **Access to project finance.**

   The important feature of Public Private Partnership is its ability to seek finance from private sector, when the funding is limited from public sector. Public Private Partnership also leverages available public capital by converting capital expenditure into flow-of-service payments.

6. **Rigorous risk appraisal and optimum allocation.**

The gestation period of infrastructure projects also requires sustainable and financial operational capacity. Public Private Partnership involves a full scale risk appraisal. This results in better cost estimation and investment decisions.

Main Characteristics of Public Private Partnership.

1. Risk sharing between public and private sectors.
2. Long-term relationship between parties.
3. Public service and ultimate regulatory responsibility remain in public sector.

Public Private Partnership schemes and modalities.

The Public Private Partnership models vary from short-term simple management contracts (with or without investment requirements) to long term and very complex BOT form, to divestiture. These models are mainly by;

- Ownership of capital assets
- Responsibility for investment
- Assumption of risks
- Duration of contract

Broad categorizations of participation are:

- Management contracts
- Turnkey projects
- Lease
- Concessions
- Private ownership of assets.

1. **Management Contracts.**

   It allows the private sector skills to be brought into service design and delivery, operational control, labour management and equipment procurement. However, the public sector retains the ownership of the facility and equipment. The private contractor is paid a fee to manage and operate services. Usually payment of fees is performance based.

   There are several variants under the management contract including,

   a. Supply or Service contract
   b. Maintenance management
   c. Operational management

2. **Turnkey**

The private contractor designs and builds a facility for a fixed fee, rate or total cost, which is one of the key criteria in selecting the winning bid. The contractor assumes risk involved in the design and construction phases. The scale of investment is generally low and for a short term. This type of private sector participation is also known as Design-build.

3. **Affermage/Lease**

   An operator is responsible for operating and maintaining the infrastructure facility and services, but generally operator is not required to make any large investment. Under Affermage, the operator and contracting authority share revenue from the users. Generally, government maintains the responsibility for investment and thus bears investment risks. Land to be developed by the leaseholder is usually transferred for a period of 15-30 years.

4. **Concessions**

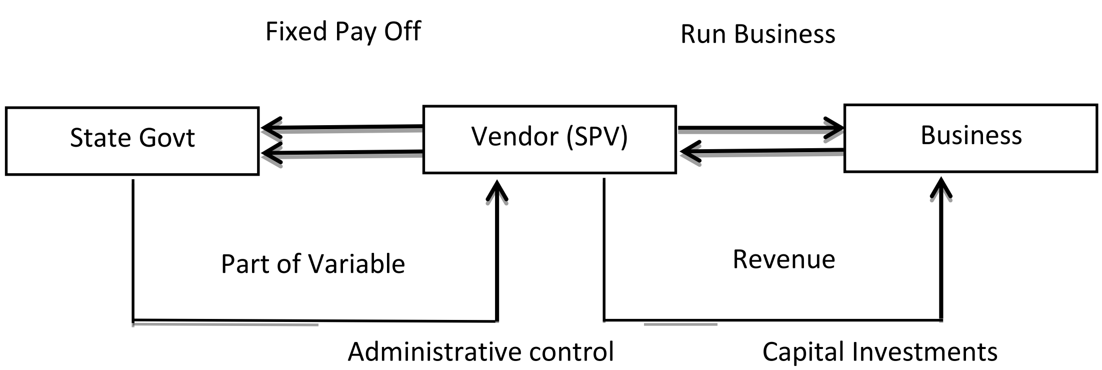
   In this form of Public Private Partnership, the government defines and grants specific rights to an entity (private company) to build and operate a facility for a fixed period of time. The government may retain the ultimate ownership of the facility and/or right to supply services. In the initial years of Public Private Partnership in the country, private sector may not have enough confidence to undertake such commercial venture. Typical concession period varies from 5-50 years.

5. **Private ownership of the assets**

   The private sector remains responsible for design, construction and operation of an infrastructure facility and in some cases the public sector may relinquish the right of ownership of assets to private sector design, construction and operation of infrastructure services into one contract, important benefits could be achieved through creation of synergies.

Revenue Sharing model

Model – 1

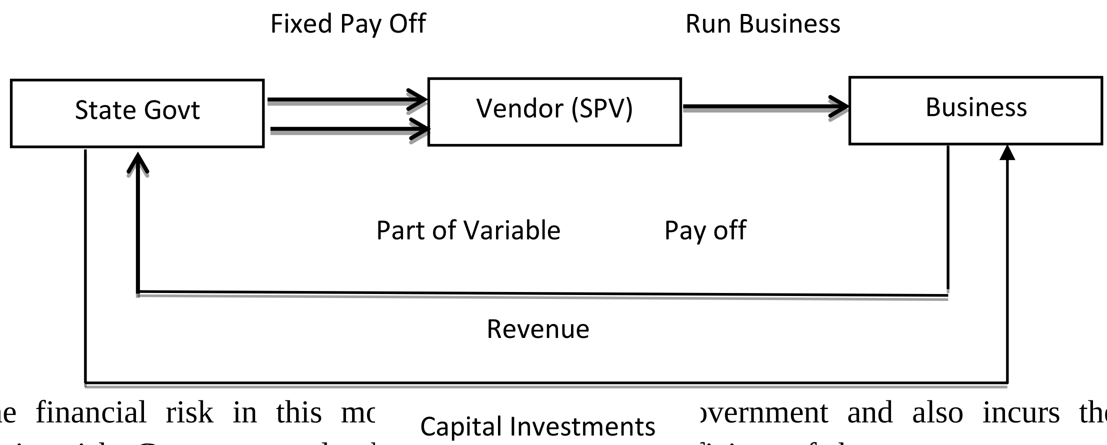


This model basically relies on the private partner's ability to find the project and run it independently of the public sector partner's intervention. This model is particularly suitable where the capital investment is low and many private vendors can be attracted to invest in to the venture. E-sewa kiosks run using this model.

The revenues can be predicted with certainty; the fixed pay off variant will be useful.

Model – 2:

In this model the capital investment is done by the government and the business is run by the private partner. This model is especially useful where the government wishes to utilize the efficiency of private sector in running important citizen services.

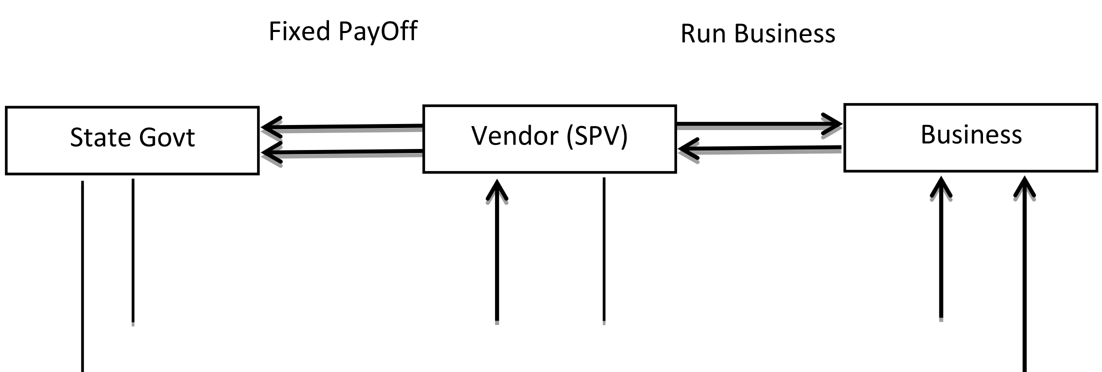


The financial risk in this mc ɔvernment and also incurs the administrative risk. Government also l ficiary of the revenue generated through this model. Large facilities like hotels and hospitals may be run by using this model.

Model 3:

In this model both partners invest capital into project. Returns are shared as per the original capital investment ratio as well as the risk perception of the partners. Project requires large capital like oil refining etc, may fall under this category.

This model tries to equally distribute the risk and return among Public Private Partnership partners. Government may make initial investment and then take annual revenue from their investments.



Part of Variable Revenue

Administrative control Capital Investments

Successful Public Private Partnership requirements.

1. Clear objectives that both parties agree. Without this at some point there will be disagreement about intent.
2. Both parties contribute something other than money. If it's only money, it's contract, not partnership.
3. Clear definition of who does what. Separation is good, but not absolutely essential.
4. Single project plan with milestones.
5. Clear legal and institutional framework.
6. Focused, dedicated and experienced public sector team – PPP task force.
7. Transparent and competitive procurement.

PUBLIC PRIVATE PARTNERSHIP IN AGRICULTURE

The technique of PPP provides adequate fund for the major developmental activities. The idea of PPP takes 'what' and 'why' from public administration. PPP can be defined as any collaboration between public and private sectors for attainment of a defined objective.

Relevance of Public Private Partnership in Agriculture.

Agriculture, the life support of rural economy can be strengthened for feeding the millions, if we want true development. With the advent of technology, many innovations are also brought in the field of agriculture. To feed the galloping population of the world more and morefood production become necessary, this was duly done with the application of modern technologies. Government throughout the world need more fund for more scientific research in the field of agriculture. But it is not possible with the prevalence of wide spread social ills. Develop countries are well placed in this regard. But developing countries cannot afford such huge investment in this regard. Ultimately private sector has to come forward for the development of agriculture. Hence, Public Private Partnership has relevance in agriculture sector as primary sector; development is the need of the hour.Public Private Partnership in agricultural sector can be implemented in a number of areas like agricultural research, agricultural supply chain management, watershed management, agricultural extension management, Biotechnology, etc.

1. Public Private Partnership in Agricultural Research

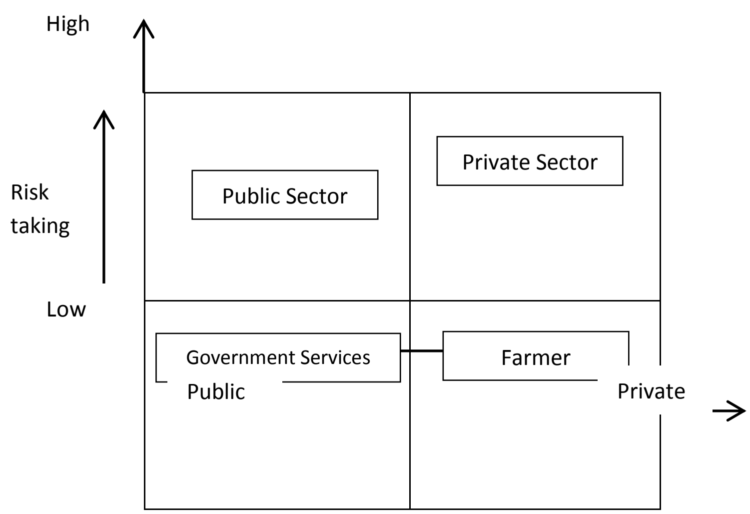
Till date, Public Private Partnership is maximum in the research field when compare to other fields of agricultural sector. The private sector has poured a good amount of money for undertaking the research, as developing countries particularly not in the position to do so. Research through Public Private Partnership is carried out for;

- Enhancing agricultural productivity both in quality and quantity.
- Developing ways for the use of depleted resources.
- Lowering the food prices, and
- Accumulating the capital resources among the vulnerable sections.

2. Public Private Partnership in Irrigation

Water is the major problem for agriculture since a long time. This creates a vicious circle of problems for the countries that are totally dependent on monsoon. Fluctuations in weather assisted by natural disasters enhance the woes for the poor farmers. Ultimately, water harvesting, proper irrigation and drainage are needed for the sustainability of agriculture. To address the problems, a number of strategies are being implemented like – integrated drainage reclamation, participatory irrigation management, pricing water and cost recovery. But the most accepted method id Public Private Partnership in large scale irrigation and drainage schemes through participation is seen in water supply and sanitation. The success of PPP in water supply and sanitation has given some lessons which can be utilized for irrigation and drainage also. But there are greater risks like – charges for using water, supply and demand problem etc. Under such circumstances, an ideal model (Figure 1) can be suggested for the sustainability of PPP in agricultural irrigation and drainage. The model suggests that high risk taking and high management and accounting practices should be assigned to the private sector.

Figure 1: Analytical model for PPP in Agricultural Irrigation.



From some of the cases of PPP in irrigation like – Irrigation Murray Ltd., Australia; Toula, Niger; Dina farm, Egypt; Eastern Uttar Pradesh, India; it has been found that PPP demand has originated from the public side with the aim of reducing recurring subsidies to Irrigation and Development system operation.

3. PPP in Agricultural Extension Management

Public extension has a significant role towards attainment of self-reliance. But in the context of multi-faceted problems of the farmers, public extension alone has failed to address the farmers' needs. In most of the times public extension is under tremendous pressure due to limited resources, disparity in number of farmers and extension personals, demand for quality, WTO, etc. A combined therapy which is needed can be provided by a multi-agency system consisting of private farms, farming communities, SHGs, NGOs, media people, co-operatives, etc. A suitable PPP model in agriculture can exploit the existing resource better.

A case study can be given in this context to prove the worthiness of PPP in agriculture. The Agricultural Technology Management agency (ATMA) regarding PPP inextension in India. Before adopting the PPP model, the major challenges were food security, creating export opportunities, financing more extensions throughout the country, expanding market demands and poverty alleviation. Getting tremendous success, of this ATMA model, Government has implemented in 252 districts throughout India.

Partnership share farming knowledge.

Public and private sector institute both possess the knowledge needed to improve global agriculture. Collaborative projects are sharing practical agricultural information and cultivation of best practise among public and private sector organisation and farmers.

Partnership to build resource access and reduce risk.

Shared projects between the private and public sector and government agencies can build fundamental resources so farmer can manage their production process more reliably at less cost and lower risk.

Successful case studies:

Gramin Suvidha Kendra Empowers Farmers:

Gramin Suvidha Kendra, a joint initiative of Multi Commodity Exchange (MCX), national bulk handling corporation and Indian postal department is empowering rural farmers by providing them spot and future prices of farm commodities. MCX, one of the India's leading commodity exchange, has partnered with Indian post since June 2006 to create an electronic price link between small village post offices and the rest of India.

This programme was started on pilot basis based on the success of the programme it was initially started in 40 post offices covering about 200 villages in 2008 in Maharashtra.

Currently Gramin Suvidha Kendra is providing services from centers like

1. Jalgoan and Dhamgaon in Maharashtra
2. Unjha in Gujarat
3. Itarsi in Madya Pradesh

To get the benefits of these services farmers has to become member of the Kendra by making one time registration fee of RS. 11 and they can also pay Rs. 10 for each query on issues like weather patterns, pest management and use of fertilizers.

This like help the farmers make decisions on which crops to the grown, when to sell their produce for better returns, use of fertilizers, use of plant protection measures. The information is given through black boards displayed at local post office and print outs contains information about local spot prices, all India spot price and futures prices.

E-Haat bazaar, Nepal

It is an example of business –to-business e-commerce. The Nepali e-haat bazaar (WWW.b2b.com.np) is a joint initiative of the Rural Urban Partnership Programme (RUPP) of the

1. Ministry of Local development and UNDP.
2. High level commission for Information Technology of the Government of Nepal and Agro Enterprise Centre (AEC)
3. The federation of Nepalese Chamber of commerce and industries (FNCCI), an apex body of the Nepali private sector.

e-haat bazaar is a portal that promotes market linkages and enables Nepali growers and producers to explore opportunities within and beyond Nepal. The initiative is linked to WWW.agripricenepal.com, a website which provides daily agriculture market price information to farmers, traders and wider business community. Agripricenepal.com is an initiative of RUPP with AEC and FNCCI and is co-ordinated with the market development division (MDD) of Department of Agriculture of Government of Nepal's Ministry of Agriculture and Cooperatives.

The portal provides market price and relevant information from 11 major markets around the country and more than 100 agriculture produce are profiled. Information on this initiative is limited.

Some lessons published on the RUPP website includes;

1. The initiative gave positive exposure to local entrepreneurs and municipalities and village development committees to the potential of ICTs.
2. Digitally supported B2B business models can be customised to suit small and micro entrepreneurs.
3. Capacity gap of local institutions and the novelty of the business as a concept result in slow uptake of the initiative.

WWW.ruralinfobd.com**, Bangladesh**

WIN Inc, a private sector firm specializing on content and information service development, is working with Grameen phone **Community Information Centre (CIC)** to develop appropriate information and advisory services for rural farmers in Bangladesh. With initial assistance from a development project, WIN has successfully developed information for the CICs in native language, Bangla. Farmers avail information from the CICs where the centre operators consult www.rurallinfobd.com for appropriate information and advisory services. For additional queries, WIN provides solution through e-mail or mobile phone tocentres. WIN has agreement with Grameen phone which requires them to regularly update the content. Win employs services of a panel of government and private sector experts that validates and authenticates the information. Win and Grameen phone make public information on agriculture available to the wider communities where the centre charges for the cost of access. The 550-plus CICs are franchise of Grameen phone and each centre is owned by the local entrepreneur. This is an example of how private sector can efficiently distribute information confined to the public domain. Low awareness among the farmers, reliability of the information and developing real time, market price information service are some of the challenges for WIN.

Agriculture is the building block for sustenance of the society. Industries are needed for the progress of the civilization but agriculture is essential for its existence. Gone are the days of public sector monopoly. People need goods and services at cheaper rates in hassle manner. Thus PPP seems to be viable method which can create competition in the market. Arriving to a partnership with government bodies, private sector can extend their brand fulfilling some corporate social responsibility. In Agricultural sectors PPP are being utilized in number of directions, although major concentration is towards agricultural research. Two major loopholes are identified in PPP in agricultural sector – one is most PPP mechanisms are not pro-poor. Barring in developed countries most farmers in developing countries are poor. The second is that in the most cases big private partners belong to developed countries. It cannot be denied that the private companies of the developing countries are not participating with the government.

Partnering with big farms has its own advantage. As they have adequate money, they can invest more in agricultural research, because it is the area which requires more investment and has no instant profit. Thus only big farms can take such risk. Another factor of PPP in agriculture is that the private parties should have expertise in agribusiness. Evidences can be drawn from the success of 'Monsanto' in achieving Genetically Modified Seeds. Active awareness programmes for the farmers empowerment and finally pro-poor policy of the government can make Public Private Partnership effective in agriculture.

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RICE + FISH + AZOLLA INTEGRATED FARMING SYSTEM (IFS) FOR SMALL AND MARGINAL FARMERS IN WETLAND

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Abstracts

Asia is the biggest rice producer, accounting for 90% of the world's production and consumption of rice. In recent years, the area under rice crop is decreasing year by year due to less profitability and there are limited possibilities of increasing additional area under cultivation. The only alternate left out is vertical expansion by integrating appropriate farming components requiring lesser space and time, and ensuring higher total productivity of the system. Integrated Farming System (IFS) hold special position, as in this system the waste of one enterprise becomes the input of another for making better use of resources. These integrated enterprises enhance agricultural productivity, improvement of soil fertility, control the weed and regarded as an important element of integrated pest management. It minimizes the use of weed killers as well as pesticides and thus protects the environment. Small and medium scale farmers all over the world have shown a remarkable ability to adapt. They look for better ways to organize their farms. They try new crops and cultivars, better animals, and alternative technologies to increase productivity, diversify production, reduce risk and to increase profits. They have become more market oriented and have learned to take calculated risks to open or create new markets for their products. Hence the farmers have linked two or more allied enterprises to enhance or improve their income and to remain employed in farms. In this context farming system play a vital role and efficiently integration of crops with animals and other enterprises clearly shows the best advantages over conventional system of cropping.

Key words: Employment, Enterprises, Integrated farming system, Rice, Small and marginal farmers, Soil fertility, Weed.

INTRODUCTION

Rice is the staple food for nearly half of the world's population. In recent years, the area under rice crop is decreasing year by year due to ill-effects of green revolution had resulted in less profitability. The need for diversification in some of this area is clear since the income of farmers who depend solely on the produce of their traditional mono crop of rice pattern is decreasing. Increasing the productivity of rice with economically viable and ecologically safer technology is the major concern to feed the ever-growing population. The farmer has to link two or more allied enterprises to enhance or improve his income. Integrated Farming System (IFS) hold special position as in this system nothing is wasted, the byproduct of one system becomes the input of another. Efficiently integration of crops with animals and other enterprises clearly showed the best advantages over conventional system of cropping. In Rice + Fish + Azolla farming system, the farm enterprises are carefully chosen, planned and executed. It is viewed as a powerful tool for natural and human resource management in developing countries which very effectively solving the problems of small and marginal farmers. It enable adequate employment, income generation and risk associated with conventional cropping system, especially for small and marginal farmers who constitute more than 80 per cent of the farming community. The agricultural technologies are being developed day to day and disseminated to the farming community for adoption and increased agricultural production. The farmers have to gain the knowledge to adopt the latest techniques in the field for enhancing the productivity of different enterprises.

Rice + Fish + Azolla Farming System

Integrated Farming System offers unique opportunities for maintaining and extending biodiversity. Different parts of the country suggest that farmers income can be increased manifold by way of diversification of enterprises in a farming system mode for sustainability and economic viability of small and marginal farmers. Integrated Rice + Fish + Azolla farming system is practiced in several countries and is associated with wetland rice farming. In Rice + Fish + Azolla farming system is gaining great attention by small and marginal farmers because of government focus on sustainable rural development, food security and poverty alleviation. This system is practiced in rice-rice cropping system. In traditional mono cropping of rice, the overuse of agrochemicals has caused environmental degradation, pest tolerance and human health concerns. The need for diversification in this area is clear and shifting towards Rice + Fish

+ Azolla farming system increased total production, decrease inorganic fertilizer and pesticide requirements, reduces the incidence of insect, pest and weeds, gives additional fish yield and improvement of soil fertility and higher economic benefit.

Role of Fish and Azolla in wetland:

In the rice - fish system, rice and fish crops were raised together in rice field, wetland. Field trenches were provided with 1.0 m depth and 1.5 m width occupying 10 per cent of the rice area, for sheltering the fish. Fish is a cheap source of protein that can be grown in rice fields . Fish culture in rice fields loosens the soil as a result of their free movement in water body and thus aerating the soil, enhances the decomposition of organic matter and promotes release of nutrients from soil. The excreta of fish directly fertilize the water in rice fields leading to increase in utilizable source of N to the rice crop.

Azolla the aquatic fern naturally grown in rice field throughout the cropping period. The dual culture method of growing Azolla with rice has gained widespread adoptability because standing water is available in rice field from seedling to panicle maturity in wetland rice fields and is effectively used as biofertilizer for rice. Azolla cultivation in rice field can improve the fish food.

Integration of allied components like Fish + Azolla with rice in wetland farming could provide wider scope for bio resources recycling. It is the most efficient resource utilization of farming system compared to a rice-fish farming system and resulting in higher productivity. The unutilized fish feed, decayed Azolla and fish excreta settled at the fish trench bottom had a higher nutrient value, which can be recycled to enrich the soil. These systems are being tried in order to fully optimize land, fully utilizes the space, improving the farm productivity through recycling of nutrients.

Effect of Fish on rice :

The fish manure serves as a organic fertilizer for plankton and crop production while the insect and pest can be directly consumed by the fish. Nutrients from the fish pond refuge as dispersed to the rice field by irrigation water or by the movement of fish. Fish that are trapped in rice fields grow along with the rice until harvesting. Azolla as fresh feed in combination with a good level of natural feeding can be beneficial to fish production. Fish, when grazing on epiphyton, inadvertently damaged weeds to varying degree, thereby inhibiting weed growth. Consumed insect pests, soil borne pathogens and improved soil fertility and rice growth. Control nematodes and insects increased the rice grain yields. On-farm resources such as fish manure and feed waste are adequately used and recycled in the system. Due to synergetic effect of fish on rice, the rice yield increased, weeds and insects were controlled by fish.

Effect of Azolla on rice :

Azolla is an inexpensive feed and grown in rice fields. Azolla can be utilized not only as organic fertilizer for crops but also as an fresh food for the fish. The major role of azolla is to control weeds and increase the microbial organisms in soil upon degradation. The integration of fish and the nitrogen-fixing aquatic fern azolla show the promise for increasing the production potential of the system. It resulted in light use efficiency, nutrient enhancement, pest control, feed supplementation and biological control. Higher N, P and K uptake at both the seasons compared to rice farming alone and it was attributed due to degradation of azolla, fish manure and fish feed (fodder for fish and manure for rice crop). Farming system reducing the cost of production for economic yield and increased the net returns compared with conventional cropping system.

Rice + Fish + Azolla farming system for Small and marginal farmers:

Small and medium scale farmers all over the world have shown a remarkable ability to adapt. They look for better ways to organize their farms. They try new crops and cultivars, better animals, and alternative technologies to increase productivity, diversify production, reduce risk and to increase profits. They have become more market oriented and have learned to take calculated risks to open or create new markets for their products. Hence the farmers have linked two or more allied enterprises to enhance or improve their income and to remain employed in farms. Rice + Fish + Azolla farming system made small and marginal farmers self sufficient by ensuring the family members a balanced diet, improving the standard of living through maximizing the total net returns and providing more employment, recycling of residues, optimizing resource use, minimizing risks and uncertainties.

Advantages of Rice + Fish + Azolla farming system:

Through Rice + Fish + Azolla farming system, we achieve

- ✓ Decrease in inorganic fertilizer and pesticide requirements.
- ✓ Reduction in incidence of insect pests and weeds.
- ✓ Improvement of soil fertility and higher economic benefits.
- ✓ Feed supplement.

- ✓ Increase in fish production.
- ✓ Effective recycling of by-products of one enterprise in another enterprise.
- ✓ Overall improvement in the socio economic status of small and marginal farmers.

Conclusion:

Integrated Farming System (IFS), the integrated enterprises enhance agricultural productivity, improvement of soil fertility, control the weed and regarded as an important element of integrated pest management. It minimizes the use of weed killers as well as pesticides and thus protects the environment. The emphasis in this system has made on optimizing resource utilization rather than maximization of individual elements. These enterprises not only supplement the income of the farmer by increasing the per unit productivity but also ensure the rational use of the resources and further create employment avenues. In this context farming system play a vital role and efficiently integration of crops with animals and other enterprises clearly shows the best advantages over conventional system of cropping. Further work is needed to be done by including more enterprise in this farming system for effective utilization of all on-farm resources and maximization of the farm income of the farmer. Extension and development agencies should pay attention to bring the benefits of the technology to the farmers.

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Status of Brackish water Fisheries in Maharashta and Opportunities for further Development

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Fish accounts for one-fifth of the world's total supplies of annual protein, a highly nutritious food and an ideal supplement to the cereals or tuber-based diets typically consumed in many parts of the world. ‘Fisheries’ is making an ever growing contribution to food supplies, to the employment and well being of the rural communities. Fisheries resources, if harvested to the maximum potential, can contribute greatly to the quality of life of the poor and hungry and render malnutrition and under nutrition.

The fisheries sector occupies a very important place in the socio-economic development of India. The sector has been recognised as a powerful income and employment generator as it stimulates the growth of a number of subsidiary industries and is a source of cheap and nutritious food. More than 6 million fishermen and fish farmers in the country depend on fisheries and aquaculture for their livelihood. The fisheries sector has also been one of the major contributors of foreign exchange earnings through export. With third position in fisheries and second in aquaculture, the country has high potentials in the sector for rural development, domestic nutritional security, employment generation, gender mainstreaming as well as export earnings, that only few other activities can provide. It is in this context that it is very important that concerted efforts are put in for pursuing sustainable fisheries development and management in the country in the long run.

Maharashtra is one of the major maritime States, offering vast scope for development of inland, brackishwater and marine fisheries. The strength of the fisheries sector in Maharashtra lies in the large under/ un-utilised freshwater and brackishwater resources. By judiciously harnessing these resources, the fish production from the capture and capture-cum-culture fisheries could be substantially augmented to meet the domestic market demands, create employment and income generating opportunities for the rural poor and enhance their food and livelihood security.

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The strength of the fisheries sector in Maharashtra lies in the large under/ un-utilised freshwater and brackishwater resources. By judiciously harnessing these resources, the fish production from the capture and capture-cum-culture fisheries could be substantially augmented to meet the domestic market demands, create employment and income generating opportunities for the rural poor and enhance their food and livelihood security.

GEOGRAPHICAL AREA :

Maharashtra State is one of the major Marine states in India. It has 720 Km long coastal line spread all over the five maritime districts viz. Thane, Mumbai and Suburban, Raigad, Ratnagiri and Sindhudurg. with 1,11,512 sq.km area with in the continental shelf, has huge potential for marine fisheries development. The freshwater resources of the State is endowed with 3,77,905 ha. water spread area under 192 large & medium projects, 2065 minor irrigation projects and 31,415 zilla parishad tanks & a network of rivers of 19456 kms , besides 12445 ha. of cultivable brackish area.

is the prime requirement.

Brackishwater aquaculture

The scheme of Distribution of Government Brackish water land has been implemented to bring brackish water land under Shrimp culture. Details of Brackish water land are as follows.

- Government Brackish water land suitable for Shrimp Culture - 14,445 Ha.
- Brackish water land allotted for Shrimp Culture - 3,067 Ha.
- Brackish water area brought under Culture

Government	- 942 Ha.
Private	- 114 Ha.
Total	- 1056 Ha.

- Number of Shrimp culture projects - 213

Vide this scheme Government Brackish water land is allotted for brackish water fish or shrimp culture on a lease for 30 years.

The brackishwater resources of the State are confined to 4 coastal districts. Out of the total availablel area of 80000 ha., 14445 ha. has been found suitable for brackishwater aquaculture. So far, 3067 ha brackishwater area has been allotted, of which 1056 ha has been brought under shrimp culture.

Constraints & Measures : Brackish water Fisheries

1. To declare "shrimp farming" as agricultural activity.

Like any other agriculture activity, under shrimp farming seed is stocked in the specially prepared ponds after drying and ploughing of ponds. Crop is carefully protected against the pests and diseases for 140 days. Even though, shrimp culture activity is very much similar to any normal agricultural activity, it is not categorized under the agricultural activity due to which, farmers were kept away from the benefits of subsidy on seed, feed and medicines. Electricity charges for shrimp farming are not as per the agriculture. Farmers has to pay commercial rates for availing the electricity. Due to which cost of production of cultured shrimp increases. Shrimp farmers do not get loans under the agriculture loans. Even though shrimp as an exportable commodity earns about Rs5500 crores every year, its contribution to agriculture sector is not properly acknowledged. It is highest export earning product under agriculture sector but completely away from the benefits of agriculture sector. If shrimp farming is declared as agricultural activity it will further boost up the much needed export earnings.

2. Re-survey of potential brackish water culture sites along the Maharashtra coast.

Maharshtra has 80000 ha of brackish water land. Government of Maharashtra conducted survey for potential suitable sites for culture of fish and shrimps during 1988, which indicated that only 14455 ha land is suitable for brackish water fish or shrimp farming. After this survey many suitable sites were brought under the mangroves. Therefore, it is very necessary to find out potential brackish water area devoid of mangroves. Government of Gurjrat has carried out satellite survey with the co-ordination of ISRO which has enabled them to declare potential suitable sites for brackish water shrimp and fish culture. On the similar pattern, potential suitable site for culture of shrimps and fish along Maharashtra coast has to be declared to boost up production of cultured shrimps and fish.

3. Immediate allocation of government brackish water lands for shrimp farming.

Along the Maharashtra coast, 14,445 ha of government brackish water land is found to be suitable for shrimp or fish farming, of which only 247.13 ha (2.30 % only) land has been allotted to 113 shrimp farmers for brackish water shrimp farming. Approx. 1056 ha of brackish water land has been developed for shrimp farming and remaining land has not been utlised for any productive purposes. This important natural resource is being ideal without its utilisation for production. The land allocation procedure under the control of District Collector has to gear up for faster allocation of land for shrimp and fish farming. In order to bring about proper coordinated efforts at administrative side, it is necessary to start 'single window' system with time limit of 3 months for allocation of brackish water land for shrimp and fish farming.

4. At the time of land allocation and development for shrimp farm, condition for permission from local

Gram-panchayat be removed.

5. Allocation of 3% land for non-agricultural activities.

For shrimp farming, it is necessory to have godowns for storage of feed, generator rooms, laboratory and farm labour's houses. These are essential facilities for shrimp culture operations. Therefore, it is very necessary to grant permission for utilisation of 3% of allocated land for non-shrimp activities purposes. If the area of allocated land is more than 5 ha, such non-agriculture land should be 2%. This permission may be extended to all shrimp farmers.

6. Provision of loan of Rs.300,000 per ha per crop basis for shrimp farming.

In Maharashtra 83% shrimp farmers have less than 5 ha of shrimp pond area. There are large numbers of marginal and small farmers. Land allocation procedure is too lengthy. Allocated government land is not appreciated for collateral of loans required for construction and operation of farms. Due to which project gets extended till such collateral are assured. Therefore it is necessary to provide loan of Rs. 300,000 per ha on non-collateral guarantee basis.

7. To start shrimp hatchery in Maharashtra.

In the development and operation of shrimp farming, seed and feed are major items of input costs. During 1990s about 6 shrimp seed hatcheries were established in private sector. However, these hatcheries were closed down due to various reasons. Shrimp farmers of Maharashtra procure seeds of shrimps from Tamil Nadu, Karnataka and Goa states through air and truck transport. Due to this, cost of seed increases beyond the reach of marginal and small farmers. As it involves long duration transport, seeds undergo stress, leading to poor survival percentage. It is therefore, very necessary to rehabilitate 'sick' private shrimp hatcheries in Maharashtra. Special economic assistance package is necessory for such sick units.

8. Promoting co-operative shrimp farming ventures through NCDC.

Shrimp catches from marine capture fisheries are stabilized. It has biological limits too. In order to increase shrimp production, shrimp farming is only suitable solution available with us. If unutilized land is allotted for shrimp farming, there is great possibility of sustainable utilization of these resources through brackish water shrimp or fish farming. Maharashtra is leading state in proving ways of development through co-operative principles. In shrimp farming so far no initiatives have been taken up to develop it through co-operative sector. National Co-operative Development Council should take up initiative to develop shrimp farming through co-operative sector.

9. Provisions of mobile laboratories for shrimp farming.

Shrimp farmers need laboratory assistance for testing of soil and water, feed and disease management. In view to provide advice and services to shrimp farmers, it is necessary to provide mobile extension and laboratory vans under the control of Agricultural Universities.

10. To promote domestic market for shrimps.

In international market prices of shrimps has been slashed down. Developing countries are producers and developed countries are net importers of shrimps. Developing countries are working under the shadow of anti-dumping duty fear. Processors and exporters of shrimps therefore do not extend good price to cultured shrimps. Due to increasing prices of seed, feed and electricity charges, per kg production cost of shrimp is more than Rs. 280 per kg. White spot and black gill disease menace encounters 100 per cent lossess in production of shrimps. In such difficult phase, domestic market is only the hope for shrimp farmers. Government should take initiative to develop and promote domestic marketing of shrimps.

11. Crop insurance support for shrimp farming.

Crop insurance support for shrimp farming is non-existent. Despite its significant contribution in export earnings cultured shrimp production does not attract insurance sector. The rates of premium for shrimp crop insurance are beyond the reach of marginal (up to 1 ha) and small (1 to 2 ha) farmers. At 2.4 per cent of sum insured for shrimp crop operation, shrimp productions by marginal and small farmers were economically un-viable. Government support for crop insurance is necessary for marginal and small farmers.

12.**Single window clearance**: To reduce inordinate delay in implementation of projects subsequent to allotment of land single window clearance is required

13. **Cluser farming approach:** Promoting shrimp farming on cluster basis with built-in infrastructure, common facilities and required permits as in case of MIDC parks.

Development of Inland Saline affected soils:

Prolonged sugar cultivation in certain districts like Sangli, Kolhapur and Satara etc has led to salinisation of large agricultural lands rendering them unfit for any agril. Activity. Approx. 30,000 ha of such areas, which are presently lying idle since last 20 years which needs to reclaimed through suitable interventions. The cause of salinization has been attributed to excessive use of water and fertilizres. Sub-surface drainage is one such viable agril intervention however, the same needs to be undertaken with a cluster approach since the infrastructure cost involving common drainage outlet is considerable and viability would work out only when such cost are shared by all landholders in the given areas,

The most viable alternative in the present situation is aquaculture involving fresh water prawn which besides being tolerant to such salinitycondition, is a high value exportable commodity, most sought after by the seafood industry.

Future Programme:

It may be possible to develop nearly 25,000 ha area for scampi farming in next 5 years. This could yield aout 23,000 tonnes of scampi amounting Rs. 513 crores.This in turn could earn foreign exchange worth 120 million US $ to the nation besides providing direct employment to nerly 40,000 rural youths and indirect opportunity several thousands of rural people in allied activities.

For successful implementation of this programme about 38 no. of Scampi hatcheries to produce 760 million seed will be required. About 14 feed mills with capacity of 2500 MT/ annum will be required to produce 34,000 MT feed.This could provide enough material for 20 no. of processing plants of capacity 10 MT /day.

Problems:

i) Most of Lift Irrigation Societies (LIS) are defunt on account of poor return from their land on account of of salinisation and turned defaulters to the financing banks.

ii) Subsurface drainage holds some possibilities but the return is not high enough. This also requires participation of all farmers in order to share infrastucure cost, which is difficult.

iii) To change the cropping pattern of land to scampi culture require approval of the competent authority.

iv)

Technology upgradation:

During technology generation process, trials are carried out in laboratories and farms managed by research institutions. The results obtained from laboratories, yard experiments and limited on-station trials when disseminated as technology to farmers under different agro-climatic conditions, often have ‘yield gaps’. It is known that either indigenous or alien technologies are available which are fully or partially being adopted by the farmers. Hence, these technologies have to be upgraded for eventual adoption by testing them in farmer’s farm conditions for refinement to suit the demands of the farming system and the farmer. The scope of the scheme for technology upgradation is to address the yield gap between on-station trials and farmers ponds; upgrade older technologies being currently adopted by farmers or fishers; and refine and adopt technologies which have not been widely disseminated. These projects would rely mainly on the effective functioning of feedback and feed forward systems taking into consideration the current expectations of users of technology and adaptive learning of technology generators and disseminators.

Criteria for technology up gradation

The following criteria would be followed to select the projects for technology up- gradation:

- The proposed technology for up-gradation addresses a current problem in the field and would benefit a large number of farmers
- The potential for up-scaling and repeatability of the upgraded technology as given in the project proposal is possible
- The project clearly outlines the techno-economic viability and the expected enhanced profit and environmental impact if any
- The project focuses on-field demonstration and evaluation with minimum of testing in the laboratories and farms of the institutions
- Attention has been paid to increase income generation beyond the existing levels
- Linkages with ongoing research, development and dissemination programmes is clear

Status of Pulses in Telangana – Productivity Constraints and Way Forward

P. Prudhvikar Reddy and M. Srinivasa Reddy[15]

Context

There are established evidencesto show that pulses are an integral part of many diets across the globe and pulsesplay a vital role in improving human health, conservingthe soil health, protecting the environment and most importantly contributing to the global food security[16]. Recognising its importance, The United Nations declared year 2016, as "International Year of Pulses" (IYP)to increase public awareness of the nutritional benefits of pulses. Dilrukhi (2016) rightly said that with limited arable lands, decreasing soil fertility, climate change, and declining water resources, the present food systems are already challenged with respect to providing

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[16] See Mohanty and satyasai NABARD Rural Pulse July-August 2015

sufficient nutrients rich foods to most global populations. Dependence on animal products is not an option for most populations in the developing world and is becoming more difficult in most developed countries. Therefore, to combat global micronutrient and calorie malnutrition, novel ways to produce nutritious foods are required. To this end, traditional food crops including pulses have potentials to provide sustainable food solutions to improve human health.These observations are also very pertinent to India as the majority of Indian population, more specifically vegetarians depends on pulses for nutritional benefits and for whom pulses are the one of the cheapest sources of protein. In addition, pulses contribute to the health of soils through their nitrogen-fixing properties. Then the question is what the status of pulses in India is?

India is the largest producer of pulses (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world i.e. to the extent of 4 to 5 million tonnes a year. In India, 85% of farm households falls in the category of small and marginal with average land holding size of 1.16 ha and they are most vulnerable to climate related risks too. Further pulses are grown in marginal lands in 22-23 million hectares with an annual production of 13-18 Mt. The projected domestic demand for the year 2030 is 32 Mt and hence the productivity needs to be doubled and an additional area of about 3 Mhaneed to be brought under pulses besides reducing pest related and post-harvest losses (Hopper et al 2016). India accounts for about 20%-23% of the world pulse production - about 93% of the world chickpea production and 68% of the world pigeon pea production. The high proportion of global production accounted for by India indicates that there are very few import sources in the world market and it is imperative to increase domestic production in order to address the food security concerns. But pulses remains one of the weak spots in Indian Agriculture even now. It received the desiredattention of research and extension systems since mid-eighties onlyand yetsuccess still eludes pulses. The stagnation in pulse production and productivity has to beviewed seriously not only from the point of security and quality of food for the people,especially the poor and the rural population, but also from the soaring import bill andimbalance in the cropping pattern.While the traditional cropping pattern always included a pulse crop either as a mixed crop or inrotation, the commercialisation of agriculture has encouraged the practice of sole-cropping.Cereal shortages of the mid-sixties and the green revolution accompanied with changes in theinfrastructures and incentives including input supplies and price support systems in favour ofmajor cereals altered the traditional cropping pattern against pulses.

On the other hand, pulseshave the advantage and can be grown on a rangeof soil and climatic conditions and play an important role in crop rotation, mixed and inter-cropping,maintaining soil fertility and thus contributingsignificantly to sustainability of the farming systems (Om Gupta, 2016). The short-duration varieties developedin the country have played a key role in expanding the area andproductivity more specifically chickpeas in central and southern India. Despite the technological advances such asimproved crop varieties and irrigation systems, weather and climate are still key factors in pulseproductivity. Despite, huge demand, pulses growth is sluggish i.e. overall, the production of pulses has grown only 45% (cumulative) since 1951, compared to that of wheat and rice, which have grown manifold (at 320% and 230%, respectively). It is because, pulses are mostly grown under rainfed conditions (84%) with low input usage, more so, by the small and marginal farmers, thus exposing its production to weather-related risks. On the other hand, evidence show that per capita net availability of pulses in India has reduced from 51.1 gm/day (1971) to 41.9 gm/day (2013) as against the recommendation of WHO i.e. 80 gm/day and ICMR recommendation of 50 gm/day. Thus, there is need for sustainable food production and pulses takes an important place in food security and nutrition.

Against this backdrop, the paper’s main objective is to assess the status of pulses in the newly formed state of Telangana, asses the constraints in the production and productivity of pulses grounded on the existing literature and the way forward to enhance the production citing the best practices.

Overview of Area and Production of Total Pulses in Different States

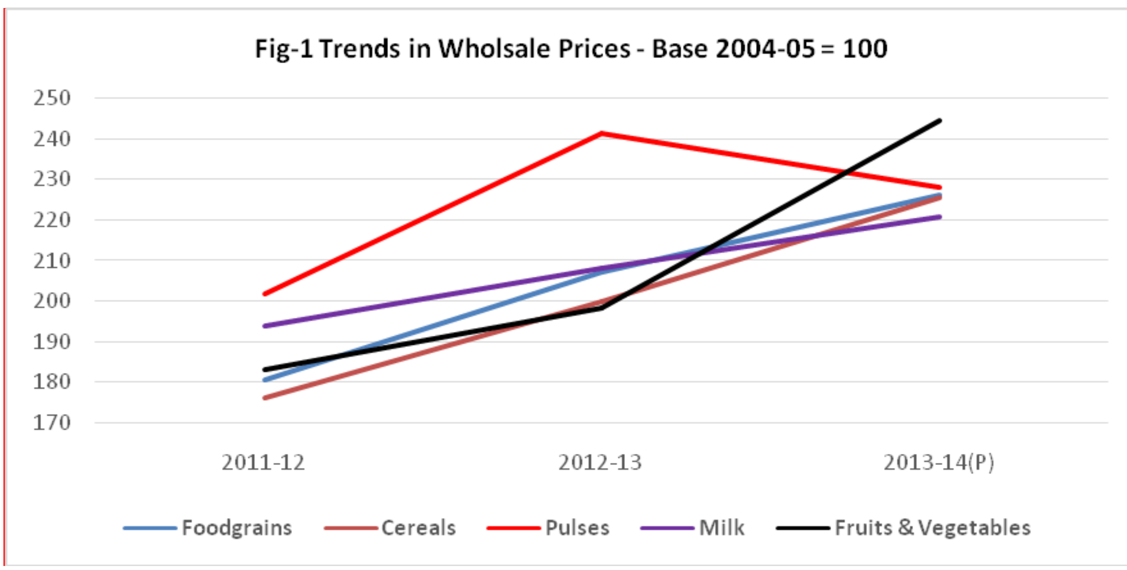
Madhya Pradesh is a leading state in area and production of pulses in India. Madhya Pradesh, Uttar Pradesh, Rajasthan and Maharashtra together accounted for more than 50 per cent of area of pulses in India. In production too, MP, UP and Rajasthan takes lion share of about 43% in the total production at all India level. Though Tamil Nadu and Bihar are not in the front run in terms of area under pulses (compared to other states), their rank in production is much better. In southern India, Karnataka tops list in terms of area and Tamil Nadu in the production. Telangana stood at 14th place both in terms of area as well as production (Table-1). On the other hand, Karnataka and Gujarat are better off in area than production reflecting the productivity is much lesser in these states compared to other states.

Table-1: Status of different states in India in Area and Production of Pulses

State Wise Area and Production of Total Pulses 2013-14				
State/ Union Territory	**Total pulses (Area `000 hect., Production `000 tonnes)**			
	Area	Rank	Production	Rank
M P	5534.84 (22.3%)	1	1013.18 (15.5%)	1
Uttar Pradesh	2203.45 (8.9%)	5	951.00 (14.5%)	2
Rajasthan	3914.63 (15.8)	2	841.09 (12.8%)	3
Tamil Nadu	812.66 (3.3%)	8	550.30	4
Maharashtra	3755.00 (15.1%)	3	513.00	5
Bihar	508.97	12	415.24	6
A P	**1743.14 (7%)**	6	**328.23**	7
Karnataka	2268.00 (9%)	4	297.00	8
Orissa	769.89	10	258.61	9
Chhattisgarh	776.00	9	237.70	10
Gujarat	875.00	7	211.00	11
West Bengal	291.12	13	210.33	12
Jharkhand	592.73	11	191.74	13
Telangana	**185.86**	**14**	**136.77**	**14**
Others	118.03	17	106.86	15
Assam	149.44	15	97.24	16
Uttarakhand	64.86	18	53.13	17
H P	28.94	20	50.56	18
Haryana	144.60	16	39.05	19
Punjab	45.80	19	34.70	20
J & K	25.88	21	13.85	21
Kerala	1.42	22	2.80	22

Source: Directorate of Economics and Statistics, Government of India (2014)

If we look at area of pulses, little over one third area in MP (35.1%) is under irrigation followed by Haryana (27.6%); WB (23.3%); Gujarat (15.2%); Rajasthan (13.1%); Chattisgarh (12.1%); TN (10.6%); and the united AP was the second least with 3.7% and Jharkhand having the least irrigated area under pulses (2.9%). Thus, vast area under pulses especially in Telugu speaking states is grown under rainfed conditions exposing to the weather risks. However at all India level, area under irrigated pulses is increasing but at aslow rate i.e. it was 9.4% in 1950-51 and increased to 16.1% in 2011-12. The rate of increase is marginally better since early nineties. Despite substantial increase in the output prices of pulses, the growth in the area is not at expected level. For instance, the wholesale prices of the pulses clearly show an increasing trend since 2004-05 compared to other food items (Fig-1). Further, price index of pulses rising more than the consumer price index.It indicates lack of awareness among the farming community to reap the price benefit.



Source: DES, Government of India

Overview of Different Pulses Grown in Telangana

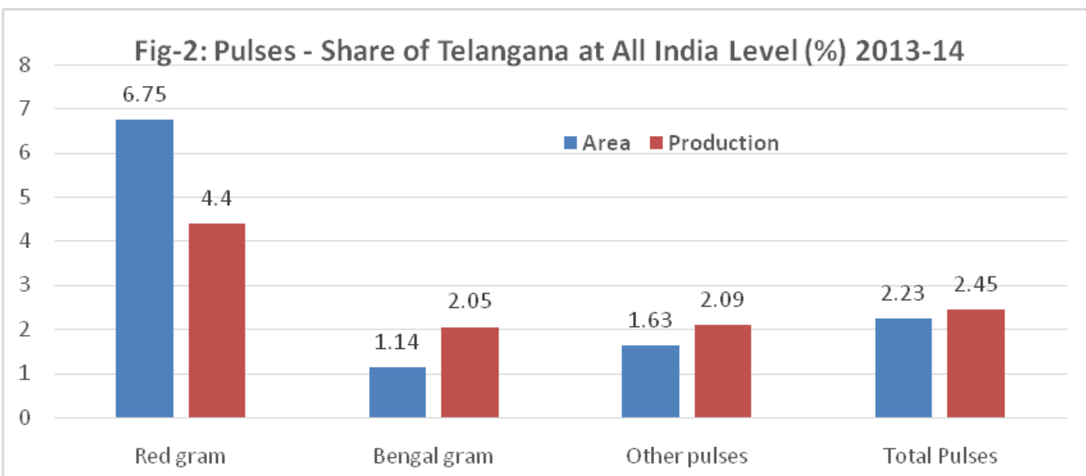
In Telangana, red gram occupies major share under pulses followed by green gram, Bengal gram and black gram. All pulses put together occupies third place in the share under gross cropped area i.e. after rice and cotton but mostly under rainfed conditions (Table-2). Its overall status in the gross cropped area remains the same for the years. On the share of important pulses grown in

Telangana with that of all India, red gram takes major share in pulses followed by Bengal gram. Overall, at all India level,the share of area and production of total pulses in Telangana is hovering around little over 2% each (Fig-2). Over the years, the area under pulses is in declining trend and production is fluctuating. Drastic decline was noticed in the year 2014-15 both in area as well as production (Fig-3) despite there is an improvement in productivity. Competing crops, and rainfall may be the prime reasons for steep decline in the area and production.

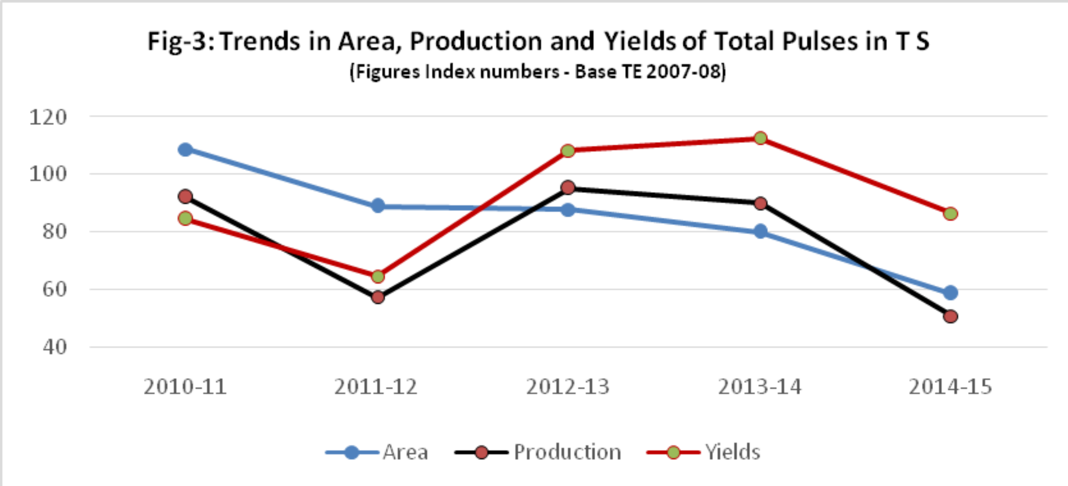
Table-2: Status of Important Pulses on the Basis of Share in the Gross Cropped Area in the State of Telangana (Area in hectares)

Crop	Five Year Avg. (ending 2013-14)	% of area in the GCA	Rank (based on five Year Avg.)	Decadal Avg. (ending 2013-14)	% of area in the GCA	Rank (based on decadal Avg.)
Rice	**1654103**	**29.07**	**1**	**1517690**	**28.46**	**1**
Cotton	**1532390**	**26.93**	**2**	**1179926**	**22.12**	**2**
Maize	**617209**	**10.85**	**3**	**605290**	**11.35**	**3**
Red gram (*Tuar*)	**294373**	**5.17**	**4**	**275903**	**5.17**	**4**
Jowar	**150109**	**2.64**	**8**	**211244**	**3.96**	**5**
Green gram (*Mung*)	**167064**	**2.94**	**6**	**198699**	**3.73**	**6**
Groundnut	**195583**	**3.44**	**5**	**195921.1**	**3.67**	**7**
Castor	**94578**	**1.66**	**10**	**148759.2**	**2.79**	**8**
Soyabean	**162085**	**2.85**	**7**	**142554.5**	**2.67**	**9**
Bengal gram	**108122**	**1.90**	**9**	**102533**	**1.92**	**10**
Chillies	82541	1.45	11	86669	1.63	11
Black gram (*Mash*)	63746	1.12	12	70307	1.32	12

Source: Reports of DES, Government of Telangana



Source: Reports of DES, Government of Telangana



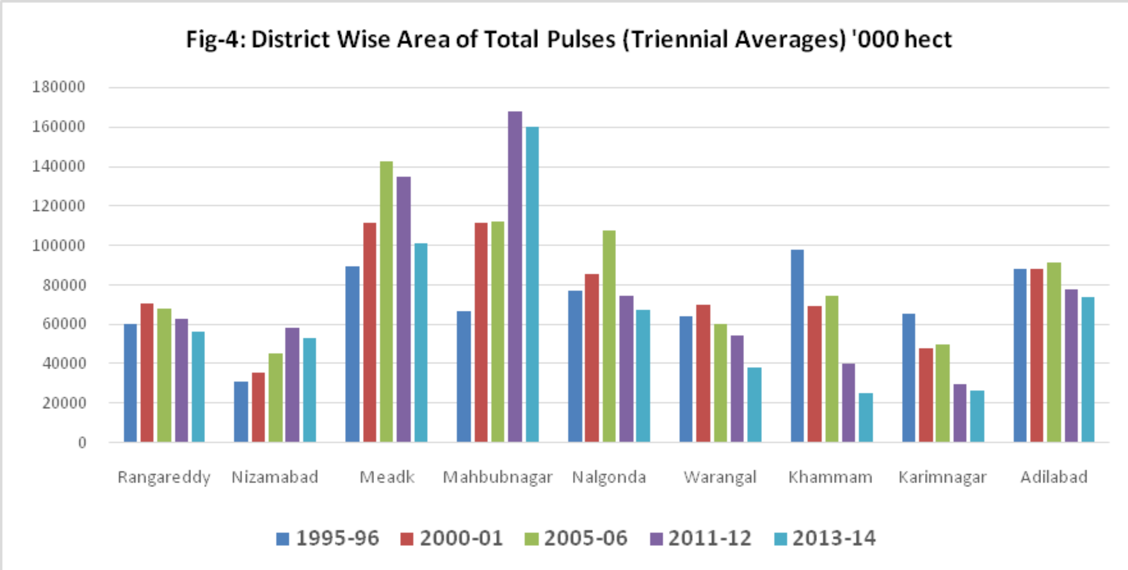
Source: Reports of DES, Government of Telangana

Within the state of Telangana, four erstwhile districts i.e. Rangareddy, Mahabubnagar, Medak and Adilabad together occupies over 70% of the area under pulses in the state and the rest five districts around 30%. Within the districts, pulses occupies around 17% in Rangareddy; 13% in Mahabubnagar; 10% each in Medak and Adilabad districts (Table-3 and Fig-4). Within the state, Mahabubnagar district occupies a lion share of around one third of the area under pulses followed by Adilabad and Medak confirming that pulses are grown under rainfed condition. One can observe that Karimnagar, Khammam and Nalgonda districts in that order where proportion of area under pulses is negligible compared to other districts.

Tabbe-3: District wise Details on the Share of Area Sown - Total Pulses

District	% to total area sown within the district 2014-15	Share in total area under pulses in TS 2014-15
Rangareddy	16.98	10.62
Mahabubnagar	13.24	31.73
Medak	10.27	13.90
Adilabad	10.02	14.76
Warangal	5.68	8.29
Nizamabad	5.09	5.61
Nalgonda	3.75	6.71
Khammam	3.68	4.08
Karimnagar	2.51	4.30

Source: Reports of DES, Government of Telangana



Source: Reports of DES, Government of Telangana

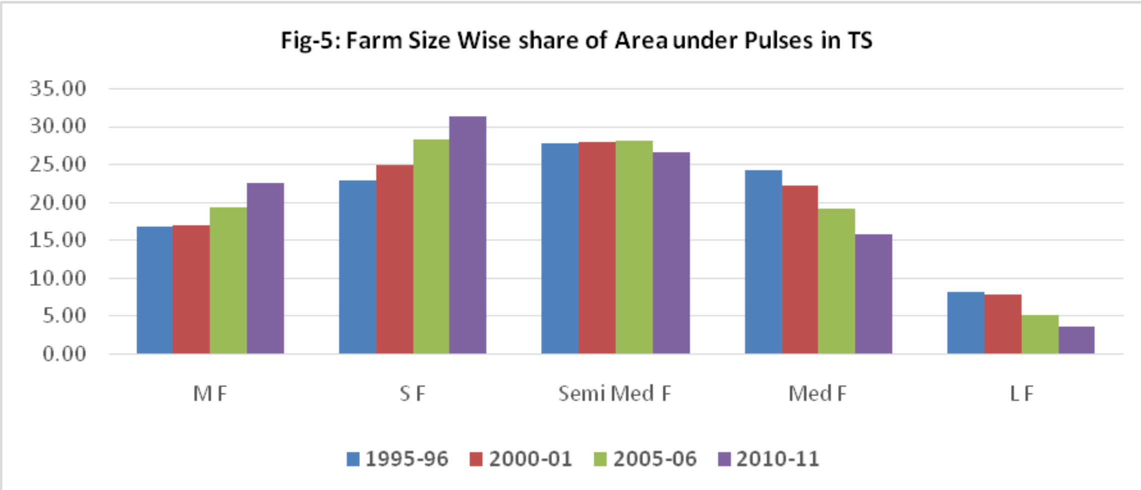
Erstwhile Mahabubnagar followed by Medak and Adilabad districts in that order have recorded top rankers in terms of area and in production. But in yields, Mahabubnagar district recorded the second least i.e. 8th rank out of nine and Nalgonda recorded the lowestrank in yields (Table-4). The productivity is relatively better in erstwhile Nizamabad and Khammam districts and it could be due to irrigation.

Table-4: District Wise Rank in Area, Production and in Yields (TE 2013-14)

District	Area	Production	Yield
Mahabubnagar	1	2	8
Medak	2	1	2
Adilabad	3	4	3
Nalgonda	4	5	9
Rangareddy	5	6	7
Nizamabad	6	3	1
Warangal	7	7	6
Karimnagar	8	9	5
Khammam	9	8	4

Source: Reports of DES, Government of Telangana

The existing literature show that the marginal farmers (MF), small farmers (SF) and semi medium farmers in that order are the prime holdings that are growing pulses and it is true in case of Telangana (Fig-5). Farm size analysis show that the share of area under pulses by the large farmers is least compared to the share of other farm sizes and it is mostly, small, semi-medium and marginal farmers are opting for pulses. It is reconfirmed that pulses are grown in marginal lands under the rainfed condition with low input use and are subjected to weather risks.



Source: Reports of DES, Government of Telangana

With regard to productivity of different pulses in the state, it is to be noted that within the pulses, red gram leads in area but in terms of yields it is one of the least among pulses and Bengal gram records highest yields. Red gram'syield is almost one third of the yields of Bengal gram (Table-5). There is every need to enhance the productivity of red gram and green gram as they occupy vast area within the pulses. Extension services may play a vital role in enhancing the productivity.

Table-5: Productivity of Different Pulses Grown in Telangana (TE 2014)

Crop	Area (in Ha)	Rank	Yield kgs/ha	Rank
Redgram	759891	1	529	4
Blackgram	129578	4	826	2
Greengram	362768	2	667	3
Horsegram	9374	5	494	5
Bengalgram	284874	3	1545	1
Average yield of total Pulses			774	

Source: Reports of DES, Government of Telangana

In this context, it is of interest to examine the yield gaps across the states and within the state of Telangana to pin point laggard areas for a suitable policy.The existing evidences show that the management practices alone can improve the yields to the extent of 30 per cent. Against this backdrop, it is important to assess the yield gaps of different pulses. In case of red gram, the yield gap is huge and Telangana state is one of the lowest state in the country in terms of productivity (Table-6) and the yield gap is to the extent of around 300 per cent compared to the highest yield producing state.

Table-6: Yield Gap Analysis – Red gram (Tur /Pigeon pea/Arhar)

Telangana State Compared with All India and Other States			
State / India / Region /District/ Zones	**Yield (kgs) / hect**	**Gap (kgs) / hectare**	**Gap (%)**
With the Yields as per the Government Statistics (Triennium ending 2013-14)			
Telangana	**457**		
I. States: > Telangana State Avg.			
Bihar	1772	1315	287.6
Delhi	1833	1376	301.2
Kerala	1444	987	216.1
Haryana	1115	658	144.0
West Bengal	1119	662	144.9
Gujarat	1079	622	136.1
Meghalaya	1074	617	135.0
UP	998	541	118.3
Jharkhand	1008	551	120.6
Arunachal Pradesh	941	484	105.9
Punjab	933	476	104.2
Nagaland	893	436	95.4
Tamil Nadu	895	438	95.8
Odisha	873	416	91.0
Uttarakhand	845	388	85.0

Assam	820	363	79.5
Maharashtra	808	351	76.8
Dadra and Nagar Haveli	818	361	79.0
India	750	293	64.1
Tripura	729	272	59.4
Rajasthan	732	275	60.2
MP	665	208	45.5
Karnataka	581	124	27.1
Chhattisgarh	553	96	21.0
II. Regions: > State Avg.			
North Telangana	624	167	26.7
III. Districts: > State Avg.			
Nizamabad	832	375	45.1
Adilabad	644	187	29.1
Karimnagar	583	126	21.6
Warangal	581	124	21.3
Medak	540	83	15.4
Inter District (NZB 832-RR 376)		**456**	**54.8**
IV. Agro- climatic Zones: > State Avg.			
Northern Telangana Zone	649	191	29.5
Central Telangana Zone	539	82	15.2
V. Regions: < State Avg.			
Southern Telangana	407	-51	12.4

VI. Districts: < State Avg.			
Rangareddy	376	-81	21.6
Mahabubnagar	387	-70	18.1
Khammam	427	-30	7.0
VII.Agro- climatic Zones: <State Avg.			
Southern Telangana Zone	386	-71	-18.5
High Altitude & Tribal Areas Zone	Data not available		

Source: Reports of DES, Government of Telangana

Within the state, there are huge inter and intra zonal differences in the productivity of the crop. Northern Telangana and central Telangana are better performers and southern Telangana and high altitude tribal zone are laggards that needs the attention of the researchers and policy makers. We made an attempt of yield gap analysis for two more important pulses i.e. Green gram and Bengal gram and the results are given in Table-7 and Table-8 respectively. Though the tables are self-explanatory, it is revealed that the yield gaps varied from crop to crop but considerable gap exist between states and within the state. For instance, the yield gap in green gram and Bengal gram to the extent of around 50% exist between the districts. Thus there is a huge potential to enhance the yields and in-turn production.

Table-7: Yield Gap Analysis – Green gram (Mung)

Telangana Compared with All India and Other States GREEN GRAM			
State / India / Region /District/ Zones	**Yield (kgs) / hectare**	**Gap (kgs) / hectare**	**Gap (%)**
With the Yields as per the Government Statistics (Triennium ending 2013-14)			
Telangana	**659**		
I. States: > Telangana State Avg.			
West Bengal	784	125	19
Bihar	686	28	4.2
II. Regions: > State Avg.			
North Telangana	682	23	3.4
III. Districts: > State Avg.			
Medak	794	135	17.0
Nizamabad	784	125	15.9
Khammam	717	58	8.1
Warangal	685	26	3.8
Inter District (MDK 794-MBNR 400)		**394**	**49.6**
IV. Agro- climatic Zones: > State Avg.			
Northern Telangana Zone	665	7	1
Central Telangana Zone	74	82	11
V. Regions: < State Avg.			
South Telangana	640	-19	2.9
VI. Districts: < State Avg.			
Mahabubnagar	400	-259	64.8

Adilabad	574	-85	14.8
Nalgonda	607	-52	8.6
Karimnagar	611	-48	7.9
Rangareddy	640	-19	3.0
VII. Agro- climatic Zones: <State Avg.			
Southern Telangana Zone	552	-107	-19.4

Source: Reports of DES, Government of Telangana

Table-8: Yield Gap Analysis – Bengal gram

Telangana State Compared with All India and Other States BENGAL GRAM			
State / India / Region /District/ Zones	**Yield (kgs) / hectare**	**Gap (kgs) / hectare**	**Gap (%)**
With the Yields as per the Government Statistics (Triennium ending 2013-14)			
Telangana	**1388**		
I. States: > Telangana State Avg.			
Delhi	4250	2862	206.2
II. Regions: > State Avg.			
North Telangana	1571	183	11.6
III. Districts: > State Avg.			
Nizamabad	1740	352	20.2
Nalgonda	1427	39	2.7
Inter District (NZB 1740-KNR 834)		**906**	**52.1**
IV. Agro- climatic Zones: > State Avg.			
Northern Telangana Zone	1577	189	
V.Regions: < State Avg.			

South Telangana	1237	-151	12.2
VI. Districts: < State Avg.			
Karimnagar	834	-554	66.4
Mahabubnagar	1123	-265	23.6
Rangareddy	1174	-214	18.2
Khammam	1331	-57	4.3
Warangal	1345	-43	3.2
Medak	1360	-28	2.1
Adilabad	1372	-16	1.2
VII.Agro- climatic Zones: <State Avg.			
Central Telangana Zone	1359	-29	-2.1
Southern Telangana Zone	1136	-252	-22.2

Source: Reports of DES, Government of Telangana

Production and Productivity Constraints and Way Forward

We relied on secondary evidences to summarise the constraints in production and productivity besides highlighting the cases of achieving higher production and productivity of pulses. Though covered the studies undertaken in different states, the present study mostly count on those covering the southern states including Telangana to relate to the state of Telangana. Main constraints include: rainfed cultivation, farmers yet to realise the scale of economies of growing in irrigated condition due to lack of awareness, low input use, insufficient farm management practices, dearth of short duration high yielding varieties, and most importantly price realisation to the output. In addition to this, lack of support services of Custom Hire of farm equipment’s in the right time with affordable rental charges especially for the small and marginal farms is another hindrance besides non- adoption and lack of knowledge of improved technologies. One of the study rightly pointed out that faulty marketing system, lack of processing and transport are the deterrents in the pulses economy (Shailendra, 2012). Fortunately, both central and state governments have realised the importance of pulses and encouraging to enhance the area and helping in the efforts to increase productivity through several programmes that include national food security mission.

A study conducted through Agro-Economic Research Centres (AERCs) across the country indicated that the net returns of pulse crops are either equal to or higher than other crops in most of the states. Further, it quoted that the yield instability does not appear to be higher for pulses than for other major crops andalso, the market prices for pulses have been generally higher and increasing in the last few years (Sekhar and Bhatt, 2012). The major determinants of yield are mainly the rainfall, fertilizer use and to a lesser extent irrigation. The marginal area effect, that is, the adverse effect on yield due to cultivation on inferior lands, is present to a small degree only. One of the study conducted in the neighbouring state i.e. Karnataka, revealed that strengthening seed supply chain, enhancing adoption of high yielding varieties, promoting cooperative and contract farming and linking farmers to marketing would be very critical to make pulses more productive and profitable (Zaheer et al 2016).

There are several studies to accentuate that frontline demonstration methods helped in enhancing the pulses area as well as productivity. The above mentioned study covering Karnataka clearly indicated the positive effects of frontline demonstrations (FLDs) over the existing practices towards enhancing the productivity in the rainfed region. The study came out that demonstrated technologies proved most remunerative and economically feasible compared with traditional production system. It is to be noted that extension efforts of KVK and also through coverage in print and electronic media and trainings to farmers helped in the adoption of new methods, the study underlined.Further, quoted that the improved technologies resulted enhanced yields in the demonstrated fields and it was 24 per cent higher than the farmers' practice. It also resulted in higher income with a benefit cost ratio of 3.7 as compared to local practice (2.98) apart from recording less incidence of pests compared to farmers' practice. Thus the concept of live field demonstrations i.e. learning by seeing and doing proved most remunerative and economically feasible against traditional production system.

M.S. Swaminathan Research Foundation in promoting the concept of "Pulse Panchayats" in two Semi- Arid States, Tamilnadu and Odisha encouraged the sowing of pulses in rice fallow which has brought an additional area (40%) under pulses production. Farmers were capacitated in

Integrated Crop Management practices with adoption of new improved varieties and package of practices based on climate variability. This has enhanced productivity by more than 30% compared to traditional method with additional incomes. Knowledge management through Farmers Field Schools and Farmers Field Days using ICT tools were integrated through Village Knowledge Centres. The “Pulse Panchayat” movement has demonstrated through multi-stakeholder platforms and policy making networks is key to effective adoption and up-scaling, if paired with knowledge management enhancement and innovative approaches to support decision making of farmers who are facing challenges of price volatility and climate change (Hopper et al 2016). Thus new innovative methods with proper extension support has enhanced both area and also productivity of pulses.

There is also evidenceto show that the presence of multi-layered, fragmented supply chain in the movement of pulses from farmer to the ultimate consumer. Information availability may help immensely in integrating farmers with market and enhancing the efficiency of the system. A study reinforces the need for adopting innovative approaches like participation of private players under PPP, integrating producers with market through group formation and enhancing the efficiency of the system through efficient processing at farm level. Further, it is observed that focus should be made on providing market information using ICT and to make marketing an integral part of various programmes of the Government like pulses promotion programme and extension programme (Shailendra 2012).

Thus,the agricultural extension played a crucial role in enhancing the area as well as productivity of pulses which is need of the hour to increase the food security, nutritional requirement of the people especially for poor. But the practices noticed have to be replicated to enhance the rural income and to have a visible change in the adoption of improved management practices besides adoption of new technology in the context of climate change. There are several models available - be it frontline demonstration method, forming farmers groups, regular electronic and print media publicity, market information through ICT, farmers’ field schools, availability of support services such as custom hiring centres and mechanisms of giving assured prices for the output etc. But all these are confined to certain parts of the area and these need to be widely replicated through different and innovative methods of extension for wide spread adoption to enhance production and productivity of pulses. Agribusiness centresneed to be roped in for training and for wider adoption of modern technology. Bringing smallholder farmers as a group, arranging more exposure visits and by expanding and improving locally-relevant and cost-effective models may go a long way in enhancing the area and productivity of pulses.Further, strengtheningof the capacity of the civil society working towards improvement of rural livelihoods is another important task need to be given priority. Thus, public and private playerscan play a more prominent and effective role in delivering agricultural extension services to underserved smallholder farmers.

Interaction with Progressive Farmers

In connection with work related to the commission for sustainable agricultural development, appointed by the government of Andhra Pradesh, we had an opportunity to visit several institutions adopting innovative methods towards better farm returns, research stations and also interacted with progressive farmers in A P and Telangana in the year 2016. Our interaction with progressive farmers more specifically on pulses reveals that: assured output prices for the pulses, implementation of PM's FasalYozana right from sowing, provision of life-saving irrigation to pulses, supply of seed which resist pests (giving the example of a farmer in Panthnagar supplying such seeds), and the need to educate farmers on market knowledge will enhance the productivity of pulses. In the public hearings too, farmers observed that marketing is the major problem faced by them.

In this context, we have also seen a successful model especially initiated by a private playerthat facilitated in enhancement of area and productivity of pulses. Such models need to be replicated widely with government or private initiatives and extension services may play a larger role in this process.

Dharani Farming and Marketing Mutually Aided Co-operative society Ltd

This society was registered in March 2008, under MACS Act, is a federation of sanghas and a producer owned business enterprise, promoted by the Timbaktu Collective, in C K Palle, Anantapur district. It is started to help the farmers with the post-production processes and marketing. It procures, stores, processes and markets its members' produce under brand name

Timbaktu Organic[17].The idea is to work towards uniting small-holder farmers in an effort to ensure their economic success facing the impact of agricultural policies and climate change.

In brief, Dharanispread over in four mandals covering1600 to 1800 farmers with 8 to 10 thousand acres of land. Enrolment of farmers is a gradual process. Every 5 farmers grouped as a "sub group" and 3 subgroups come together to form a Sangham and now there are 120 sanghams. Every village have one office with all agricultural implements (numbering 15)and these implements are used on sharing basis and they are also preparing required inputs including organic inputs. The main features are that every village has one volunteer andevery farmer has one ID card and he/she has to write a dairy,eachplot has GPS link and cadre is also deployed depending upon the number of Sanghas in the village. All the financial activities between sangahs and Dharani are transparent and Dharani decisions will depend upon the Sanghas observations.

Dharani undertake the responsibility of procurement of output from the farmers and the output is processed for value addition and marketed by Dharani.Specialized implements and customized machinery established for processing of small millets, pulses and cereals that include oil extraction. Dharaniannounces the support price at the time of sowing and if market price is higher than the announced price at the time of harvest, Dharani pays the market price. It gives freedom to the farmers to decide on the crop he/she needs to grow. For instance, at the time of our visit, Dharani announced Rs.50/- per kg of red gram as a support price. Dharani is also giving bonus to the farmers and the farmers received bonus continuously for the last three years.

There is every need to replicate such efforts with handholding by government or private players/NGOs for the benefit of farmers more specifically small and marginal farmers in dry land areas. Agriculture extension services need to locate such models and extensively educate farmers and convince them to form as a group and reap the benefits. We have seen such initiatives in other places too not similar to the activities of Dharani. For instance, Ramakrishnapuram, Allagadda, Kurnool district; T kothapalle, Gooty, Anantapur district; Kotanka, garladinne, Anantapur; Mareddipalle- Prakasam District are some to mention. Thus, the concept of forming a farmers' group and nurturing like SHGs at different levels may help the farming community

[17] See website for more details

especially small and marginal farmers to withstand the challenges of changing agricultural policies nationally and internationally and to handle the complexities of agriculture in all aspects. To sustain such initiatives in the long run, handholding of government/NGOs/philanthropic private players is necessary, more so in the state of Telangana.

Thus, to sum-up, pulses occupy a unique place in India's nutritional food security as they are a major sources of proteins for vegetarians. India being the largest producer of pulses, and also importing pulses to cap the demand gap, the sources for importing at competitive price is a difficult task.There is every need to enhance the production and productivity of pulses within the country to cater the health requirements. In the state of Telangana too, pulses are grown in marginal lands under rainfed condition, mostly by small and marginal farmers. Pulses are concentrated in few districts and vast irrigated belt going to cereals. The productivity scenario of pulses clearly show that the state is at the bottom in terms of productivity of pulses and there are huge yield gaps within the state in all the major pulses. It reveals that there is a large scope for enhancement of productivity of pulses since this crop can be grown in all types of lands. Lack of awareness among farmers, low adoption of technology, low input use and lack of market intelligence are some of the constraints and these can overcome with proper extension services and by forming farmers' groups to act collectively. Government and non-government support services are required to sustain such groups in the long run.

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CONSTRAINTS AND SUGGESTIONS ON THE ACCEPTABILITY OF MOBILE APPS IN DELIVERING EXTENSION SERVICES BY THE LIVESTOCK FARMERS.

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ABSTRACT

The advancement in the mobile technology, there is global explosion of usage of smart phones and mobile apps had become the one of the mobile enabled information services for extension service delivery. So, the present research was formulated to study the constraints faced by the livestock farmers in accepting mobile apps as extension service delivery tool and to elicit the suggestions to overcome the constraints faced by the livestock farmers in accepting mobile apps as an extension services delivery tool. The study was conducted in Chittoor district of Andhra Pradesh with 100 WSHG members who were involved in livestock farming as income generating activity. A mobile app on fodder cultivation through hydroponics was developed in the vernacular language i.e., Telugu and the data was collected through interview schedule and were tabulated and analyzed using suitable statistical tools. Majority of the respondents found of no immediate answers for their questions, the cost of internet packages were high, typing the Uniform Resource Locator (URL) to access the web page to download the mobile app were constraints. Other constraints as perceived by the respondents in accepting were need of internet facility, network connectivity and difficulty in handling the mobile apps and smartphones.

WSHG members opined their suggestions of the mobile app should be in local language, interactive in nature, contain need based and latest information and available in offline mode in order to accept the mobile app as extension service delivery tool. They also suggested the updating of the information is also needed whenever there is advancements or new technologies in the livestock farming.

INTRODUCTION

Information is wealth for the livestock farmers in the recent past for availing benefits in their enterprise. But, there exist great information asymmetry among the farming community. This can be due to inability of providing them with information they need as reachability have become a tremendous task for the extensional personnel. Information and Communication Technologies can act as an effective and efficient tool to support the livelihoods of rural people providing more subject matter coverage, decision support and direct rural access to information, minimize time and distance barriers (Mruthunjaya and Adhiguru, 2007).

Among various ICT tool, mobile phone has the greater rural penetration, mainly due to rapid growth in mobile ownership, signal coverage and affordable telecommunication policies. There are many mobile enabled information services of voice calls, Short Message Service (SMS) alerts, toll free call centres, etc. With the advent of smartphones, there has been also a global explosion in the number of m-apps which can also act as mobile enabled information services. Thus, increasing penetration and mobile-enabled information services can reduce information asymmetry of farming community and complement the role of extension services through time saving, offering instant out-reach and continuity in availability. Thus, the reachability of the information to the farming community would be increased exponentially.

Given this dramatic change, smartphones in general and mobile applications in particular hold significant potential in delivery of various extension services to the information needy farmers. Mobile apps provided the most affordable way for farmers to access information on new scientific technologies for better farming, markets, and finance which were previously unavailable to them. So, the constraints faced by the livestock farmers need to be studied and also the suggestions from the farmers to overcome these constraints are to be known. By knowing the constraints and suggestions of the famers, it would be helpful in developing the mobile apps for the extension services delivery which would help in providing useful, relevant information and services to the farmers with ease. Thus, present research was formulated to study the constraints and suggestions of livestock farmers on the acceptability of mobile apps in delivering extension services by the livestock farmers so that they were used in providing the needed information to livestock farmers.

MATERIALS AND METHODS

The present study was conducted in Chittoor district of Andhra Pradesh. A total of 100 WSHG members who were involved livestock farming as income generating activity were selected purposively from 4 mandals of 4 divisions of the district with 25 WSHG members from each mandal. A mobile app on fodder cultivation through hydroponics was developed in the vernacular language i.e., Telugu and the data was collected through interview schedule and were tabulated and analyzed using suitable statistical tools. Data was collected with the help of pre tested schedule. The data collected from the respondents were scored, tabulated and analyzed using suitable statistical tools.

RESULTS AND DISCUSSION

1. Constraints felt by the respondents in accepting the mobile apps in delivering extension services

From the Table 1, it is evident that, majority (81.00%) of the respondents had felt there were no immediate answers for their questions. The costs of internet packages were felt as a constraint by more than three-fourths (76.00%) of the respondents. About 62 per cent of the respondents opined that they faced constraint to type the Uniform Resource Locator (URL) to access the web page to download the mobile app as it was in English language (Siraj, 2016). Some of them needed the help of their family members like husband or children to type the URL to access the webpage. Need of internet connection every time for accessing the information for online mode of mobile apps was felt as a constraint by 59 per cent of the respondents. As in the case of offline mode of mobile app, internet connection is needed only to download the app but in case of online mode of mobile app there is need of internet every time it is used. The cost of smart phones also felt as a constraint by more than half (54.00%) of the respondents who perceived it was high. Ajwag (2014) found similar findings that though Mfarm application had a downloadable app which the farmers with android powered smartphone could use to directly access information, most of the smallholder farmers could not use as they could not afford the smartphone. Similar findings were reported by Nyamba and Mlozi (2012).

Majority (52.00%) of the respondents felt that it was difficult to use as it is the new technology and they were not exposed nor had any prior experience in accessing the information on livestock farming through mobile apps. This could be overcome by helping them with the usage of mobile apps by creating awareness in them. About 46 per cent of the respondents had difficulty in handling the smart phones. They also faced the constraint of network connectivity problem which was poor as the finding of Nyamba and Mlozi (2012) and Genesis (2010).

Table 1: Perceived constraints of the livestock farmers in accepting the mobile apps in delivering extension services

N=100

S.No	Constraint	f*	%
1.	Mobile app is new technology	52	52.00
2.	Network connectivity problem	41	41.00
3.	Need of Internet connection	59	59.00
4.	No immediate answers for their questions.	81	81.00
5.	Cost of the smart phones	54	54.00
6	Difficulty in handling of smart phones	46	46.00
7	Difficulty to type the URL to access the web page	60	60.00
8	Cost of internet packages	76	76.00

*Multiple responses not to total

2. Suggestions for accepting the mobile apps in delivering extension services by the livestock farmers

From the Table 2, it could be found that 90 per cent of the WSHG members had suggested that offline mode of mobile app would be better as there would be convenience of using the app even when there is no network once it is downloaded. Majority (82.00%) of the respondents had suggested that interactive mobile apps would be more acceptable as they provide the advantage of the interaction with the experts such as follow up with the option of Short Message Services etc. About 65 per cent of the respondents had suggested that the mobile apps had to be in their local language as they can be able to get the information in more understandable form. About 61 per cent had suggested that the m-apps must be tailor made as per the needs of the farmers so that the farmer is benefitted in gaining knowledge and to gain profits. More than half (54.00%) of the respondents had suggested that the information provided by the m-apps had to be location specific as there is much variation in the livestock management in different locations. The updating of information on the m-apps (49.00%) had to be done whenever there is advancement in the subject on which the m-apps is on, or the new scientific techniques developed to increase their productivity.

Table 2: Suggestion of the livestock farmers to accept the mobile apps in delivering extension services

N=100

S.No	Suggestion	f*	%
1.	Offline mode of apps	90	90.00
2.	Interactive in nature	82	82.00
3.	As per information needs	61	61.00
4.	Location specific information	54	54.00
5.	Updating of information	49	49.00
6.	Local language	65	65.00

*Multiple responses not to total

CONCLUSION

The usage of the mobile apps assisted livestock farmers to reach information with minimum efforts with just click away. The constraints faced by the livestock farmers in accepting the mobile apps for deliverying extension services could be mainly lack of interaction, cost of the smartphones, internet packages and network connectivity. So, suggestions of developing a offline mode app with interactivity would be helpful to framers. The mobile apps have the benefit of having the information dissemination to the farmers with various formats like the text and voice in their local language and also local dialect and the same has made mobile apps as viable alternative for information dissemination and the liberal use of mobile phones and mobile apps would help also the extension personnel to develop the various extension services delivery systems which are farmers centric and tailored to the needs of the farmers.

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A STUDY ON NATURAL RESOURCE MANAGEMENT OF WATERSHED FARMERS OF ANDHRA PRADESH STATE

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ABSTRACT

The study was focused on NRM behavior of watershed farmers for this an index was developed with four indicators namely level of attitude, level of knowledge, extent of participation and extent of adoption to measure NRM behaviour of the watershed farmers. Majority of the respondents had favourable attitude (27.08%), low extent of participation (46.25%), medium levels of knowledge (36.25%), medium extent of adoption (38.35%) and medium level of NRM behavior (46.67%). The variables like education, farm size, trainings, input usage pattern, information seeking behavior, team work, farming experience and risk taking ability were positively and significantly related with the NRM behavior, where as education, farm size, trainings undergone, input usage pattern, environmental awareness, information seeking behavior, status of watershed and team work explained 90.11 per cent variation.

INTRODUCTION

The nature and status of natural resources play a pivotal role for sustainable yields in various crops. The potentiality of these resources especially like soil and water is decreasing in alarming propositions, there by effecting farming situation as well as crop production both at micro and macro level. The isolated approach of natural resource management does not yield expected results whereas community based management derives maximum benefits to the farmers in terms of soil, water and moisture conservation for sustainable use of these resources for better crop production. There is every need to gauge the degree of Natural Resource Management behaviour of the farmers for their sustainable use. Keeping this in view the present investigation entitled as “**A study on Natural Resource Management of watershed farmers of Andhra Pradesh state**”

MATERIAL AND METHODS

The state of Andhra Pradesh and the three regions i.e. Telangana, Coastal Andhra and Rayalaseema and from each region one district i.e Mahaboobnagar from Telangana, Prakasham from Coastal Andhra and Anathapur from Rayalaseema were selected purposively. From each district two IWMPs, from each IWMP area one mandal, from each mandal four villages and from each village ten watershed farmers were selected randomly, thus a total of six (6) IWMPs, six (6) mandals, twenty four (24) villages and two hundred and forty (240) farmers were considered as sample for the study. From each district, ten members of officials were selected randomly, thus comprising 30 officials for the study. The official as a respondent for the study is operationally defined as the officer who is directly involved in planning, implementing and monitoring the NRM activities under IWMP.

NRM behaviour of the watershed farmers:

It is operationally defined as the behaviour expressed by the watershed farmers in practicing various soil and water conservation practices for development of farm and increasing crop production. The biggest problem faced by every attempt was to measure the concept as a variable based on some standard indicators.

Efforts in the direction of measurement of NRM behaviour have not been spelt out clearly so far. However, they indicated that the components that have been identified were based on secondary data and were also not further operationalised. Hence, the researcher’s thrust was to identify components that truly reflect NRM behaviour of farmers, amenable to operationalisation, accessible to farmers’ information domain and more importantly, take stock of the conflicting and synergetic effect of these components.

An attempt has been made to measure NRM behaviour of the watershed farmers in watershed environment by considering all the factors suggested by many authors. The details of procedure adopted are presented below.

Item pool: Based on the review of literature as well as discussion with the experts in the field of water management, soil physics, watershed management, NRM and agriculture extension, ten indicators (perception on NRM practices, NRM planning, level of attitude towards NRM, level of knowledge, decision making behaviour, extent of participation, commitment towards NRM, extent of adoption of NRM practices, resource mobilization and critical consciousness) were enlisted in accordance with the situation on soil and water existed in watershed environment.

Item scrutiny: After assessing the relevancy of these indicators four indicators were retained as essential for measuring NRM behaviour of watershed farmers.

Judges rating on indicator

After defining indicators of measurement of NRM behaviour, they were given to 30 judges comprising the experts in the cadre of Assistant Professor and above in the areas of Agricultural Extension, Agronomy and Soil science in the Professor Jayashanker Telangana State Agricultural University, Hyderabad; ICAR institutions located in Hyderabad and also the officers in watershed projects to get the relevancy of each indicator on five point relevance continuum *viz* most relevant, relevant, somewhat relevant, less relevant and not relevant with the weightage of 5,4,3,2 and 1 respectively for inclusion in the final scale based upon the mean score. The range of mean score is 1 to 5. The indicators whose mean score is above 2.5 were selected for inclusion in the scale, while the indicators whose mean score is below 2.5 were omitted. Likewise four indicators were selected for the study and remaining six indicators were deleted (Table 1)

Table 1 Relevancy of the indicators on NRM

S. NO	**Indicators**	**Response categories**					**T.S**	**M.S**
		MR	**R**	**SWR**	**LR**	**NR**		
1	Perception on NRM practices	2	2	2	10	14	58	1.9
2	NRM planning	2	2	2	14	10	62	2.1
3	**Level of Attitude towards NRM**	10	10	5	2	3	110	3.6
4	**Level of knowledge on NRM**	7	11	7	3	2	108	3.6
5	Decision making behaviour	3	2	4	8	13	64	2.1
6	**Extent of participation**	8	14	4	3	1	115	3.8
7	Commitment towards NRM	2	2	5	14	10	71	2.3

S. NO	Indicators	Response categories					T.S	M.S
		MR	R	SWR	LR	NR		
8	**Extent of adoption of NRM practices**	13	7	6	2	2	117	3.9
9	Resource mobilization	4	4	5	5	12	73	2.4
10	Critical consciousness	2	1	4	10	13	59	2.0

RESULTS AND DISCUSSIONS

Level of attitude of watershed farmers towards various NRM practices

The results in the Table 2 indicate that majority of the watershed farmers (27.08%) had favourable attitude towards NRM practices, followed by high (22.92%), less (20.84%), least (16.16%) and highly favourable attitude (12.50%).

Table 2 Distribution of watershed farmers according to their level of attitude n=240

S. No.	Category	Class interval	Frequency	Percentage
1	Least favourable attitude	46-52	40	16.16
2	Less favourable attitude	52-58	50	20.84
3	Favourable attitude	58-54	65	27.08
4	High favourable attitude	64-70	55	22.92
5	Highly favourable attitude	70-76	30	12.50

The favourable attitude of watershed farmers towards NRM practices can be attributed to the fact that the continuous implementation of NRM activities continuously since 1995. It is very easy to sense the benefits accrued through the NRM activities by way of recharging the ground water, improvement in flora and fauna and the micro climate as a whole. The farmers are slowly realizing the adverse affects due to indiscriminate use of natural resources thereby they felt no one has the right to use natural resources as he/she feels. They also felt to give fresh life to the natural resources by gradual restoration and replenishment in order to minimize the climatic aberration and also to maintain ecological balance. The farmers were not felt the utility of growing of grass species on bunds for maintains long life of bunds. The farmers felt under impression that the NRM activities did not increased income both from agriculture and non agricultural activities taken up under watershed area. They also did not feel the importance of cost sharing with beneficiaries to ensure respect and responsibility in watershed development. They had an idea that the resources cannot be managed effectively through community based organizations. In order to improve the impression of farmers on these issues of NRM, more awareness programmes, campaigns, trainings, exposure visits to the well established NRM areas should be organized by the Department of Agriculture, IWMP, DWMA and KVKs. This finding is in conformity with those of Gowda (1996), Padmavathi (1996) and Chataway *et al.* (2003).

Level of knowledge of watershed farmers on various NRM practices

The results in the Table 3 indicated that majority of the watershed farmers fell under the category of medium (36.25%) level of knowledge followed by low (33.33%) and high (30.42%) level of knowledge.

Table 3 Distribution of watershed farmers according to their level of knowledge

n=240

S. No.	Category	Class interval	Frequency	Percentage
1	Low level of knowledge	35-40	80	33.33
2	Medium level of knowledge	40-45	87	36.25
3	High level of knowledge	45-50	73	30.42

The medium followed by low level of knowledge of watershed farmers might be due to lack of inquisitiveness to understand the logistics of implementation of various NRM activities. Farmers used to practice the agriculture technologies without knowing the rationale on implementation of these practices. This finding is in conformity with those of Doli (2006) and Raju (2002).

Extent of participation of watershed farmers at different stages of watershed management programme

The results in the Table 4 indicate that majority of the watershed farmers fell under the category of low (46.25%) extent of participation followed by medium (27.92%) and high (25.83%) extent of participation.

Table 4 Distribution of watershed farmers according to their extent of participation n=240

S. No.	Category	Class interval	Frequency	Percentage
1	Low extent of participation	50-60	**111**	**46.25**
2	Medium extent of participation	60-70	**67**	**27.92**
3	High extent of participation	70-80	**62**	**25.83**

Extent of adoption of various NRM practices by the watershed farmers

The results in the Table 5 indicated that, majority of the watershed farmers fell under the category of medium (38.33%) extent of adoption of various NRM practices followed by high (32.50%) and low (29.17%).

Table 5 Distribution of watershed farmers according to their extent of adoption of various NRM practices n=240

S. No.	Category	Class interval	Frequency	Percentage
1	Low extent of adoption	45-50	70	29.17
2	Medium extent of adoption	50-55	92	38.33
3	High extent of adoption	55-60	78	32.50

The medium followed by high adoption of NRM practices could be attributed to the reason that the farmers are slowly realizing both short and long lasting effects of these practices, in addition to this the government is giving financial support to take up various NRM activities under watershed. Government is offering cent per cent subsidy to take up various NRM activities under watersheds. This finding is in conformity with those of Krishnamurthy (1993), Reddy (1996) and Anil *et al.* (2010).

Measurement of indicators of NRM behaviour

The four indicators namely level of attitude, level of knowledge, extent of participation and extent of adoption measure the NRM behaviour index of the watershed farmers.

Computation of NRM Index

The four indicators namely attitude, level of knowledge, extent of participation and extent of adoption were measured and expressed in different units. Hence, all these units were converted into unit values by using simple range and variability as given below to develop an index to measure the NRM behaviour of the watershed farmers.

$$U_{ij} = \frac{Y_{ij} - \text{Min.}Yj}{\text{Max.}Y_j - \text{Min.}Y_j}$$

Where, Y_{ij} = Value of the i^{th} respondent on j^{th} component

Min.Yj = Minimum score on the j^{th} component

Max.Y_j = Maximum score on the j^{th} component Min.Y_j

U_{ij} = Unit value of the i^{th} respondent on j^{th} component

These unit values ranged from 0 to 1, when Y_{ij} is minimum, the unit value is 0 and Y_{ij} is maximum, the unit value is 1

Then, these, unit values of each watershed farmer were multiplied by respective component scale value, summed up, divided by total scale value and multiplied by 100 to get NRM index for each watershed farmer.

Where, U_{ij} = Unit value of the i^{th} respondent on j^{th} component

S_j = Scale value of the j^{th} component

Total scale value= 13

After obtaining the index score, the watershed farmers were grouped into following three groups based on exclusive class interval technique. The maximum and minimum obtained scores were 100 and 4 respectively.

Category	Class interval
Low NRM behaviour	4-36
Medium NRM behaviour	36-68
High NRM behaviour	68-100

NRM BEHAVIOUR OF WATERSHED FARMERS

The results in the Table 6 indicated that majority of the watershed farmers fell under the category of medium (46.67%) level of NRM behaviour followed by low (32.50%) and high (20.83%).

Table 6 Distribution of watershed farmers according to their NRM behaviour

n=240

S. No.	Category	Class interval	Frequency	Percentage
1	Low NRM behaviour	4-36	78	32.50
2	Medium NRM behaviour	36-68	112	46.67
3	High NRM behaviour	68-100	50	20.83

The Table 6 refers that medium NRM behaviour is mostly observed among the respondents followed by low and high. NRM is one of the sensible areas of watershed programme, the importance of which is not completely felt by the farmers. The results accrued through NRM practices cannot be gauged in a short period of time. The cumulative effect of NRM practices can be seen over a period of time. The state department of agriculture, DWMA and KVKs should conduct more awareness programmes, campaigns, exposure visits *etc* to inculcate the spirit of sensing the importance of NRM in watershed programme.

Relationship of profile characteristics with the NRM behaviour of watershed farmers in watershed areas

Correlation of profile characteristics with the NRM behaviour of watershed farmers

In order to study the relationship of NRM behaviour of watershed farmers with the profile characteristics of watershed farmers, the correlation co-efficient (r) values were computed and tested with relevant null and empirical hypotheses.

Null Hypothesis

There will not be significant relationship between NRM behaviour of watershed farmers and their profile characteristics and both of these are independent

Empirical Hypothesis

There will be significant relationship between NRM behaviour of watershed farmers and their profile characteristics and both of these are dependent.

It is revealed from the Table 7 that calculated ‘r’ values between education, input usage pattern, team work, farming experience, risk taking ability and NRM behaviour of watershed farmers were greater than table ‘r’ value at 0.05 level of probability. Hence, null hypothesis was rejected and empirical hypothesis was accepted. Whereas, the calculated ‘r’ value of the variables, farm size, trainings undergone and information seeking behaviour were greater than table ‘r’ value at 0.01 level of probability. Hence, null hypothesis was rejected and empirical hypothesis was accepted. Therefore, it can be concluded that there was a positive and significant relationship between NRM behaviour of watershed farmers and the variables, education, farm size, trainings, input usage pattern, information seeking behaviour, team work, farming experience and risk taking ability.

The personal characteristics of watershed farmers as seen in the Table 7 like education, farm size, trainings, input usage pattern, information seeking behaviour, team work, farming experience and risk taking ability had positive and significant relationship with NRM behaviour of watershed farmers. The characteristics like these have direct bearing on improving the profile and personality of an individual. The formal schooling, large land holdings, high farming experience, more number of trainings undergone on various facets of NRM, frequent usage of non- chemical inputs to improve the soil fertility, seeking the information from various formal and informal sources on NRM activities, high risk taking ability in adopting innovative NRM activities and peer group effect while working teams definitely enhance the NRM behaviour of the watershed farmers.

Table 7 Relationship of profile characteristics with the level of attitude, level of knowledge, extent of participation and extent of adoption of NRM practices of watershed farmers n=240

Independent variables	NRM Behaviour
Age	0.088NS

Education	**0.1374***
Farm size	**0.1839****
Farming experience	**0.1545***
Trainings undergone	**0.8377****
Extension contact	0.08517NS
Input usage pattern	**0.1513***
Environmental awareness	0.0804NS
Socio-political participation	0.0768NS
Mass media exposure	0.0844NS
Information seeking behaviour	**0.8529****
Innovativeness	0.0857NS
Risk taking ability	**0.1411***
Status of watershed	0.1199NS
Group cohesiveness	0.0870NS
Group communication	0.0892NS
Group leadership	0.0825NS
Team work	**0.1344***
Group norms	0.1189NS

* Significant at 0.05 level of probability (0.1269)

** Significant at 0.01 level of probability (0.1663) NS –Non Significant.

Prediction of independent variables contribution for maximum variation in the NRM behaviour of watershed farmers.

Multiple linear (step down) regression analysis was carried out to assess the contribution of all the 19 independent variables towards explaining variation in NRM behaviour of watershed farmers and was tested with the help of relevant null and empirical hypotheses.

Null hypothesis

The variables which can contribute towards maximum variation cannot be delineated from rest of the variables, which have negligible contribution for variation in the NRM behaviour of watershed farmers.

Empirical hypothesis

The scores on variables, which contributed towards maximum variation could be delineated from rest of the variables, which have negligible contribution for variation in the NRM behaviour of watershed farmers.

The value of the coefficient of multiple determination (R^2) as given in Table 8 indicated that the eight independent variables (education, farm size, trainings, input usage pattern, environmental awareness, information seeking behaviour, status of watershed and team work) put together could explain 90.11 per cent of variation in the dependent variable of NRM behaviour of the watershed farmers.

The computed F-value and corresponding partial regression coefficient (b) values of these ten variables were found significant at 0.01 level of probability. Hence, the null hypothesis was rejected and empirical hypothesis was accepted for eight variables and vice-versa for the other eleven variables.

Table 8 Multiple linear regression analysis of selected independent variables with the NRM behaviour of watershed farmers

n= 240

No.	**Variable**	**'b' value**	**SE**	**'t' value**
X_2	Education	1.45132**	0.4397	3.301
X_3	Farm size	0.53136**	0.2127	2.498
X_5	Trainings undergone	0.84527**	0.3246	2.604
X_7	Input usage pattern	6.48333**	1.4496	4.473
X_8	Environmental awareness	1.32946**	0.5776	2.302
X_{11}	Information seeking behaviour	2.60232**	0.7430	3.502
X_{14}	Status of watershed	6.19961**	1.2615	4.915

X_{18}	Team work	6.94447**	1.5233	4.559

R^2 = 0.9011 F value = 217. ** Significant at 1% level of probability

The characteristics like education, trainings undergone and information seeking behaviour enhances the thinking and cognisance levels of the farmers on NRM activities to be taken up at farmers fields. Larger farm holdings are much feasible to implement various categories of soil and water conservation NRM practices. The conscious application of organic inputs continuously drove the farmers to march towards to apply NRM activities. The degree of awareness on changes in soil, water and different floral fauna will proportionately enlightens the farmers on NRM. The nature and developmental status of watershed in term of possession of NRM activities, structures, dividends, accruing benefits, short and long term impacts created will motivated and inspired the farmers to take up NRM activities. The behaviour of working in teams had coherent and synergetic effect and get influenced by each other to understand and perceive the relevance and applicability of the NRM practices.

CONCLUSION

Based on the results it can be concluded that the low level of participation of farmers at various stages of watershed management programme can be improved by enlightening the farmers on need and importance of participation and what kind of benefits are accrued through participation. The local bodies should strive to ensure participation of farmers. The extent of adoption of some of the NRM technologies is medium to high, because of financial support provided by the government, where as the maintenance of these technologies is poor. Hence the officials of IWMP, DWMA, SDA, KVK and SAU should provide continuous technical advice and supportive mechanism to sustain these NRM technologies. NRM behaviour of the farmers can be improved by enhancing the socio-economic and psychological profile, creating social organizations and village institutions, establishing various information and service providers on NRM and accessing the farmers to witness success stories on NRM activities under watersheds. In order to enhance the degree of favourability of farmers on NRM, they need to be oriented on the value of various kinds of NRM technologies, the long and short term benefits accrued, ecological balance and improvement in status of natural resources.

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Redgram productivity Enhancement through Front Line Demonstrations in Prakasam District of Andhra Pradesh

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ABSTRACT

The present investigation was carried out in Prakasham District of Andhra Pradesh. Total 30 Front line demonstrations were conducted during 2013-14 in Kharif season in three villages (Cumbum, Bestavaripeta and Pusalapadu) of 3 mandals. During this year 12 hectares under redgram were demonstrated with best management practices using high yielding varieties. Ninety farmers were closely associated with redgram demonstrations (10 demonstration farmers and 20 other farmers from each village). The results of demonstrations showed that farmers could increase the redgram productivity notably by switching over to improved variety and adoption of improved production technology. There was an yield increase of 26.67 per cent, decreased cost of cultivation of 30.77 per cent and increased net returns of 38.86 percent in demonstration plots over control plots. The CB ratio recorded in demo units was 1: 3.7 over 1:1.25 in farmers practice. Regarding the effect of FLDs on adoption of demonstrated practices almost sixty percent (56.67%) of the farmers not adopted recommended High Yielding variety before conducting demonstrations whereas more than eighty percent of them have adopted LRG 41 variety after demonstration. With respect to seed treatment great majority (91.11%) have not adopted seed treatment, but after seeing the results almost seventy seven percent of them were adopting seed treatment. Cent percent of the farmers were not using neem oil as a prophylactic spray previously but sixty one per cent of them were adopting neem oil spray as prophylactic against Maruka after conducting demonstrations. Regarding need based pest and disease management 84.00 per cent of the farmers were going for indiscriminate sprays before organizing demonstrations, but sixty eight percent of them switched over to need based sprays after noticing the results in demonstrated plots. Majority of the redgram framers expressed production constraints like flower drop due to continuous dry spell (87.77%), poor seed quality supplied by Govt. agencies (84.44%), severe incidence of *Maruca*, Spodoptera and pod fly (80.00%),increased cost of cultivation (73.33%), severe wilt problem (67.78%) and non availability of drought tolerant varieties (51.11%)

Redgram in India is the most important pulse crop which is cultivated in the gross cropped area (3.58 million ha) under pulses providing 20% of the national pulse production. This accounts for 90% of the worlds Redgram production (Nene and Sheila, 1990 and Niranjan *et al.*,1996).The production and productivity of Redgram in our country are 31.58 lakh tonnes and 7.6 q/ha, respectively. In India, Redgram ranks second i.e. next to chickpea among important pulse crops. Redgram is of dietary importance with a seed protein content more than that of other important grain legumes (Nene and Sheila, 1990). India alone accounted for about 81 percent of total world's production in the year 2002 and 90 percent of total world's consumption of Red gram. The total pulse production of the country was 11.08 million tonnes in 2000-01 including Red gram (2.25 million tonnes) (Annual report 2001-02).

In addition to being an important source of human food and animal feed, Redgram also plays an important role in sustaining soil fertility by improving physical properties of soil and fixing atmospheric nitrogen. Being a drought resistant crop, it is suitable for dry land farming and predominantly used as an intercrop with other crops. Redgram is one of the most important legumes grown in Andhra Pradesh with an area of 1.46 lakh ha, 0.85 lakh tonnes production and 585 kg/ha productivity. It is largely grown in Prakasam district of Andhra Pradesh in an area of 55,891 ha. predominantly under rainfed cropping situation. The pulse production in the country can be sustained through productivity growth. The productivity can be increased with the increase of the level of knowledge and adoption of recommended technology. In this context, Front Line Demonstrations (FLDs) and trainings on recommended Redgram production technology were being implemented by Krishi Vigyan Kendra (KVK), Darsi in Prakasam district for the year 2013-14 with the twin objectives of minimizing productivity with maximized adoption levels of critical interventions. With this background in view, to know the effect of FLDs and trainings on productivity and adoption levels of farmers, this particular study was taken up with the following specific objectives.

1. To analyze the effect of Front Line Demonstrations on productivity enhancement
2. To analyze the effect of Front Line Demonstrations on adoption levels of farmers
3. To elicit constraints of farmers in redgram production

Material and Methods

The present study was conducted during 2014 in Prakasam district of Andhra Pradesh three villages namely Viz., Tarlupadu, Cumbum, and Pusalapadu were purposively selected as Redgram FLDs were organized in these areas. From each of selected village 10 FLD farmers and 20 other farmers who regularly participated in demonstrations and trainings were selected to represent the group. Thus a total of 90 Redgram farmers were selected for the study purpose. Economic effect of the FLDs was studied in terms of yield increase, decreased cost of cultivation, increased net returns and CB ratio over control. To analyze the effect of FLDs on adoption levels five critical interventions viz., recommended variety, seed treatment, timely fertilizers, neem oil as prophylactic spray for Maruca and need based pest and disease management demonstrated were considered. Adoption was operationalized for the purpose of investigation as practicing the recommended production technology by the respondents. The data on adoption levels were collected from the sample of Redgram farmers through personal interview technique by using the pre-tested schedule before and after organizing FLDs. To analyze the constraints faced by Redgram farmers, open ended questions were used and based on the frequency and percentages major constraints were identified.

Results and Discussion

Details of the critical interventions demonstrated trough FLDs

From Table 1 & 2 it could be inferred that using High Yielding Variety (LRG 41), seed treatment (with 10 gm Trichoderma viride/kg seed), timely fertilizer management (1 DAP bag as basal per 0.4 ha), neem oil as a prophylactic spray (1lt/0.4 ha) and need based pest and disease management were the critical interventions and critical inputs given through Front Line Demonstrations after analyzing adoption gaps in redgram production technology. Thirty FLDs were carried out (10 FLDs in each village). The area of demonstration was 0.4ha and critical inputs were given to the demo farmers.

Details of the extension activities organized

Two training programmes and two field days at critical stages of crop growth viz., one at vegetative phase and another at flowering stages of the redgram were organized to gain the confidence of the farmers. Leaflets on redgram production technology were distributed to the farmers participated in training programmes and field days.

Economics of Demonstration and control Plots

The results of the demonstrations in terms of productivity, cost of cultivation, net returns and CB ratios were presented in Table 4. It is evident from the results there was an average productivity enhancement of 26.67 per cent in demo plots over control. With respect to cost of cultivation 30.77 per cent decrease was recorded over control plots. There was an average increase of 38.86 per cent in terms of net returns in FLD plots over control. The CB ratio was 1:3.7 in demo units where as it was 1:2.5 in control plots. The major reasons for productivity enhancement were using High yielding Variety and timely fertilizer management. Regarding the decreased cost of cultivation seed treatment, prophylactic neem oil spray and need based pest and disease management were the major factors contributed. The results were in conformity with Tripati *et.al.*(2015).

Effect of Front line demonstrations on adoption of critical interventions

From table 5 it could be inferred that there was a considerable variation in adoption of critical interventions demonstrated before and after organizing FLDs. Regarding adoption of High Yielding Variety almost sixty (56.67%) per cent of the farmers were not adopting previously, but eighty one per cent of them switched over to LRG 41 variety after organizing FLDs. This is majorly because of the confidence gain in terms of yield potential of the variety among the farmers. Seed treatment was the another aspect where very meager per cent (8.89%) of the farmers were adopting previously, but with the positive result in terms of tolerance to wilt disease more than three fourth (76.67%) were adopting seed treatment after conducting demonstrations. As Redgram was cultivated in red soils under rainfed situation majority (75.56%) of the farmers were not interested in timely fertilizer management but after noticing the yield enhancement more than sixty per cent (64.44%) of the farmers were convinced and adopting recommended fertilizer at right time. Cent per cent of the farmers were not using neem oil spray as prophylactic against Maruka previously but after observing its effectiveness in demonstrations more than sixty per cent (61.11%) of the farmers were spraying neem oil at bud initiation and flowering stages. Great majority of the farmers (84.44%) were going for indiscriminate sprayings previously but 67.67 per cent of them were convinced with need based pest and disease management and adopting.

Production Constraints encountered by Redgram Farmers

It is evident from the table 6 that majority of the farmers expressed that flower drop due continuous dry spells (87.77%), poor seed quality supplied by Govt. agencies (84.44%), severe incidence of *Maruca*, Spodoptera and pod fly (80.00%), increased cost of fertilizers and pesticides (73.33%), severe wilt problem (58.00%) and non availability of drought tolerant varieties (51.11%) were the major constraints in redgram production. Similar constraints were reported by Singh *et al*,2007.

The critical interventions demonstrated were found to be the main reason for increase in the yield of redgram and thus it can be said that FLDs were the most successful tools for transfer of technology. The concept of front line demonstration may beapplied to all farmer categories including progressive farmers for speedy and wider dissemination of the recommended practices to other members of the farming community so the front line demonstration (FLDs) plays a very important role to disseminate recommended technologies because it shows the potential of technologies resulting in an increase in yield at farmers' level.

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Table 1 Details of the demonstrations organized

Crop	Variety	Farming situation	Area covered(ha)	Number of the farmers	Critical inputs given
Redgram	LRG 41	Red soils, rainfed	12	30	1. Seed (LRG 41) 2. Seed treatment chemical (Trichoderma viride) 3. Fertilizer (DAP) 4. Neem oil 5. Dichlorovos 6. Novoluran

Table 2. Details of critical interventions demonstrated in the frontline demonstrations (FLDs) vs.Farmers practice (FP).

S.No	Package of practices	FLDs	FP
1	Seed	LRG 41	Local
2	Seed treatment	Treated seed with *Trichoderma viride* 10gm/kg seed	No seed treatment
3	Fertilizer	1 DAP bag per 0.4 ha as basal	No fertilizer as basal
4	Neem oil	As a prophylactic spray for maruca	No prophylactic spray
5	Pest and disease management	Need based sprays	Indiscriminate use of chemicals

Table 3. Details of Extension Activities organized

S.No	Extension Activity	No. of programmes	No. of participants	Title/details of the programmes/crops
1	Training programmes	2	30	Production technologies in Red gram
			30	Integrated Pest & disease management in Red gram
2	Field Days	2	58 59	Demonstration of HYV LRG 41
3	Literature distributed			Distributed leaflets developed on Red gram production technology during trainings and field days

Table 4. Economics of Demonstration and control Plots

	Yields q/ha	% increase in yield over local check	Cost of cultivation per ha. (Rs)	% decrease in cost of cultivation over local check	Net returns (Rs)	% increase in net returns over local check	CB ratio
Demonstration	18.75	26.67	11250	30.77	65625	38.86	1:3.7
Control	13.75		16250		40125		1:2.5

Table 5. Effect of Front line demonstrations on adoption of critical interventions

N=90

Recommended technology	Before				After			
	Adopted		Not adopted		Adopted		Not adopted	
	Frq	%	Frq	%	Frq	%	Frq	%
Recommended variety	39	43.33	51	56.67	73	81.11	17	18.88
Seed treatment	8	8.89	82	91.11	69	76.67	21	23.33
Timely fertilizers	22	24.44	68	75.56	58	64.44	32	35.56
Using neem oil	0	0.00	90	100.00	55	61.11	35	38.89
Need based pesticide use	14	15.56	76	84.44	61	67.78	29	32.22

Table 6. Production Constraints encountered by Redgram Farmers

N=90

Sl. No	Constraint	Frequency	Per cent
1.	Flower drop due continuous dry spells	79	87.77
2.	Poor seed quality supplied by Govt. agencies	76	84.44
3.	Severe incidence of *Maruca*, Spodoptera and pod fly	72	80.00
4.	Increased cost of fertilizers and pesticides	66	73.33
5.	Severe wilt problem	53	58.00
6.	Non availability of drought tolerant varieties	46	51.11

Sustainable Agriculture &Livelihood Diversification: A Case of Mushroom Farming in Bihar

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Abstract

Mushroom cultivation has been identified as one of the important livelihood strategy that fits in very well with sustainable farming. This has several advantages, for example, it uses agricultural waste products, it works like quick cash crop with no use of land, a high production per surface area can be obtained, after picking, the spent substrate is still a good soil conditioner.*JEEViKA*–a Bihar Rural Livelihoods Promotion Society (BRLPS) sponsored by the State Rural Livelihoods Mission (SRLM) - with the objective of enhancing the social and economic empowerment of the poorest of the poor (PoP), especially through microfinance among women, provides a compelling case to understand the impact of livelihood intervention of mushroom farming. The study also delineates the production economics of the mushroom cultivation in the survey villages.

A study was also conducted at three villages in Nalanda district in the state of Bihar to identify the determinants and constraints to livelihood diversification as well. The study has shown that educational level, asset position, access to credit, and, rural infrastructure, are some important driving force towards livelihood diversification in the region. The resource-poor are particularly vulnerable and unable to diversify because of the entry barriers imposed by their weak asset base.

Acknowledgements

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Introduction

Being a good cash crop, mushroom cultivation has emerged as one of the viable alternative in the recent times, especially among landless, as it can help to reduce vulnerability to poverty and strengthens livelihoods through the generation of a fast yielding, and nutritious source of food and a reliable source of income. It does not require access to land; not any significant capital investment as substrate can be prepared from any clean agricultural waste material; can be produced in temporary clean shelters; can be cultivated on a part-time basis, and require little maintenance (Marshall and Nair, 2009).Bihar,being one of the poorest and most populous States in India, is 12thlargest in terms of geographical coverage (2.8% of the total land area) and 3rdlargest by population (8% of the total population of the country). The state with lowest per capita income, highest population density, and low nutritional security among Indian states is struggling to get out of the low income equilibrium trap. The state is largely rural, with almost 90% of habitation, and poor, with more than 30% total population. Furthermore, more than 90% of the farming population is marginal with a holding of less than one hectare. As a consequence, when the horizontal expansion of agricultural production difficult to attain, one of essential means of raising rural incomes and improving nutritional security is through livelihood diversification. The human development indicators of health and education are way below the national average of developing India. Against this backdrop, the government of Bihar with the supportof the World Bank initiated*Jeevika* - Bihar Rural Livelihoods Project with the objective of enhancing the social and economic empowerment of the rural poor, especially through microfinance among women. In this regard, the mushroom cultivation through microfinance has emerged as a viable means of economic well-being for the farm and non-farm dependent populationcarrying poor balance sheet.

The present study has been conducted on SHGs members in three villages, viz. Sarilchak, Surajpur, and Anantpurof Nalanda district, Bihar. The overall objective of the study is to assess the viability of mushroom production through SHGs as an alternative means for the alleviation of rural poverty leading to inclusive growth. An attempt has been done to understand the determinants of livelihood diversification in the study area.The study is undertaken with specific objective like: to understand the factors that determine the level of diversification of the rural households in general? What are the various constraints to livelihood diversification? The study is an attempt to answer these questions. The study is organized as follows: starting with the brief overview of development narrative since few decades, a case of microfinance has been discussed. The mechanism of mushroom cultivation in the region has been contextualised in the sustainable livelihood framework in the next section. The censored regression model has been used to understand the issue of diversification discussed above. The subsequent section, drawing upon the field study, try to examine the case of livelihood diversification. The challenges, opportunities and policy implications are discussed in the concluding section.

Overview

The contemporary development narrative recognises the benefits of livelihoods thinking and approaches, including, for example, its stress on the importance people centred change, a holistic approach, people's access to different assets, poor people's vulnerability, partnerships, sustainability, change, and the multi-faceted nature of livelihoods.Following figure 1 delineates he key strands and switches in the rural development ideas since 1950s(Ellis and Biggs, 2001).

Figure 1: Evolution of Rural Development Ideas

1950s	**1960s**	**1970s**	**1980s**	**1990s**	**2000s**	**2010s**
Modernisation Dual economy model						
	Transformation Approach Technology Transfer Mechanisation Green Revolution (start)					
		Redistribution with growth Basic needs Integrated Rural Development State-led Agricultural Policies Urban Bias Induced Innovation Green Revolution (Continued) Rural Growth Linkages				
			Structural Adjustment Liberalisation, privatization 'getting prices right' Retreat of state Rise of NGOs Rapid rural appraisal (RRA) Farming system Research (FSR) Development as process and			

			not product Women in development Poverty alleviation			
				Microcredit Participatory rural appraisal (PRA) Safety nets Gender and Development Environment and Sustainability		
					Sustainable Livelihoods Good Governance Decentralization Critique of participation Millennium development goals (MDGs) Sustainable development goals (SDGs)	

Source: Ellis and Biggs (2001, p. 439), 2010s appended by author

Slightly modifying Anna Karenina principle of Leo Tolstoy, 'Rich households are alike; every poor household is poor in its own way', impliesthat the poverty and their livelihoods are heterogeneous and divergent in nature. The poor carries a weak balance sheets with no cash, no adequate collateral, no guaranteed income streams, are unlikely to have access to sources of finance. Using social capital, defined as “the collective value of all social networks (*who people know*), and the inclinations that arise from these networks to do things for each other (*norms of reciprocity*) (Sander, 2015),” as collateral, a number of initiatives on the part of state and non-state organizations have tried to strengthen the balance sheet of poor by lending to groups rather than to individuals. An important manifestation of social capital is the trust and norms of reciprocity people of a group or community have in each other, thereby minimising the problem of adverse selection on decision on loans and moral hazard of loan usage and repayment by peer monitoring, which any financial transaction faces. The poor organize themselves in groups and each participant accepts joint responsibility for the loan. Members of a group value their reputation within the group, as they will be chosen for valuable interaction or given discretionary power if they are deemed trustworthy or reliable. A well-known example is the Grameen Bank in Bangladesh, but similar institutions exist in several developing countries, including India.

Microfinance Modalities

Microfinance has worked as an intervention made necessary by the conditions of material deprivation of millions of people in the not so developed part of the world (Nair,2005).A comprehensive overview of institutions, incentive considerations, and empirical data in microfinance can be found in Armendáriz de Aghion and Morduch (2005).Further, the ideological construct to support poor women through microfinance as central to poverty reduction strategies across the developing world, have been due to public policy and business case (Ackerly, 1995). Women comprise majority of the rural population with high levels of male outmigration in developing countries, including India. Thus, targeting women borrowers makes sense from a public policy standpoint, and they uses the income to enhance the nutritional status of her family,educates her children and begins to participate in major family decisions (Garikipati, 2008). The business case for focusing on them is substantial, as they register higher repayment rates (UN, 2009; p.57).

The *JEEViKA* intervention was done in terms of formation and mobilization of self-help-groups (SHGs) for extending credit support and promotion of thrift to promote viable economic activities. An SHG, comprising of 10 to 20 homogenous people, in general, are encouraged to make voluntary thrift on a regular basis in pooled resources to make small interest bearing loans to their members. Once an SHG has demonstrated the commitment of its members to contribute regular savings, and the capacity to keep records of these finances, it becomes eligible for access to an initial capitalization fund of ₹50,000 for lending among its members. Additional interventions such as training in intensive farming and animal husbandry are also planned for targeted populations. The process helps them imbibe the essentials of financial intermediation including prioritization of needs, setting terms and condition, and account book-keeping. This gradually builds financial discipline in all of them in addition to handling resources of a size that is much beyond individual capacities of any of them:

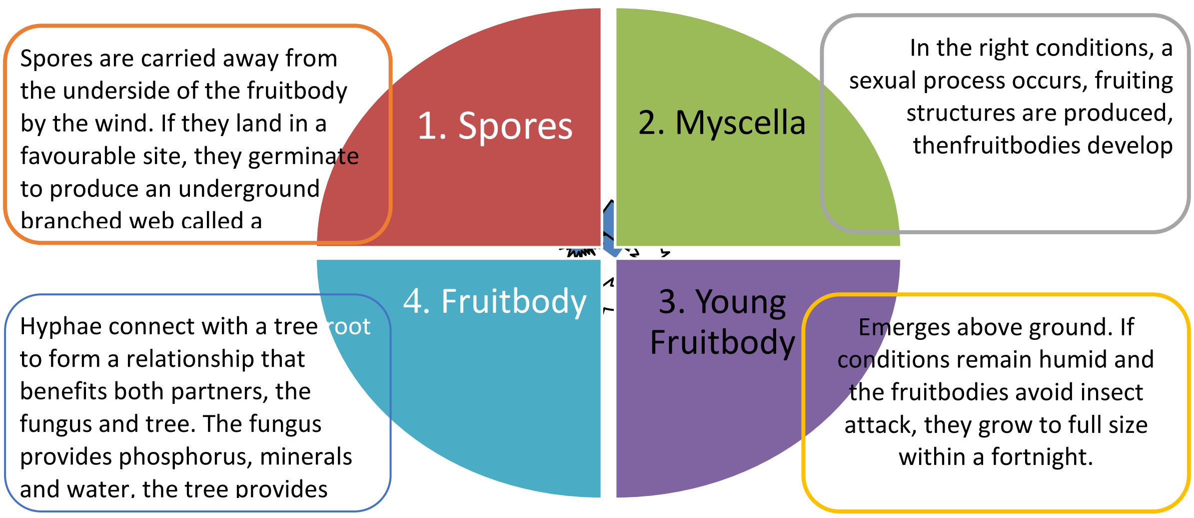
> The broader goal of the Micro-Finance intervention is to create an ambience of faith… and aimed at creating institutions of the poor who are empowered enough to run the institution on merits of financial prudence and sustainability.

Further, a broadening of income and livelihood strategies away from purely crop and livestock production towards both farm and non-farm activities to generate additional income has been considered desideratum (Hussein and Nelson, 1999). Putting this sort of diversification in the ‘livelihoods’ has broadened the concept to include “the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standard of living” (Ellis, 1998).Overall successful implementation of the *Jeevika*programme in mushroom cultivation among poor in the villages of Nalanda, Bihar, offers a compelling case to explore further.The study has been segmented as follows: the production mechanism of mushroom cultivation has been described with the life cycle. The key business processes involved are discussed thereafter. The sustainable livelihoods approach (SLA) framework are used to identify the entry points of livelihood intervention. The opportunities and challenges are identified in the concluding part of the study.

Mushroom Cultivation Mechanism

Mushrooms belong to the kingdom of Fungi. Fungi, unlike the leaves of green plants, which contain chlorophyll to absorb light energy for photosynthesis (the process by which plants convert carbon dioxide and water into organic chemicals), rely on other plant material (the substrate, the material in which the mycelium grows) absorbing nutrients from the organic material in which they live for their food.[18] The living body of the fungus is mycelium made out of a tiny web of threads (or filaments) called hyphae. These sexually compatible hyphae fuse to form spores under specific conditions. Released from the gills, spores germinate and develop to form hyphae. Hyphae are the main mode of vegetative growth in fungi, which are collectively referred to as mycelium. These feed, grow and ultimately produce mushrooms (Figure 2).

Figure2: Life Cycle of a Mushroom



Source: Marshall and Nair, 2009; p.10

The three basic sources of nutrients for mushrooms are:

1. **Saprobic**, grows on dead organic matter. Saprobic edible fungi can be wild harvested, but are most widely valued as a source of food and medicine in their cultivated forms. They need a constant supply of suitable organic matter to sustain production and, in the wild, this can be a limiting factor in production.
2. **Symbiotic**, grows in association with other organisms. The majority of wild edible fungi species (e.g. chanterelles - Cantharellus and Amanita species) are symbiotic and commonly form mycorrhizas with trees, where the fungus helps the tree gather water from a wider catchment and delivers nutrients from the soil that the tree cannot access and the tree provides the fungus with essential carbohydrates.

[18]Mycelium are the network of hyphae that form the vegetative body of the fungus. Mushrooms are the fruiting bodies of the mycelium.

3. **Pathogenic** or parasitic, plant pathogenic fungi cause diseases of plants and a small number of these microfungi are eaten in the form of infected host material.

Further, mushroom species can be cultivated in two ways:

1. **Composted substrates**: wheat and rice straw, corn cobs, hay, water hyacinth, composted manure, and various other agricultural by-products including coffee husks and banana leaves
2. **Woody substrates**: logs or sawdust.

Thus the key steps in mushroom production – a cycle that takes between one to three months from start to finish depending on species– to start with some mushroom spores, which grow into mycelium and expand into a mass sufficient in volume and stored up energy to support the final phase of the mushroom reproductive cycle, which is the formation of fruiting bodies or mushrooms.[19] The BRLPS intervention follows the cheapest cultivation system using composted substrate is one where mushrooms are grown in plastic bags (which can be sterilized and re-used with new substrate) containing substrate or compost, in a simple building to provide controlledgrowing conditions.

Step I: Making Mushroom Compost

The compost preparation usually occurs outdoors although an enclosed building or a structure with a roof over it may be used. A concrete hemisphere slab is required for composting. 40 ml of formalin added to one litre of water are used to pasteurization and sterilization.[20] After this fresh 45 litre water added, in a mixture consisting of 125 ML formalin, 4 Gram bevestin, 100 Gram processed lime (gypsum), and 10 kg of straw.Once the pile is wetted and formed, aerobic fermentation (composting) commences as a result of the growth and reproduction of microorganisms, which occur naturally in the bulk ingredients. Heat, ammonia, and carbon dioxide are released as by-products during this process.After 24 hours, this straw mixture dried completely in the sunlight.

Step II: Production

The next step is to put this dried straw into a 40 micron polythene bag of 1.5 kg bag capacity with 100 gm spawn (Latin expandere = to spread out, also called Mushroom seed) spread through system root intensification (SRI) methods at a distance of 2 inches. Once it is done tightly, it is pricked to take air.

Step III: Harvesting

The bags are kept in dark quarantined room for 20 days. It is important to maintain optimal temperature, moisture, hygiene and other conditions for mycelium growth and fruiting, which is the most challenging step. It is essential to maintain hygienic conditions over the general cropping area, in order to protect the crop from contamination.Between 20 to 23 days, fruits

[19]The mycelium will form mushrooms in its reproductive stage. This is called fruiting as the mushrooms are actually the fruiting bodies of the mycelium.

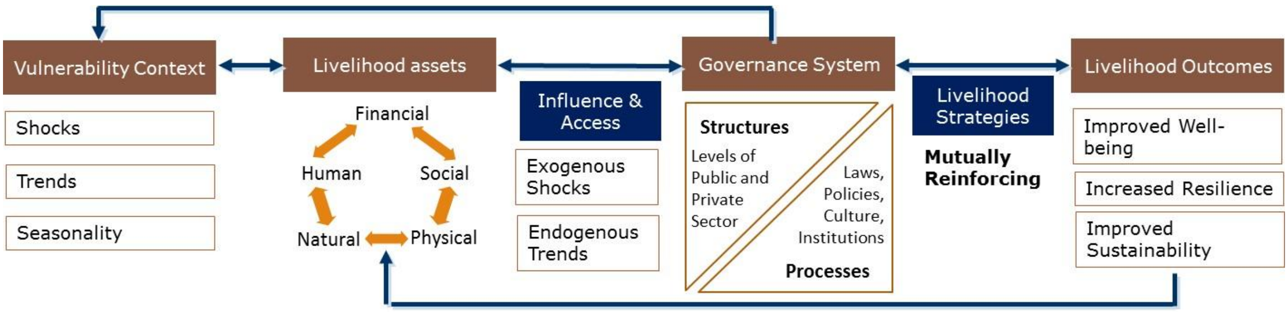
[20]A 30% solution of formaldehyde used to sterilise areas. The gasses kill living micro-organisms and spores.

can be cropped in three cropping method, first crop can be done on 25th day, second crop on 32nd day and third on 45th day.

Sustainable Livelihood Context

Drawing upon the idea of “Sustainable Livelihoods” with the intention to enhance the efficiency of development cooperation by Robert Chambers in the mid-1980s, the British Department for International Development (DFID) developed the Sustainable Livelihoods Approach (SLA) visualises five types of household assets – natural, social, financial, physical and human capital, as main factors of influence to understand the livelihoods of the poor (Figure 3).

Figure 3: Sustainable Livelihoods Framework (adapted from DFID framework), *DFID, 1999*.



Key assets or resources associated with mushroom cultivation are described below.

Natural assets: Due to minimal role of land and climate in the mushroom cultivation, thelivelihood enterprise is suitable for farmers with limited land, as well as the landless.Access to sufficient, suitable and locally-sourced substrate and spores are key determinants of successful and sustainable mushroom cultivation. The agricultural by-products, used as substrate, are available easily and cheaply. A sterilized composted substrate once inoculated with spawn, can be used for three harvests and then recycled by incorporating it as an organic mulch or fertilizer in other horticultural or agricultural systems, which can improve soil structure, or it can be used as a nutritious fodder for the backyard poultry practiced in the region.[21]

Social assets: The formation of social capital through JEEViKA help people meet to their livelihood objectives,including networks and support from families, friends, organizations and membership of SHG groups. Thesocial capital strengthen the individual by helping them and their communities access information and resources including technical information, basic training, sources of mushroom spores, and marketing outlets to sell their crop.As a result of the high perishability of mushrooms, it can be of great benefit, for small-scalecultivators selling their crop, to be organized with other growers and to share transport costs, market contacts, etc. In addition, working in collaboration with other growers may enable cultivators to establish local production, processing, or packaging facilities to increase harvest output or product shelf-life i.e. a drying facility. Mushroom cultivation represents a

[21]Inoculation helps in transferring an organism into a specific substrate.

very suitable and empowering income generating option for women in particular, because it can be combined with traditional domestic duties and can be undertaken at home. Several programmes related to rural mushroom production have given women the opportunity togain financial independence, farming skills and higher self-esteem.

Human assets: Human assets relate to the skills, knowledge, ability to work and level of health that people need to pursue different livelihood strategies and to achieve their objectives. Being non-labour intensive, mushrooms can be undertaken as an additional livelihood activity which fits around other household or productive tasks. Qualities identified as being useful for mushroom cultivators include the ability to carry out operations on time, be attentive to detail, be vigilant about pest invasions, and for marketing, excellent skills in public relations.

Physical assets: Many of the physical assets required to undertake mushroom cultivation are not exclusive items, but rather assets which help meet livelihood needs in general, including the transport and communication infrastructure,clean water, a source of energy, and buildings for shelter and storage. Mushrooms are best cultivated indoors in a dark, cool and sterilized and enclosed building.This enables the growing conditions to be maintained most suitable for mushrooms, in terms of temperature, humidity, uniform ventilation and substrate moisture levels. Unwanted contaminants, moulds and sunlight can also be kept away from the crop. Any small room withventilation and a cement floor can be used. The interior should be arranged so that it is easy to clean at the end of each cropping cycle. The mushroom house should be well insulated (by using, for example, fibre glass wool or expanded polystyrene) to maintain a steady temperature, and concrete or clay tiles are preferable over corrugated metal for roofing.

Financial assets: Mushroom cultivation is attractive for the resource-poor for two reasons. Firstly, because mushroom cultivation can be done on any scale, the initial financial outlay to establish a basic cultivation systemneed not be very great, and substrate materials are often free. An example from village illustrates the point: a mushroom house of area 100 sq. feet is large enough to hold 100 mushroom bags with a yield of 3-4 kg per day could cost less than ₹200, utilising the materials available locally. Secondly, compared to many agricultural and horticultural crops, mushroom production systems have a short turn around; a harvestable crop can be produced and sold within two tofour months, which is very helpful for small-scale producers.

Illustrative Production Economics of Mushroom Cultivation in the Region

Mushroom Cultivation has provided an important stepping stone in improving livelihood security in the region. The poor cultivators have added value to the product innovation, like dry mushroom, mushroom pickles, mushroom jelly, mushroom powder, and so on. They have added few more recipes to their kitchen, like, Mushroom Halwa, Mushroom Pooaa, and so on. We try to understand the production economics on average of the Mushroom cultivation in the region (Table 1).

Table 1: ProductionEconomics

Spawn Production

Particulars	Description
1. Capacity	**250 kg/month**
2. Rate	**₹80/kg**
3. Income	**₹20,000/month**
4. Cost of Inputs	**₹10,000/month**
5. Net Profit	**₹10,000/month**

Mushroom Production

Particulars	Description
1. Capacity	**100 Bags/100 Sq. Ft.**
2. Yield	**3 kg/day**
3. Cost of Cultivation	**₹100**
4. Income	**₹300/Day**
5. Net Profit	**₹200**

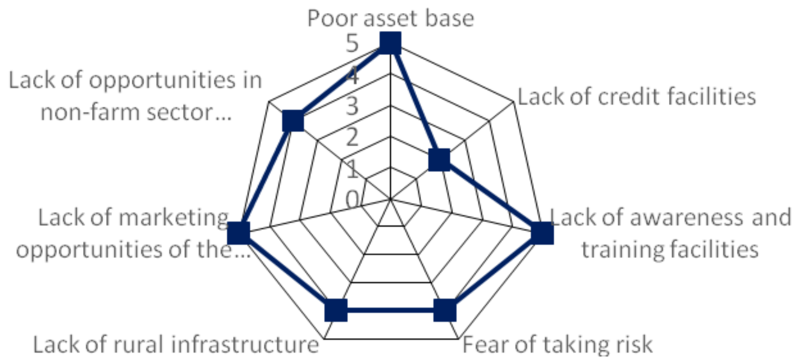
Table 2: Mushroom Product Innovation

Products	Amount	Rate (₹)	Income (₹)	Cost of Inputs (₹)	Net Profit (₹)
Dry Mushroom	**20kg/year**	**1,000/kg**	**20,000**	**12,000**	**8,000**
Mushroom Pickle	**50kg/year**	**300/kg**	**15,000**	**10,000**	**5,000**
Mushroom Jelly	**50kg/year**	**200/kg**	**10,000**	**6,000**	**4,000**
Mushroom Powder	**10kg/year**	**1,000/kg**	**10,000**	**6,000**	**4,000**
Additional Income through Value Addition			**55,000**	**34,000**	**21,000**

Constraints to Mushroom Cultivation

Mushroom Cultivation is an important livelihood strategy for the rural households in the region. However, there are several constraints identified, especially, socio-economic, technological,institutional and policy constraints to Mushroom Cultivation. The major constraints to were: poor asset base, lack of credit facilities, lack of awareness and training facilities, fear of taking risk, lack of rural infrastructure, lack of marketing opportunities of the product, and lack of opportunities in non-farm sector diversification.

Figure 3: Constraints to Mushroom Cultivation



Mushroom cultivation among rural poor-because the units are small-will not generate a huge income. However, it can make a valuable contribution to sustainable livelihoods for them, because they are highly compatible with other livelihood activities, requiring minimal physical and financial inputs and resources.

Study Sites, Data and Methodology

The study was based on collaboration with *JEEViKA* in Nalanda district, Bihar. The three villages, viz. Anantpur (Chandi Block), Surajpur and Sarilchak (Both of Silao Block), are chosen purposively for twin reasons, one,these villages had strong SHGs presence, thanks to the Jeevika intervention and support, and two, the villages have adopted cash crop of mushroom cultivation as one of the dominant livelihood strategy.

Definitions

Livelihood diversification –Livelihood diversification, different from income diversification, can be defined as `the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living'(Ellis, 1997, p5). The diversification can take place through both agricultural diversification i.e., production of multiple crops or high-value crops; and non-agricultural livelihood diversification i.e., undertaking small enterprises, or choosing nonagricultural sources of livelihood like casual labour or migration.

Livelihood diversification index – There are various indicators, and indices are there to measure livelihood diversification like number of income sources and their share, Simpson index, Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite Entropy index (Shiyani and Pandya, 1998), etc. In this study Simpson index is used because of its computational simplicity, robustness and wider applicability. The Simpson index (SI) is:$SI = 1 - \sum_{i=1}^{N} P_i^2$where, N is the total number of income sources and Pi represents income proportion of the i-th income source. Its value lies between 0 and 1. The value of the index is zero when there is a complete specialization and approaches one as the level of diversification increases.

Tobit Analysis

As dependent variable constructed takes value between 0 and 1 or in other words, censored, thus the ordinary least squares (OLS) estimate may be biased and inconsistent (Wooldridge, 2003). To identify the major drivers of livelihood diversification, we use latent dependent variable model also called censored regression model proposed by James Tobin (1958). The structure of the model believes that there is unobservable variable and the values of the sample are testifying at a certain threshold instead of at the actual values. The vector of the independent variables determines the latent variable and normally distributed error term is there to capture the impact of this association.

$$Y_i = \alpha + \beta' X_i + \epsilon_t$$

And observable variable comply with

$$Y = Y^*, if\ Y^* > A$$

$$Y = \mathrm{A}, if\ Y^* \leq A$$

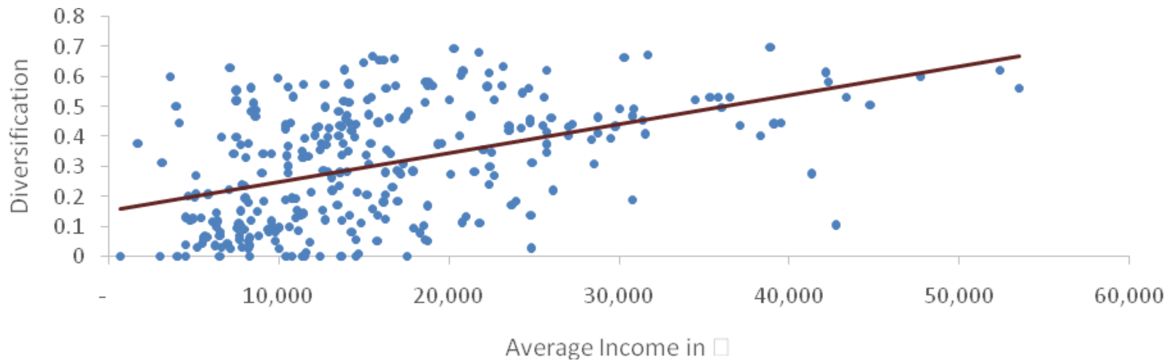
for certain threshold A.

Where, Y_i is a latent variable implying the livelihood diversity of ith observation, vector of estimated coefficients and $\beta' X_i$ independent variables and ϵ_i is an error term which is assumed to be $\epsilon_i \sim IID(0, \sigma^2)$. The latent variable Y^* would take value minimum if the diversity is lowest and else maximum if diversity is increasing.

Results and Discussion

A scatter plot between diversity index and per capita income shows a positive association between the two and validates Ellis' (1997) proposition (Figure 3).

Figure 3: Average Income vis-à-vis Extent of Diversification



The main livelihood groups, their level of livelihood diversification and contribution of different sources of income in the study area are given in Table 1.

Table 1: Level of Livelihood Diversification and Per Capita Income

Village	Indicator	Farm	Non-Farm	Causal Labourer	Petty Business	Salaried
Anantpur		**0.35**	**0.13**	**0.24**	**-**	**0.48**
Sarilchak	**Diversity Index**	**0.36**	**0.44**	**0.24**	**0.37**	**0.39**
Surajpur		**0.29**	**0.27**	**0.25**	**0.40**	**0.31**
Overall		**0.34**	**0.32**	**0.25**	**0.39**	**0.36**
Anantpur		**20,859**	**21,000**	**11,706**	**-**	**21,942**
Sarilchak	**Per Capita Income**	**19,645**	**14,241**	**16,400**	**18,545**	**15,170**
Surajpur		**29,071**	**18,455**	**13,919**	**25,277**	**19,395**
Overall		**22,120**	**17,203**	**14,782**	**21,490**	**18,107**

The above table 1 shows the level of diversification is highest for salaried group as well as farm group at overall, and it is less diversified for the labourer groups. This may be due torelatively stronger asset base among salaried and farmgroups. Resource-poor households, on the other hand, lack assets, skill and education which hinder them from engaging in remunerative activities, which forced them to diversify in low-return activities for survival. It, however, varies across the villages.

Tobit Results

The results of Tobit regression estimates are presented in Table 2. The likelihood ratio chi-square of 24.19 (df=7) with a p-value of 0.001 tells us that our model as a whole fits significantly better than an empty model (i.e., a model with no predictors). All the estimated coefficients, except per capita land availability, have the expected signs and are statistically significant.

Table 2: Determinants of Livelihood Diversification

	Coefficient	Std. Err.	t-stat	P>t

Intercept	0.083413	0.054395	1.53	0.126
Mobility	0.146159	0.074417	1.96	0.05
PeccaHousehold	0.036757	0.026346	1.40	0.164
Education	0.014358	0.010344	1.39	0.166
Dependency Ratio	0.012512	0.011185	1.12	0.264
Per Capita Income	1.68E-06	7.51E-07	2.23	0.026
Borrowing	0.013529	0.005112	2.65	0.009
Per Capita Land	-0.00128	0.001731	-0.74	0.46
LR chi2(5)	24.19			
Prob> chi2	0.001			

We hypothesized that the livelihood diversification index is a function of a set of factorsthat included following variables in the model: mobility medium (vehicle in the house as proxy for mobility), pecca household, education, per capita income, dependency ratio, per capita land, and borrowing. The region lacking basic mobility infrastructure, vehicle, including bicycle in the house is considered as one of the important component for the livelihood enhancement as it increases the access to wider network. The education level is important determinant for livelihood diversification as it creates an entry point to non-farm sector. Similarly, the availability of pecca household, per capita income, and per capita landcan constitute household asset base. This offers a store of wealth as well provide opportunities to invest in alternative livelihoods and show a positive association. The lack of these may provide entry barrier for resource poor household to diversify. However, the negative and statistically insignificant association of per capita land and livelihood diversification shows a decrease in its value creates overpressure on land which in turn results very low or zero marginal productivities, and so disguised unemployment. As a consequence, this surplus labourare finding jobs in the non-farm sector.The dependency ratio, percentage of non-working population, has positive influence on the livelihood as this this improves the ability to meet household needs. The positive association of borrowing with livelihood diversification shows that since resource-base is very poor for most of the households, providing credit to households will improve their livelihood.

Way Forward

In the case of mushroom cultivation, since the basic skills required in growing medicinal mushrooms are the same as those for growing edible mushrooms, growers can diversify from growing edible mushrooms to producing mushrooms with medicinal values. Another diversification option may be to integrate mushroom cultivation with other livelihood activities practiced in the region, for example, the spent mushroom substrate acts as organic mulch in growing other horticultural crops, e.g. vegetables, and protein supplier to backyard poultry farming. This may result in not only diversification for securing additional income but also in recycling the organic waste created from mushroomcultivation. The recycling process makes this sustainable farming.Furthermore, the mushroom farmers have mainstreamed mushroom produce in their food consumption basket with wonderful indigenous recipes, like Mushroom Pickles, Child Mushroom food, and so on.

However, they need organizational strength to manage post-harvest storage and obtain the best prices. The economies of scope and the scale improves their overall strategy. A way forward is setting up member-based Producer Organisations (POs), which can leverage bargaining power to access financial and non-financial inputs and services and appropriate technologies, reduce transaction costs, tap high-value markets, and help the members to move further up the value chain, entering into post-harvest management. Direct retailing, value-added services, storage and processing, and engaging in contract production of primary agricultural produce.

Summary and Policy Implication

Opportunities

The mushroom cultivation, being tradeable goods and of high nutritional contents, provide quick cash and so strengthen livelihood security for the poor. A good understanding of the mushroom cultivation, however, whether based on local knowledge or acquired through external support, allows cultivators to provide consistent and predictable quantities and qualities of mushrooms, thereby attracting buyers more easily.

Challenges

One of the most important aspects of growing mushrooms by subsistence farmers for commercial purposes is the ability to maintain a continuous supply for chosen market outlets. This *per se* is labour and management intensive, given the fact that mushroom production systems, to some extent, are vulnerable to sporadic yields, invasions of ‘weed’ fungi, insect pests, and unreliable market prices for traded goods.Formation of cooperative or community groups can help in streamline production costs, harvesting and marketing, and reducing vulnerabilities and risks. Public orientation can also drive demand.Marketing information, business and entrepreneurial skills, training on cultivation and processing, productivity challenges

Policy Implications

From the public policy point of view, the provision of public goods, such as roads, electricity, telecommunication, rural markets, can be considered as eco-system to enable small-scale producers to improve their livelihoods. Public investments therefore highly desirable, which have an impact on people’s capabilities to carry out livelihood activities. As their capabilities increase, so does efficiency, while costs, risks andvulnerability reduce.

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Constraints Hindering the Adoption of Scientific Dairy Farming Practices by Members and Non-Members of Dairy Co-operative Societies (DCS) /Milk Producer Institutions (MPI)

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ABSTRACT

The present study was conducted in four districts of newly formed Telangana State viz. Karimnagar, Warangal Urban, Siricilla and Jagtial with 120 respondents in which 60 were members and other 60 were non-members of DCSs/MPIs. Constraints perceived in dairy farming and suggestions elicited by members and non-members were noted, tabulated and analysed. The major constraints perceived by half or more than half of members were scarcity of water (91.67%), lack of green fodder (88.33%), preferring Natural Service than Artificial Insemination (83.33%), negligence in feeding pregnant and dry animals (81.37%), insufficient loan amount (78.33%), tendency to feed only grass and brans (71.67%), lack of availability of sufficient labour (70.00%), lack of remunerative price for milk (66.67%), high cost of feed (61.67%), lack of fodder conservation (55.00%) and high cost of animals (50.00%) whereas major constraints perceived by non-members were scarcity of water (96.67%), lack of green fodder (93.33%), preferring Natural Service than Artificial Insemination (88.33%), lack of availability of sufficient labour (85.00%), negligence in feeding pregnant and dry animals (83.33%), tendency to feed only grass and brans (78.33%), high cost of animals (75.00%), complex procedure for obtaining loans (71.67%) and high cost of feed (66.67%). Suggestions elicited by members majorly were providing subsidy for purchase of animals/providing loans on par with the cost of animal (81.67%), enhancing the procurement price (70.00%), providing more incentives (60.00%), encouraging calf rearing (58.33%) conducting frequent animal health camps (50.00%) whereas in case of non-members they were conducting frequent animal health camps (68.33%) and providing subsidy on purchase of animals/providing loans on par with the cost of animal (58.33%). Considering the above constraints and taking help of the suggestions elicited by dairy farmers a proper linkage strategy should be developed between private and public sectors in providing services based on needs of the dairy farmers.

Key words: *constraints, suggestions, dairy co-operative societies, milk producer institutions, members, non-members.*

INTRODUCTION

India ranks first in terms of milk production and bovine population in the world. Dairy is providing livelihood to 60 million rural households in India. Milk production in country is lesser than the milk and protein demand. Milk productivity is very low in the country. Constraints perceived and facing by dairy farmers hindering the adoption of improved scientific dairy farming practices which in turn hindering the milk production and productivity. Thus livelihood of dairy farmers is also affected. Various services provided by DCSs/MPIs to their members like input services, market access, veterinary aid etc. made the members more advantageous than non-members. Constraints perceived not only by non-members but also by members hinders the adoption of improved scientific dairy farming practices. The present study was conducted to analyse the constraints perceived by both members and non-members and suggestions elicited to overcome the constraints.

METHODOLOGY

The study was conducted in Karimnagar, Warangal Urban, Siricilla and Jagtial districts of Telangana State. One mandal from each district was randomly selected and from each mandal three villages were selected based on their milk procurement (one low, one medium and one high). From each village 5 members and 5 non-members were selected randomly). Thus a total sample of 120 was obtained with 60 members and 60 non-members. An interview schedule was prepared and pretested in non sample area. Data was collected, statistically analysed and interpreted.

RESULTS AND DISCUSSION

Table 1: Constraints perceived by members and non-members

S.No	Constraints	Members			Non-members		
		F	%	Rank	F	%	Rank
1	Lack of remunerative price for milk	40	66.67	VIII	15	25.00	XIII
2	Lack of veterinary aid	7	11.67	XIX	21	35.00	XI
3	Irregular supply of feed	-	-	-	7	11.37	XVII
4	Untimely/lack of supply of fodder slips/seeds	8	13.33	XVIII	14	23.33	XIV
5	Scarcity of water	55	91.67	I	58	96.67	I
6	Lack of incentives	13	21.67	XV	-	-	-
7	Lack of training	11	18.33	XVI	18	30.00	XII
8	High cost of medicines	19	31.67	XII	3	5.00	XX
9	High cost of animals	30	50.00	XI	45	75.00	VII
10	High cost of feed	37	61.67	IX	40	66.67	IX
11	Complex procedure for obtaining loan	16	26.67	XIII	43	71.67	VIII
12	Unfriendly repayment schedule	14	23.33	XIV	4	6.67	XIX
13	High rate of interest on loans	-	-	-	6	10.00	XVIII
14	Negligence in feeding pregnant and dry animals	49	81.37	IV	50	83.33	V
15	Preferring NS (Natural Service) than AI (Artificial insemination)	50	83.33	III	53	88.33	III
16	Tendency to feed only grass and brans	43	71.67	VI	47	78.33	VI
17	Lack of green fodder	53	88.33	II	56	93.33	II
18	Distant location of milk collection center	-	-	-	1	1.67	XXI
19	Interference of politics in DCSs/MPIs	5	8.33	XX	-	-	-
20	Lack of fodder conservation	33	55.00	X	25	41.67	X
21	Preferring growing cash crops than green fodder	10	16.67	XVII	12	20.00	XV
22	Indiscriminate usage of pure semen	4	6.67	XXI	-	-	-
23	Lack of availability of sufficient labour	42	70.00	VII	51	85.00	IV

24	Insufficient loan amount	47	78.33	V	8	13.33	XVI

From the Table 1 it could be noticed that constraints perceived by the members were in the rank order of scarcity of water (91.67%), lack of green fodder (88.33%), preferring NS than AI (83.33%), negligence in feeding pregnant and dry animals (81.37%), insufficient loan amount (78.33%), tendency to feed only grass and brans (71.67%), lack of availability of sufficient labour (70.00%), lack of remunerative price for milk (66.67%), high cost of feed (61.67%), lack of fodder conservation (55.00%), high cost of animals (50.00%), high cost of medicines (31.67%), complex procedure for obtaining loan (26.67%), unfriendly repayment schedule (23.33%), lack of incentives (21.67%), lack of training (18.33%), preferring growing cash crops than green fodder (16.67%), untimely/lack of supply of fodder slips/seeds (13.33%), lack of veterinary aid (11.67%), interference of politics in DCSs/MPIs (8.33%) and indiscriminate usage of pure semen (6.67%).

In non-members perception of constraints were in descending trend of scarcity of water (96.67%), lack of green fodder (93.33%), preferring NS than AI (88.33%), lack of availability of sufficient labour (85.00%), negligence in feeding pregnant and dry animals (83.33%), tendency to feed only grass and brans (78.33%), high cost of animals (75.00%), complex procedure for obtaining loans (71.67%), high cost of feed (66.67%), lack of fodder conservation (41.67%), lack of veterinary aid (35.00%), lack of training (30.00%), lack of remunerative price for milk (25.00%), untimely/lack of supply of fodder slips (23.33%), preferring growing of cash crops than green fodder (20.00%), insufficient loan amount (13.33%), irregular supply of feed (11.37%), high rate of interest on loans (10.00%), unfriendly repayment schedule (6.67%), high cost of medicines (5.00%) and distant location of milk collection center (1.67%).

Similar findings were obtained by Malivad *et al.* (2016), Bharwad *et al.* (2016), Nagrale *et al.* (2015), Minu Singh *et al.* (2015), Narayan *et al.* (2014), Meena *et al.* (2013), Ashraf *et al.* (2013), Rathod (2012).

From the above table it could be inferred that scarcity of water, lack of green fodder, preferring NS than AI, lack of availability of sufficient labour, negligence in feeding pregnant and dry animals, tendency to feed only grass and brans were the major constraints perceived by both members and non-members in decreasing priority order.

This phenomenon seen in study area might be due to drought prevailing in study area during investigation. Animals of all dairy farmers were sent for grazing together along with male animals resulted natural breeding activity in the grazing area. Unlikeliness of people to be as a labourer in others farm and less family labour were available due to not employing their children in farms so as to make them well educated and well employed. This might be the reason for lack of availability of sufficient labour. Reasons for the last two constraints mentioned in above paragraph might be concentration of dairy farmers only on milch animals which gives immediate source of income by neglecting other animals.

Other major constraints perceived by members in decreasing rank order were insufficient loan amount, lack of remunerative price for milk, high cost of feed, lack of fodder conservation and high cost of animals.

The probable reasons for above constraints might be provision of loan amount equally for all the applicants by the DCSs/MPIs not considering the cost of animals, and high costs of feed and animals in the market. Drought conditions prevailing in the study area made members to get aware and perceive fodder conservation as one of the major constraints.

Other major constraints perceived by non-members in decreasing order of preference were high cost of animals, complex procedures for obtaining loans from banks, high cost of feed, lack of fodder conservation, lack of veterinary aid and lack of training.

High cost of animals combined with complex procedures for obtaining loans might made buying animals a burdensome task for them. As feed costs are touching skies which are very far away from the affordability of the farmers, might made them to perceive feed cost as a constraint. Lack of fodder conservation facilities and meagre number of professional veterinary staff in the study area might be the reasons for last three constraints mentioned in above paragraph.

Table 2: Suggestions elicited by members and non-members

S.No	Suggestions	Members			Non-members		
		F	%	Rank	F	%	Rank
1	Enhancing the procurement price	42	70.00	II	-	-	-
2	Improving veterinary services	27	45.00	VI	19	31.67	IV
3	Providing more incentives	36	60.00	III	-	-	-
4	Conducting regular training programmes	24	40.00	VII	23	38.33	III
5	Encouraging calf rearing	32	58.33	IV	16	26.67	V
6	Encouraging fodder cultivation In their fields	20	33.33	IX	13	21.67	VII
7	Conducting frequent animal health camps	30	50.00	V	41	68.33	I
8	Providing subsidy on purchase of animals/ providing loans on par with the cost of animal	49	81.67	I	35	58.33	II
9	Encouraging fodder cultivation in waste lands	16	26.67	X	15	25	VI
10	Need of special help line for dairy	10	16.67	XII	9	15	VIII
11	Increasing attendance in training	21	35.00	VIII	-	-	-
12	Timely supply of fodder slips/seeds	5	8.33	XIII	7	11.67	IX
13	Fodder conservation	14	23.33	XI	4	6.67	X

Suggestions elicited by members in the descending order of their importance were providing subsidy for purchase of animals/providing loans on par with the cost of animal (81.67%), enhancing the procurement price (70.00%), providing more incentives (60.00%), encouraging calf rearing (58.33%), conducting frequent animal health camps (50.00%), improving veterinary services (45.00%), conducting regular training programmes (40.00%), increasing attendance in training (35.00%), encouraging fodder cultivation in their fields (33.33%), encouraging fodder cultivation in waste lands (26.67%), fodder conservation (23.33%), need of a special help line for dairy (16.67%) and timely supply of fodder slips/seeds (8.33%).s

Suggestions elicited by non-members in rank order were conducting frequent animal health camps camps (68.33%), providing subsidy on purchase of animals/providing loans on par with the cost of the animal (58.33%), conducting regular training programmes (38.33%), improving veterinary services (31.67%), encouraging calf rearing (26.67%), encouraging fodder cultivation in waste lands (25.00%), encouraging fodder cultivation in their fields (21.67%), need of special help line for dairy (15.00%), timely supply of fodder slips/seeds (11.67%) and fodder conservation (6.67%).

Bharwad *et al.* (2016), Malivad *et al.* (2016), Dhayal *et al.* (2015) and Ranuji (2006) were also reported similar findings.

Providing subsidy for purchase of animals/providing loans on par with the cost of the animal, enhancing the procurement price, providing more incentives, encouraging calf rearing, conducting frequent animal health camps, improving veterinary services, conducting regular training programmes and increasing attendance in training were major suggestions elicited by members. Whereas, conducting frequent animal health camps, providing subsidy on purchase of animals/providing loans on par with the cost of the animal, conducting regular training programmes and improving veterinary services were major suggestions elicited by non-members. This depicts that dairy farmers in the study area were in need of financial, educational and medical support from concerned authorities.

CONCLUSION

Scarcity of water, lack of green fodder, preferring NS than AI and tendency to feed only grass and brans were the major constraints perceived by both members and non-members. Besides that insufficient loan amount, lack of remunerative price for milk and high cost of feed were majorly perceived by members while high cost of animals, complex procedures for obtaining loans from banks and high cost of feed were majorly perceived by non-members. providing subsidy for purchase of animals/providing loans on par with the cost of the animal, enhancing the procurement price, providing more incentives, encouraging calf rearing and conducting frequent animal health camps were the major suggestions elicited by members whereas conducting frequent animal health camps, providing subsidy on purchase of animals/providing loans on par with the cost of the animal, conducting regular training programmes and improving veterinary services were major suggestions elicited by non-members. Mission Kakatiya a program of restoring all the tanks and lakes in Telangana State may take care of year round production of fodder crops that may reduce the feeding constraints. Department of Animal Husbandry, co-operative agencies and milk producer institutions that are operating in the area should make efforts to educate the farmers on fodder conservation, preparation of low cost balanced feed with locally available resources. Government should have proper regulatory mechanism to work out cost of milk production at farmers' level and fixing the remunerative price. Considering strengths and weaknesses of public and private sectors, it is felt appropriate to develop a proper linkage strategy between private and public veterinary services in providing training programmes and need based services. If the constraints are tackled and productivity of dairy animals is enhanced not only the livelihood of dairy farmers will be increased but also fodder shortage will be decreased.

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Combating Malnutrition among Vulnerable groups – Role of Agricultural Extension

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Introduction

A close knit or web of poverty, malnutrition, hunger and status of well being of community with specific reference to vulnerabilities due to age, gender, access, and availability of resource or service was broken to evaluate and examine whenever the development agenda is reviewed for either resource allocations, targets & achievements, framing of programmes and policies or growth on well being indicators of the country. Tracing out for needed interventions be it science and technological, knowledge and practice management, institutional arrangements, extension delivery models is a continuous phenomena when considerable changes are sensitized and identified to be factored in to the in the existing development models. It is here, there is need to reframe the models with suitable strategies so that the vulnerabilities are combated. The role of agricultural extension is in this context important as a converging partner responsible for drawing action plans leading to the achievement of anticipated developmental targets; leader in designing and delivery of extension communication and technology available in science and technological institutions, universities; a watch dog as third party for tracing out the impact of frame work on development agenda with midterm monitoring and evaluation reports. The paper dwells on to answer on the present scenario of vulnerability on malnutrition in India operated through government programme from ministry of women and child development and ministry of health and family welfare; achievements and pitfalls; directives of change to be brought in; models and frame work plans by converging the roles of agricultural extension.

1. **Scenario of malnutrition in India**

The problem of hunger, poverty and malnutrition has been bogging our country for years. Every successive government has attempted with varied degree of success to tackle this problem. The effort in the last ten years to tackle this issue seems to be bearing some fruits now. The global hunger index reports, of 2000 & 2016 has indicated a reduction in the percentage of undernourished children from 17 to 15.2; prevalence of wasting in children under 5 years as 17.1% to 15.1%. Prevalence of stunting in children less than 5 years was reduced from 54.2 per cent to 38.7 per cent. Less than five mortality is reduced from 9.1% to 4.8%. Over all India has improved on its hunger score from 38.2 to 28.5 as of 2016. But when compared to emerging economies, India is still trailing behind countries like Thailand, China, Ghana, Iraq, Sri Lanka and Nepal.

2. **How malnutrition has been fought in India and our shortcomings**

India was able to improve its GHI score as the government rolled out and expanded several programmes after 2006 that targeted a mix of direct and indirect causes of malnutrition.

2.1. The ICDS programme

The main initiative was a push given to expand the Integrated Child Development Services (ICDS) programme that aims to improve the health, nutrition and development of children in India and established 1.4 million centers. It has remained in the forefront of the efforts of the

Government of India (GOI) and the State Governments to achieve the child nutrition related Millennium Development Goals (1 to 8).

2.1.1. Progress traced through evaluation reports

- **<u>The issue of alarming state was reduced but the chronic state of malnutrition is still persisting :</u>**
  Evidence from the audit of the flagship Integrated Child Development Services (ICDS) says that 49% children in Andhra Pradesh, Bihar (82%), Haryana (43%), Jharkhand (40%), Odisha (50%), Rajasthan (43%), UP (41%) and Delhi (50%) are moderately to severely malnourished. The number of severely malnourished children exceeded 1% of total weighed children in eight states, including Bihar, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Uttarakhand and West Bengal. The figure was a high 3% and 4% in Maharashtra and West Bengal, respectively. The scenario indicate the vulnerabilities still remain but the degree of vulnerability could be reduced as of now.
- **<u>Basic sanitation and water facilities still to be improved</u>**

  The audit, covering 2006-07 to 2010-11, says 52% of anganwadis surveyed lack toilets, 32% don't have drinking water and reveals 33%-45% gap between eligible beneficiaries and actual recipients of supplementary nutrition. Around 61% aganwadis did not have their own buildings and 25% were functioning from semi-pucca or open or partially covered spaces. A strong need to boost the sanitation and water management is therefore needed.

- **<u>Poor facilities to monitor the status of child health.</u>**

  There was no data in six states on beneficiaries of pre-school kits who joined mainstream education, in five states. The shortfall in the number of children who took up formal education ranged between 7% and 30%. Functional weighing machines for babies and adults were not available in 26%-58% in test-checked aganwadis. Medicine kits are not available in 33%-49% of aganwadis that formed the sample. The shortfall under various categories of training ranged from 19% to 58% of targets and the supplementary nutrition was under-funded by 15%-36% between 2006 and 2011. Some 33%-47% children were not weighed for monitoring their growth from 2006-07 to 2010-11. There is need to re look into monitoring and evaluation management for making midterm corrections of the programme for meeting end goals.

2.2 Mid day meal programme – Supplementary nutrition through local food model

The Mid-Day Meal Scheme (MDMS) is the India's second largest food security programme of women and child development ministry (GOI) and implemented at state by Department of women and child development and Department of Social welfare as the nodal departments . For the children, it is perhaps the largest food security programme in the world. A mid-day meal is an important instrument for combating classroom hunger and promoting better learning as many children reach school with an empty stomach in the morning, since a good early morning breakfast is not a part of the household routine.

2.2.1. Progress traced through evaluation reports

- **Marked improvement in enrolment pattern of children in primary school and academic achievement of students**

  National Institute of Public Cooperation and Child Development, Indore (2007) conducted a study on Mid-Day Meal Scheme in Madhya Pradesh and found that school indicated marked improvement in enrolment pattern of children in primary school. Julia (2005) assessed the implementation of MDMS and its impact in Udaipur district and found cooked MDM had become a permanent part of the daily routine of rural primary schools in Udaipur. Introduction of menu based Mid-Day Meal has positively impacted enrolment and daily attendance of children. Noronha and Samson (2005) conducted a survey of 12 Municipal Corporation of Delhi (MCD) schools in Delhi and found out that school children in all the schools were getting cooked food. Paul and Mondal (2012) studied the impact of Mid-Day Meal in upper primary schools of Burdwan district in West Bengal and revealed that Mid-Day Meal programme has a significant positive impact in academic achievement of students.
- **Short comings**
  - Periodically controversies arise on this programme, sometimes on quality and content and sometimes the religious, political and social prejudices dictating these programmes.
  - Cooking on site also giving rise to certain emergencies such as in case of Bihar in 2015 where in children got hospitalized.

Therefore, adding quality to the food, community participation and fixing responsibility for the delivery of local based nutritious food as per daily requirements of the child, accountability at various levels on the supply and delivery of the meal ensuring sanitation and hygiene is important.

2.3. Multi – sectoral programme to address the maternal and child malnutrition in selected 200 high burden districts

National Nutrition Mission a new scheme introduced by the Government of India during 2002-03 for implementing subsidized food grains to adolescent girls, expectant and nursing mothers belonging to Below Poverty Line families and undernourished. The objectives of the programme are to reduce in malnutrition, elimination of micro nutrients deficiencies relating to iron, iodine, vitamin A etc. and reduction of chronic energy deficiency. The programme is to be implemented through a convergence approach with the Department of Food and Civil Supplies and the Deputy Commissioner of the concerned district for necessary arrangement of food grains and distribution through Public Distribution System.

2.4. National Rural Health Mission (NRHM)

The launch of the National Rural Health Mission (NRHM), a community based outreach and facility-based health initiative to deliver essential health services to rural India is another initiative. It has emerged as a major financing and health sector reform strategy to strengthen States Health systems and large number of voluntary community health workers and facilities were expanded. The institutional deliveries to total deliveries (Institutional +home) increased from 56.7% in 2006-07 to 78.5% in 2010-11.

2.4.1. **Progress on health**

India report card on health related MDG's between 2000–2015, were summarized and wherein 3 out of 8 MDGs were related directly to health. It indicated that the 1st goal to reduce mortality among children under five is only moderately on-track. The 2nd goal was to reduce maternal mortality, India is off-track. The 3rd goal of Halt and reverse the spread of HIV/AIDS was on track. The 4th goal, which was to halt and reverse the spread of malaria and other major diseases, was also found moderately on-track.

2.5. Directives of change

The directives of change can be traced from the issues as

2.5.1. Focus on women and children with greater direct and visible impact by monitoring on

- early breast feeding and complementary feeding practices
- conducting informative meetings with fathers and mothers
- regular village meetings and household visits by AWWs, and nutrition workers;
- providing adolescent girls with information on nutrition, IFA supplements and sanitation

2.5.2. Making District Actions Plans for nutrition mandatory.

2.5.3. Using ICT for effective communication and reporting; stepping up IEC and disseminating information

2.5.4. Implementing community level third party monitoring of services;

2.5.5. Providing greater focus to high-burden districts and getting the state to select high-priority districts

2.5.6. Strengthening health care services for regular growth monitoring and identifying cases of severe malnourishment, reviewing and following-up condition of severely malnourished.

2.5.7. Synchronizing Malnutrition Treatment Centre/Nutrition Rehabilitation centre parameters;

2.5.8. Hiring nutrition experts at block level in states where the intergenerational cycle of malnutrition needs to be addressed;

2.5.9. Addressing the problems of Water, Environmental Sanitation and Hygiene

2.5.10. making water testing kits available;

2.5.11. Chlorinating water; encouraging use of low cost filters; discouraging keeping cattle in toilets

2.5.12. Maternal, Infant and Young Child Caring and Feeding Practices:

2.5.13. Providing childcare services under MGNREGS;

2.5.14. imparting intensive skilled counselling to husband and mother in- law to

address cultural practices that may prevent the mother from ensuring optimal nutrition and care;

2.6. Models and frame work plans

Today's attention is to re look into the models of extension delivery, for understanding the paradigm shifts, shaping the change for sustained progress, drawing out a frame of convergence between stakeholders so that community at large is progressed and sustained on this development indicator. The following models may be considered in this context.

Models	Action plan
Panchayat - led Models	• Empower panchayat with regard to nutrition programmes; • Working out communication strategies for bringing about behavior change; • set up an institution at the block level for capacity building, • promote village health and nutrition committees through panchayat • data collection and monitoring through a third party by seeking EOI.
Nutrition Counseling Service Model – ICDS led	• Provide one village level nutrition counselor/additional AWW for every 1,000 persons or as per ICDS norms; • appoint a supervisor for every 20 village counselors; • form a multi sectoral team by involving medical colleges and Home science institutes.
3. **Institutional Arrangements at National/State/District/Local Levels**	• Create an empowered Council of nutrition within MoHFW or MoWCD with down ward linkage at state level • make arrangements for advocacy, awareness and counseling; • place interventions such as SNP in the hands of trained and empowered local women

Role of agricultural extension

The extension personnel can take part in the following ways in the models given above.

1. **Knowledge imparting resource / repositories**
    - This capacity building modules are needed tailored to the needs.
    - Linking knowledge portals to community led institutions.
2. **Training and Consultancy services**
    - Can take part effectively in Nutrition counseling and advocacy through media and e resources
    - Training resource
3. **Organizing vulnerable groups for information access and delivery**
    - Synergizing efforts of communication and delivery systems
4. Problem solving: Can lead the collective decision making by facilitating alternative identification and evaluation related to upgrading nutritional security among vulnerable groups.

EFFECT OF ORGANIC AND INORGANIC SOURCE OF NUTRIENTS ON YIELD ATTRUBUTES AND YIELD OF GROUNDNUT (*Arachis hypogaea* L.)

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ABSTRACT

Field experiments were carried out to study the effect of different sources of organic manures and inorganic fertilizers on yield attributes and yield of groundnut at Krishi Vigyan Kendra, Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam during *Rabi* 2014 and 2015. The experiments were laid out in split-plot design consisting of twelve treatments with 3 replications. The main plot consisted of Farm yard manure @ 12.5 t ha^{-1}(M1), Vermicompost @ 5.0 t ha^{-1} (M2), Fish pond silt @ 5.0 t ha^{-1} (M3) and Composted poultry manure @ 5.0 t ha^{-1} (M4) and sub plot consisted of 100 per cent recommended dose of fertilizers NPK (S1), 75 per cent recommended dose of NPK (S2) and 50 per cent of recommended dose of NPK (S3). Data on yield parameters *viz*., Number of pods $plant^{-1}$, Number of kernels pod^{-1}, 100 kernel weight (g), pod yield and haulm yield of groundnut (kg ha^{-1}) were collected for different treatments. Results revealed that application of vermicompost @ 5.0 t ha^{-1} (M_2) recorded significantly higher number of pods $plant^{-1}$ (24 and 25 nos.), higher groundnut pod yield (2488 and 2549 kg ha^{-1}) and higher haulm yield (4170 and 4279 kg ha^{-1}) as compared to other organic manure treatment in both the season. Similar trend was observed in the case of number of kernel pod^{-1} also, whereas, the 100 kernel weight was not significant due to the application of different organic manure. In addition, application of recommended dose of 100 per cent NPK (S_1) significantly recorded higher number of pods $plant^{-1}$ (22.9 and 24 nos.), higher groundnut pod yield (2436 and 2490 kg ha^{-1}) and higher haulm yield (4092 and 4190 kg ha^{-1}) over 75 and 50 per cent of NPK levels in both the years. However, the interaction between organic manures and fertilizer levels were not significant on number of kernel pod^{-1}, 100 kernel weight, pod yield and haulm yield of groundnut but highly significant on number of pods $plant^{-1}$. The study showed that groundnut crop responded well in terms of yield attributes, pod yield and haulm yield by the application of vermicompost @ 5.0 t ha^{-1} and 75 per cent recommended dose of NPK fertilizers.

Keywords: Groundnut, vermicompost, fish pond silt, composted poultry manure, yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a unique and important oilseed crop of Tamil Nadu. In Tamil Nadu, groundnut is cultivated in 3.39 lakh ha with a production of 7.85 lakh tonnes and productivity of 2751 kg ha^{-1} (2012-13). The groundnut kernel is used mainly for edible oil and contains nearly half of the essential vitamins and one-third of the essential minerals. Hence, groundnut played an important role in nutritional security to the resource poor farmers. In addition, the haulms provided excellent fodder for livestock, cake obtained after oil extraction was used in animal feed and overall the crop acted as good source of biological nitrogen fixation (Nautiyal *et al*, 2011). In recent years, crop cultivation requires the use of chemical fertilizer, but it is expensive for people who have not capacity to buy fertilizer. Therefore, the current trend is to explore the possibilities of supplementing organic manures like farm yard manure, vermicompost, poultry manure etc. Indigenously available organic sources of nutrients have enhanced the efficiency and reduced the requirements of chemical fertilizers (Bhat *et al*., 2007). Hence, it is necessary to integrate different sources of nutrients to meet the crop requirement. Sustainable yields in groundnut can be achieved through the conjunctive use of organic and inorganic fertilizers (Singh *et al*., 1990). Such integrated approach with special emphasis on combined application of inorganic fertilizers with organic manures would sound well in oilseed crops like groundnut grown under aberrated climatic conditions. Therefore, an experiment was conducted to study the effect of integrated use of organic and inorganic sources of nutrients on yield of groundnut in Kancheepuram district of Tamil Nadu.

MATERIALS AND METHODS

Field experiments were carried out to study the effect of different sources of organic and inorganic nutrients on yield attributed and yield of groundnut at Krishi Vigyan Kendra, Tamil Nadu Veterinary and Animal Sciences University, Kattupakkam located at North Eastern zone of Tamil Nadu at lies between 11° 00' to 12° 00' North latitudes and 77° 28' to 78° 50' East longitudes during *Rabi* 2014 and 2015. The soil of the experimental site was moderately well drained, sandy clay loam in texture and chemical analysis showed low in available nitrogen (199.5 kg ha^{-1}), medium in available phosphorus (19.8 kg ha^{-1}) and high in available potassium (461.3 kg ha^{-1}), 0.55 per cent of organic carbon and 7.8 pH of the soil. The experiments were laid out in split-plot design consisting of twelve treatments (four main and three sub plots) with 3 replications. The main plot consisted of Farm yard manure @ 12.5 t ha^{-1}(M1), Vermicompost @ 5.0 t ha^{-1} (M2), Fish pond silt @ 5.0 t ha^{-1} (M3) and Composted poultry manure @ 5.0 t ha^{-1} (M4) and sub plot consisted of 100 per cent (25:50:75 kg NPK ha^{-1}) recommended dose of fertilizers (S1), 75 per cent recommended dose of fertilizers (S2) and 50 per cent of recommended dose of fertilizers (S3).

The groundnut variety *TMV-13* was used for treatment. Beds and channel were formed, layout was taken and organic manures were applied to each plot in accordance with the treatments assigned, incorporated manually and levelled. The seeds were sown in a plot size of 6.0 m x 5.0 m spaced with 30 x 10 cm for each treatment during *Rabi* 2014 and 2015. Full dose of phosphorus and potassium along with half dose of nitrogen in all the treatments was applied as basal. Remaining dose of nitrogen was applied at 30 days after sowing at the time of weeding as per the treatments. All other recommended cultural practices and prophylactic plant protection measures were followed to raise healthy crop. Observations were recorded in 10 randomly taken and tagged plants from each replication on Number of pods plant^{-1}, Number of kernels pod^{-1}, 100 kernel weight (g), pod yield and haulm yield of groundnut (kg ha^{-1}) of different treatments. The harvested pods yield from each net plot cleaned separately as per the moisture content and expressed in kg ha^{-1}. The haulm yield of groundnut was recorded from the net plot area after enough sun drying and expressed in kg ha^{-1}. The data on various parameters were statistically analyzed in split plot design as suggested by Gomez and Gomez (2010). Wherever the treatment difference was significant, critical differences were worked out at five per cent probability level.

RESULTS AND DISCUSSION

Yield attributes of Groundnut

The number of pods plant^{-1} and number of kernel pod^{-1} were positively influenced by the application of organic manures and different levels of NPK fertilizer, whereas 100 kernel weight of groundnut was not significantly influenced by the application of organic manures and different levels of NPK fertilizer during *Rabi* 2015 and 2015 (Table 1 and 2).

Among different organic manure application, vermicompost application @ 5.0 t ha^{-1} (M_2) significantly recorded higher number of pods plant^{-1} (24 and 25 nos.) in both the years. The composted poultry manure application @ 5.0 t ha^{-1} (M_4) was the next best treatment followed by the application of FYM @ 12.5 t ha^{-1} (M_1) during both the years. Similar trend was observed in the case of number of kernel pod^{-1} also, whereas, the 100 kernel weight was not significant due to the application of different organic manure. With regard to different NPK fertilizer levels tried, higher number of pods plant^{-1} (22.9 and 24 nos.) was observed with the application of 100 per cent recommended dose of NPK fertilizers (S_1). It was followed by the application of 75 per cent recommended dose of NPK fertilizers (S_2). These two were comparable with each other. Application of 50 per cent recommended dose of NPK fertilizers (S_3) registered lowest number of pods plant^{-1}. Similar trend was observed for number of kernel pod^{-1} also. Different levels of recommended dose of NPK fertilizers did not show any significant improvement on the 100 kernel weight during both the years.

Interaction effect between organic manures and NPK fertilizers levels was highly significant on number of pods plant^{-1} in both the years. Combined application of vermicompost @ 5.0 t ha^{-1} along with 75 per cent of recommended dose of NPK (M_2 S_2) registered higher number of pods plant^{-1} (26.3 and 27.4 nos) in both the years. It was on par with application of vermicompost along with 100 per cent of recommended dose of NPK fertilizers (M_2 S_1) in both the years. The interaction effect on number of kernel pod^{-1} and 100 kernel weight of groundnut was not at all significant in both the years.

Pod yield of Groundnut

Groundnut pod yield was significantly influenced due to the application of organic manures and different levels of NPK fertilizers during both the years. Among organic manures application, vermicompost application @ 5.0 t ha^{-1} (M_2) recorded significantly higher groundnut pod yield of 2488 and 2549 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was followed by the application of composted poultry manure treatment @ 5.0 t ha^{-1} (M_4), which recorded on yield of 2379 and 2417 kg ha^{-1}. The lowest groundnut pod yield of 2344 and 2391 kg ha^{-1} was observed with fish pond silt @ 5.0 t ha^{-1} (M_3) during *Rabi* 2014 and 2015, respectively (Table 3 and 4).

Regarding fertilizer levels, application of recommended dose of 100 per cent NPK fertilizers (S_1) significantly recorded higher groundnut pod yield of 2436 and 2490 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was on par with the application of 75 per cent of NPK fertilizers (S_2), which recorded on yield of 2421 and 2463 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. Application of 50% recommended dose of NPK fertilizers recorded the lowest groundnut pod yield of 2323 and 2370 kg ha^{-1} in both the years. The interaction effect between organic manures and NPK fertilizer levels was non-significant on groundnut pod yield in both the years.

Haulm yield of Groundnut

Groundnut haulm yield was significantly influenced by the application of organic manures and different levels of NPK fertilizers in the both the years (Table 3 and 4). Application of vermicompost @ 5.0 t ha^{-1}(M_2) recorded significantly higher groundnut haulm yield of 4170 and 4279 kg ha^{-1} in during *Rabi* 2014 and 2015, respectively. It was followed by the application of composted poultry manure @ 5.0 t ha^{-1} (3996 and 4092 kg ha^{-1}). The fish pond silt (M_3) recorded conspicuously the lowest groundnut haulm yield. Among the different fertilizer levels tried, application of 100 per cent recommended dose of NPK fertilizers (S_1) recorded significantly higher groundnut haulm yield of 4092 and 4190 kg ha^{-1} during *Rabi* 2014 and 2015, respectively. It was on par with the application of 75% recommended dose of NPK fertilizers (S_2) in both the years. The lowest groundnut haulm yield was observed with the application of 50 per cent recommended dose of NPK fertilizers (S_3). Interaction effect between organic manures and fertilizer levels did not exhibit any significant variations on the haulm yield of groundnut in both the years.

Number of groundnut pods $plant^{-1}$, pod yield and haulm yield was positively influenced by the application of organic manures and different levels of NPK fertilizer during both the years. Combined application of vermicompost and 75 per cent of recommended dose of fertilizers recorded significantly higher yield compared to lower level of NPK fertilizers. The yield improvement could be attributed to continuous availability of nutrients, growth promoting effect of vermicompost and ultimately leads more photosynthetic activities, cell division and cell elongation, enhanced carbohydrate as well as metabolic process and improvement of soil structure by increasing the soil water holding capacity, good aeration, which encourages better root growth and nutrient uptake. These results were corroborated with the findings of Ramasamy and Umapathi, (2010). The beneficial effect of vermicompost on yield and yield attributes might be attributed to its ability of sustain availability of nutrients throughout the growing season. The increased balanced C:N ratio might have increased the synthesis of carbohydrates with ultimate improvement in yield and yield attributes. These findings corroborate with those of Mathivanan *et al*. (2012), Kondappa *et al.* (2009) and Yadav and Yadav (2010).

Poultry manure is excellent organic manure, since it contains high amount of nitrogen, phosphorus, potassium and other essential nutrients. Poultry manure improves the number of pods per plant, pod yield and haulm yield in groundnut as reported by Subrahmaniyan *et al*. (1999). Groundnut being a leguminous crop, capable of fixing atmospheric nitrogen and application of fertilizers including gypsum with organic manures enhanced the productivity of groundnut. Veeramani *et al.* (2012) observed similar findings.

In agricultural land soil fertility depletion is an important draw back due to continuous cultivation with inorganic nutrients. In order to increase the soil fertility, inorganic fertilizers are being widely utilized in cultivable lands. Even though they promote the growth of crops, their toxic effect is the negative impact by means of their over utilization of fertilizers. To overcome these factors, the combined application of organic manure especially vermicompost, poultry manures and farm yard manure along with NPK fertilizers is recommended. The study showed that the yield attributes, pod yield and haulm yield parameters of groundnut were enhanced by different sources of organic manures and levels of NPK fertilizers. Among the organic manure treatments, application of vermicompost performed better than the other sources through improved number of pods plant^{-1}, number of kernel pod^{-1}, pod yield and haulm yield of groundnut crop. It could be concluded that the groundnut crop responded well in terms of yield attributes, pod yield and haulm yield by the application of vermicompost @ 5.0 t ha^{-1} and 75% recommended dose of NPK fertilizers.

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Table 1. Effect of treatments on yield attributes of groundnut during *Rabi* 2014

Treatments	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	22.0	21.2	19.4	**20.8**	1.61	1.60	1.50	**1.57**	44.1	44.0	44.0	**44.0**
M_2	23.6	26.3	22.4	**24.0**	1.64	1.69	1.62	**1.64**	44.2	44.6	44.2	**44.3**
M_3	22.2	20.6	19.2	**20.6**	1.54	1.52	1.50	**1.52**	43.9	43.8	43.7	**43.8**
M_4	24.2	23.1	21.0	**22.7**	1.60	1.60	1.58	**1.59**	44.0	43.8	43.8	**43.8**
Mean	**22.9**	**22.8**	**20.5**		**1.59**	**1.60**	**1.55**		**44.0**	**44.0**	**43.9**	

	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	M	S	M at S	S at M	M	S	M at S	S at M	M	S	M at S	S at M
SEd	0.1	0.2	0.3	0.4	0.01	0.01	0.03	0.03	0.5	0.3	0.8	0.7
CD(P=0.05)	0.2	0.4	0.7	0.8	0.03	0.03	NS	NS	NS	NS	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}

M_2 - Vermicompost @ 5.0 t ha^{-1}

M_3 - Fish pond silt @ 5.0 t ha^{-1}

M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK

S_2 - 75 per cent recommended NPK

S_3 - 50 per cent recommended NPK

Table 2. Effect of treatments on yield attributes of groundnut nut during *Rabi* 2015

Treatments	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	23.2	22.5	20.2	**21.9**	1.62	1.56	1.50	**1.56**	44.2	44.1	44.0	**44.1**
M_2	24.2	27.4	23.5	**25.0**	1.61	1.68	1.60	**1.63**	44.2	44.6	44.2	**44.3**
M_3	23.1	21.7	20.1	**21.6**	1.55	1.50	1.50	**1.51**	44.0	43.9	43.9	**43.9**
M_4	25.6	24.8	22.2	**24.2**	1.61	1.60	1.58	**1.59**	44.2	44.0	44.0	**44.0**
Mean	**24.0**	**24.1**	**21.4**		**1.59**	**1.58**	**1.54**		**44.1**	**44.1**	**44.0**	

	Number of pods plant^{-1}				Number of kernel pod^{-1}				100 kernel weight (g)			
	M	S	M at S	S at M	M	S	M at S	S at M	M	S	M at S	S at M
SEd	0.3	0.2	0.4	0.4	0.01	0.02	0.03	0.04	0.7	0.3	0.9	0.7
CD(P=0.05)	0.8	0.4	1.1	0.9	0.04	0.04	NS	NS	NS	NS	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}

M_2 - Vermicompost @ 5.0 t ha^{-1}

M_3 - Fish pond silt @ 5.0 t ha^{-1}

M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK

S_2 - 75 per cent recommended NPK

S_3 - 50 per cent recommended NPK

Table 3. Effect of treatments on pod and haulm yield of groundnut during *Rabi* 2014

Treatments	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	2411	2368	2306	**2362**	4096	3915	3825	**3945**
M_2	2476	2595	2392	**2488**	4152	4350	4007	**4170**
M_3	2405	2340	2286	**2344**	3984	3923	3813	**3907**
M_4	2451	2381	2306	**2379**	4136	3946	3905	**3996**
Mean	**2436**	**2421**	**2323**		**4092**	**4033**	**3887**	

	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	M	S	M at S	S at M	M	S	M at S	S at M
SEd	40	22	54	43	85	44	112	89
CD(P=0.05)	99	46	NS	NS	NS	94	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}
M_2 - Vermicompost @ 5.0 t ha^{-1}
M_3 - Fish pond silt @ 5.0 t ha^{-1}
M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK
S_2 - 75 per cent recommended NPK
S_3 - 50 per cent recommended NPK

Table 4. Effect of treatments on pod and haulm yield of groundnut during *Rabi* 2015

Treatments	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
M_1	2460	2405	2361	**2409**	4157	4126	3910	**4064**
M_2	2565	2644	2439	**2549**	4251	4468	4117	**4279**
M_3	2451	2385	2337	**2391**	4098	4012	3922	**4011**
M_4	2486	2419	2345	**2417**	4253	4026	3998	**4092**
Mean	**2490**	**2463**	**2370**		**4190**	**4158**	**3987**	

	Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
	M	**S**	**M at S**	**S at M**	**M**	**S**	**M at S**	**S at M**
SEd	21	22	42	44	33	51	90	102
CD(P=0.05)	52	47	NS	NS	81	108	NS	NS

Main Plot

M_1 - FYM @12.5 t ha^{-1}
M_2 - Vermicompost @ 5.0 t ha^{-1}
M_3 - Fish pond silt @ 5.0 t ha^{-1}
M_4 - Composted poultry manure @ 5.0 t ha^{-1}

Sub plot

S_1 - 100 per cent recommended NPK
S_2 - 75 per cent recommended NPK
S_3 - 50 per cent recommended NPK

Extent of utilization of mobile service on under Intelligent Advisory System for Farmers (IASF) in North East India

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Abstract

The revolution in mobile communication is providing a lifeline to agricultural communities around the developing world. Mobile phones significantly reduce communication and information costs. Poor communication facilities lead to limited access to information and this can lead to loss of income. Mobile phones also provides new opportunities for farmers to obtain access to agricultural information, such as market prices, weather report, agricultural techniques in various formats like audio (voice), videos (internet) and text (SMS).Information Technology (IT) enabled services could help in solving some of the problems that Indian farmers are facing. Hence, keeping this in mind, a study was taken up to assess the extent of utilization of information disseminated through mobile service.

The present study was conducted in Bishnupur District of Manipur. The study was taken up in four villages of Bishnupur block which were selected based on the highest number of registered farmers under Intelligent Advisory System for Farmers (IASF). A sample of 120 registered farmers was selected by using proportionate random sampling technique. Data were collected with the help of a well structured and pre tested interview schedule. The data collected were scored, tabulated and analyzed using the statistical tools viz., percentage analysis, cumulative frequency method. With respect to overall utilization of information received through mobile service 50.00 per cent of the respondents had medium level of utilization pattern followed by high (45.00 per cent) and low (4.17 per cent) levels. More than half of the respondents (59.16 per cent) had high level of utilization of mobile service for the practisewise recommended paddy technologies, followed by medium (24.17 per cent) and low (16.67 per cent) levels.

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Extent of utilization of mobile service on under Intelligent Advisory System for Farmers (IASF) in North East India

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Introduction

Agriculture is the main occupation of the majority of rural households in India. More than 50% of the population in India depends on agriculture. Farming in India is being undertaken by a large section of population under extreme diverse condition. Most of these farmers are small and marginal farmers who don't have access to relevant and timely information that adversely affect the agriculture growth and productivity.

Recent advances in Information and Communication Technologies (ICT) have changed the way knowledge is produced, processed, stored, retrieved and transferred to stakeholders in agriculture. Telecommunications, especially mobile phones, have the potential to provide solution to the existing information asymmetry in various sectors like agriculture. Nowadays, ICTs have become increasingly integrated into the dissemination and exchange of information to farmers in India, and it has become more prevalent in agriculture advisory service. ICTs according to Chapman and Slaymaker (2002) are expanding the assembly of technologies that can be collected, stored and shared information between people using multiple devices and multiple media. Even the changes in the jargon used in various ICT discourses from ICT4D (ICT for Development) to ICT4Ed (ICT for Education) to ICT4Ag (ICT for Agriculture) is a reflection of the changes in development scholarship and thinking.

The use of mobile phones in poverty reduction and development has ignited much interest over the past decade. To take advantage of the rapid expansion of mobile phones in developing countries, business firms, government agencies and non-governmental organisations are increasingly turning their attention to the delivery of services through mobile phones in areas such as health, education and agriculture.

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Information like weather forecast, commodity prices, plant protection, pest management, livestock management, agricultural practices etc, is needed by the farmers at right time for their growth and development. The mobile phone has reduced the gap among traders and farmers and at the same time farmers directly communicate with buyers and customers to fetch the good price of their product. In the rural areas of India, mobile phones spread day by day and different organizations have launched many projects for the agricultural development and increase the production by using different ICT technologies in agriculture.

In countries like India, services such as IFFCO Kisan Sanchar Limited (IKSL) and Reuters Market Light (RML) are already reaching thousands of farmers in rural areas. These mobile services mainly provide information regarding weather, crop and animal husbandry advisory, market prices, fertilizer availability, insects, pests etc. Farmers are taking great advantages of these services and making most use of it.

As a telephonic device, the mobile enables access to information sources that may not otherwise be reachable. As an information platform to receive SMS, menu or voice message information, mobiles provides the ability to get connected to new knowledge and information sources not previously available with the possibility of real time, highly tailored information delivery. Mobile phones can help farmers in decision making by making the right information available at right time and place. Besides, it can help educating and networking with fellow farmers. The farmers used the mobile phones for a variety of purpose. However, it is yet to be established as to what extent the farmers would be willing to use and pay for getting the information through mobile service. Some of the private companies have already started specialised agriculture service in the form of message alerts or voice calls for farmers in different states.

IASF Service in Manipur

Intelligent Advisory System for Farmers (IASF) is a web based platform which is seamlessly integrated to mobile service delivery gateway (MSDG), connecting KVK scientists and experts from Department of Agriculture to farmers through an e-platform in order to solve farmer's problems in real time. IASF is an advisory service meant only for farmers in North-East India. Both farmers and experts are registered in the IASF database. Only registered agricultural experts under the direct supervision of Project Co-ordinator can provide solutions to the registered farmers' query. The all India 51969 short code is used for all mobile services. To date, IASF is benefiting more than 10,000 registered farmers in 9 districts of Manipur and 5 districts of Meghalaya who use the platform to redress their farm problems. The first working version of IASF for farmers in Manipur has been deployed on the 11th August, 2011 in the Plant Health Clinic, Directorate of Agriculture, Sanjenthong.

There is a scope to expand the use of the IASF in North-East India and increase the productivity of agricultural production. In view of these factors, a study was taken up to determine the extent of utilization of mobile service by the respondents.

Methodology

The study was taken up to assess the extent of utilization of information disseminated through mobile service. The present study was conducted in Bishnupur District of Manipur. The study was taken up in four villages of Bishnupur block which were selected based on the highest number of registered farmers under IASF. A sample of 120 registered farmers was selected by using proportionate random sampling technique. Data were collected with the help of a well structured and pre tested interview schedule. The data collected were scored, tabulated and analyzed using the statistical tools viz., percentage analysis, cumulative frequency method.

The farmers were asked to express their opinion about the utility of information disseminated through mobile service as a tool for transfer of technology. Their opinion was assessed under two dimensions viz., mobile service was utilized and not utilized. Percentage analysis was worked out for easy interpretation of the results. Their extent of utilization was assessed upon the recommended technologies in paddy and other general information transferred through mobile service. Further the suggestions of the respondents were elicited for better utilization of IASF service.

Findings and discussion

Overall utilization of the information received through mobile service

The results on analysis on overall utilization of information received through mobile service are presented in Table 1.

Table 1. Distribution of respondents according to their overall utilization of information received through mobile service

(n=120)

S.No.	**Category**	**Number of**	**Per cent**
1.	Low	5	4.17
2.	Medium	61	50.83
3.	High	54	45.00
	Total	**120**	**100.00**

It could be noticed from the Table 1, that 50.00 per cent of the respondents had medium level of utilization pattern followed by high (45.00 per cent) and low (4.17 per cent) levels. It could be concluded that majority of the respondents possessed medium to high levels of utilization of information on recommended paddy and sugarcane technologies in addition to general information on agriculture. Most of the enthusiastic farmers might have utilized the information received through mobile service due to efficiency of the IASF service. This finding is in line with the findings of Ansari and Pandey (2013)

Extent of overall utilization of mobile service on recommended paddy technologies

The results on distribution of respondents according to their utilization of mobile service on recommended paddy technologies are given in Table 2.

Table 2. Distribution of respondents according to their overall utilization of mobile service on recommended paddy technologies (n=120)

S.No.	**Category**	**Number**	**Per cent**
1	Low	20	16.67
2	Medium	29	24.17
3	High	71	59.16
	Total	**120**	**100.00**

From the data in Table 2, it could be concluded that more than half of the respondents (59.16 per cent) had high level of utilization of recommended paddy technologies, followed by medium (24.17 per cent) and low (16.67 per cent) levels. High level of utilization may be due to the transfer of relevant paddy technologies in time by the IASF and their tendency to utilize the message or information provided by the service. The finding on majority of the respondents belonging to high category of utilisation derives support from the findings of Hassan et al (2010).

Practice wise utilization of mobile service on practice wise recommended paddy technologies

In order to have an in depth idea about the utilization of mobile service on practice wise paddy technologies by the respondents was worked out and the results are given in Table 3.

Table 3. Distribution of respondents according to their utilization of mobile service on practise wise recommended paddy technologies

(n=120)

S.No.	Subject matter	Number	Per cent
1.	Selection of varieties	30	25.00
2.	Time of sowing	70	58.33
3.	Nursery management	40	33.33
4.	Nutrient management	94	78.33
5.	Weed management	94	78.33
6.	Pest management	72	60.00
7.	Disease management	76	63.33
8.	Seed production technique	22	18.33
9.	Marketing information	62	51.67
10.	Post harvest management	20	16.68

It could be observed from the Table 3, that most of the respondents had utilized the technologies viz., nutrient management (78.33 per cent) weed management (78.33 per cent), disease management(63.33 per cent), followed by pest management (60.00 per cent). As the respondents felt that these technologies transferred as useful they might have utilized the information to a greater extent. Almost a similar percentage (58.33 per cent) of the respondents had utilized the recommended time of sowing, followed by marketing information (51.67 per cent). The probable reason for the utilization of marketing information to a lesser extent might be due to lack of complete information provided by the IASF service. As the respondents are very much familiar with the practice viz. time of sowing they might have utilized their own experience without referring the information through mobile service. Sife et al (2010) also inferred that half the portion of the respondents had utilized the market information.

Similar findings on pest management was reported by Nicholas et al (2012).The findings on disease management is similar to the findings reported by Ganesan et al (2013) .

It could be observed from the same table, that nearly one-third of the respondents (33.33 per cent) had utilized the information on nursery management, followed by selection of varieties (25.00 per cent) and seed production techniques (18.33 per cent). Only 16.68 per cent of the respondents had utilized the recommended the information on post harvest management practices under paddy cultivation. This might be due to the fact that the respondents had been following these practices traditionally on which they would have already gained adequate knowledge and hence they might have not indicated the practices nursery management and selection of variety as useful.

Extent of utilization of mobile service on general information in agriculture

The results on distribution of respondents according to their overall utilization of mobile service on recommended general information in agriculture are given in Table 4.

Table 4. Distribution of respondents according to their overall utilization of mobile service on recommended general information in agriculture

(n=120)

S.No.	Category	Number	Per cent
1.	Low	21	17.50
2.	Medium	49	40.83
3.	High	50	41.67
	Total	**120**	**100.00**

The result in Table 4, indicate that nearly two-fifth of the respondents (41.67 per cent) had high level of utilization of recommended general information followed by 40.83 per cent and 17.50 per cent of the respondents with medium and low levels of utilization respectively. Majority of the respondents might have utilized the information on weather information, latest agricultural technologies and information on training programmes. They also might have utilized the recommended general information as these are vital for successful farming. This finding is in line with the findings of Meera et al (2004).

Practice wise utilization of mobile service on general information in agriculture

Eight practices were selected for assessing the utilization of mobile service by the respondents on the recommended general information in agriculture. Results regarding the practice wise utilization of mobile service on general information by the respondents are furnished in Table 5.

Table 5. Distribution of respondents according to their practice wise utilization of mobile service on general information in agriculture

S.No.	Subject matter	Number	Per cent
1.	Latest technologies in agriculture	98	81.67
2.	Information on government schemes	66	55.00
3.	Information on training programmes	64	53.33
4.	Availability of agricultural inputs	42	35.00
5.	Weather information	72	60.00
6.	Crop insurance	20	16.67
7.	Value addition	12	10.00
8.	Marketing information on other commodities	34	28.33

It could be seen from the Table 5, that a higher percentage of the respondents (81.67 per cent) had utilized the information on latest technologies in agriculture. Majority of the farmers perceived information on latest technologies in agriculture as most useful and they were eager to try out new technologies. These might have been the reasons for the resultant high utilization of the recommended technologies.

Majority of the respondents (60.00 per cent) had utilized the weather information followed by information on government schemes (55.00 per cent) and information on training programmes (53.33 per cent). Since, the respondents considered the information on these technologies as most important and reliable, this would have resulted with high level of utilization. The findings on weather information derive support from the findings of Duncombe (2011) and Chhachhar et al (2014).

It could be inferred from the results from the same table, that among the eight technologies, low level of utilization was found on the availability of agricultural inputs (35.00 per cent), followed by marketing information on other commodities (28.33 per cent), crop insurance (16.67 per cent) and value addition (10.00 per cent). Most often the respondents visit the towns which are located within easy reach and hence they might have gained awareness about the availability of agriculture inputs and marketing information on other commodities. Only eight farmers (6.66 per cent) had big sized farm holdings and the rest belonged to marginal and small farmers. Hence, the small and marginal farmers would not have shown interest in utilizing the information on crop insurance and value addition.

Conclusion

More than half of the respondents (59.16 per cent) had high level of utilization of mobile service on recommended paddy technologies, followed by medium (24.17 per cent) and low (16.67 per cent) levels. Most of the respondents had utilized the mobile service on paddy technologies viz., nutrient management (78.33 per cent) and weed management (78.33 per cent). 63.33 per cent of the respondents had utilized the information on disease management, followed by pest management (60.00 per cent), time of sowing (58.33 per cent) and marketing information (51.78 per cent).

Higher percentage of the respondents (81.67 per cent) had utilized the mobile service for seeking information on latest technologies in agriculture. Majority of the respondents (60.00 per cent) had utilized the weather information, followed by information on schemes (55.00 per cent) and information on training programmes (53.33 per cent).

Medium to high level of utilization of information was found on recommended paddy technologies which is a good indicator of organisational performance and hence mobile service can be utilized in other potential areas.

Further, their utilization of mobile service on information on agricultural inputs, marketing information, crop insurance and value addition was found to be low. To facilitate adoption of agricultural technologies disseminated through mobile service, it is crucial to embed additional information in these areas to increase the effectiveness of mobile service.

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Extension Strategies on Agro-advisory to farmers on improved production technologies in Agricultural crops in Visakhapatnam district

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ABSTRACT

Visakhapatnam district in Andhra Pradesh (State) is an important area for Agricultural production in North-Coastal zone with net cultivated area of 3.00 lakh ha and gross cultivated area of 3.60 Lakh ha. The

major crops grown in the district are paddy (1,17,000 ha) and sugarcane (39,300 ha). The other crops include pulses, oilseeds, millets and maize. Significant area (1,40,841ha) is under cultivation with Horticultural crops also. Due to poor socio economic status of farmers, small holdings, less risk bearing ability and illiteracy of the farmers, Visakhapatnam district is ranking low in terms of productivity in many of the crops. Keeping this in mind, a special focus was given on Agro-advisory for dissemination of technologies to farmers through Agricultural Extension wing of Regional Agricultural Research Station (RARS), Anakapalle.

Crop-wise Agro-advisory information seeking behavior studied (2013-14, 2014-15 and 2015-16) at RARS, Anakapalle showed that paddy ranks first due to majority (50.7%) of the farmers seeking advice on paddy crop, as it is the major staple food crop of the district. On the other hand, sugarcane crops ranks third (11.1%) as it is a hardy crop with lesser susceptibility to pests & diseases, in general and the cane growers are traditional and habituated to various cultural practices. The poor purchasing capacity of small and marginal farmers does not compel them to seek advice for investing on adopting improved management practices in sugarcane, except looking for getting quality seed of promising varieties. The increased sought of agro-advisory in respect of Horticultural crops which ranks second (21.4%) is due to shift in cropping pattern, climate change, absent land lordism and guarantee of getting minimum economic gains with less risk and investment.

On the other hand, majority (>50%) of farmers are approaching the research station for getting plant protection advice compared to other technological advices, especially in paddy crop. This may be due to the fact that the apparent attack of pests & diseases throw the rice cultivators into panic and they rush to the research stations for seeking advice to protect the crop, as paddy is the major staple food crop for their livelihood. Since, farmers in the district are small and marginal; they bestow their efforts on instant sustainability of the crop rather than paying attention towards long term benefit yielding practices like soil health management, improved agronomic management practices, farm mechanization and other technological aspects.

Seasonal frequency of visiting farmers showed that farmers are seeking agro-advisory during September and October months due to occurrence of more of pests & diseases during that period. This observation prompts the resource persons offering agro-advisory to bestow their attempts on diagnostic field visits during that period to reach the needy farmers in time for getting desirable results.

In conclusion, the present study had revealed that due to heterogeneous farming conditions prevailed throughout the season and locations and limited availability of resource persons, concerted planned efforts are required in establishing localized plant health clinics at Mandal level and developing master trainers at village level; recruiting qualified graduates in the input dealers shops and organizing seasonal diagnostic visits at field level besides organizing vocational training programmes at Institute level for rapid strives in agricultural growth.

Key words : *Agro-advisory, Seasonal frequency of visiting farmers, Frequency of seeking advice in different crops and technologies.*

INTRODUCTION :

Visakhapatnam district in Andhra Pradesh (State) is an important area for Agricultural production in North-Coastal zone as the cultivated area in Visakhapatnam district is 3.00 lakh ha under net cultivation and 3.60 Lakh ha under gross cultivation (**In :** Directorate of Economics & Statistics, New Delhi). The major crops grown in the district are paddy (1,17,000 ha), millets (23,914ha), maize (7,191ha), sugarcane (39,300 ha), pulses like green gram, black gram, red gram, other pulses (15,096ha), oilseed crops like ground nut, sunflower, sesame (16,923ha). Significant area (1,40,841ha) is under cultivation with respect to Horticultural crops like mango, cashew, banana, guava, coconut, vegetables, flowers, spices and also to some extent medicinal plants. Due to poor socio economic status of farmers, small holdings, less risk bearing ability, illiteracy of the farmers and poor information seeking behavior of farmers on latest technologies, Visakhapatnam district is ranking low in terms of productivity of many crops. Poor transfer of technology is also another constraint (Meena *et al*. 2010). For example, Visakhapatnam district though ranks 1st in area, but ranks 13th in productivity of sugarcane, because of the above mentioned factors. Similar is the case with reference to paddy and other crops also.

Methodology

Agro-advisory information seeking behavior among the farmers of Visakhapatnam district of North-Coastal Andhra Pradesh was studied (2013-14, 2014-15 and 2015-16) by taking the data of visiting farmers came for Agro-advisory to Agrl. Extension wing of RARS, Anakapalle. The data was assessed in terms of seasonal frequency of visiting farmers and frequency of seeking advice in different crops and technologies. A total of 351 farmers, came from different areas of Visakhapatnam district, had received Agro-advisory during the period under report. Frequency distribution, percentage and mean per cent score were used for analysis of data. Extension strategies have been proposed based on Agro-advisory seeking behaviour of the farmers in the district.

Results and Discussion :

I. Agro-advisory seeking behavior was studied in the following two ways.

1) Crop-wise Agro-advisory information seeking behavior
2) Technology-wise Agro-advisory information seeking behavior

II. Extension strategies have been proposed based on the agro-advisory seeking behavior for making rapid development of Agriculture in Visakhapatnam district.

I. Agro-advisory seeking behavior :

(A) Crop-wise Agro-advisory information seeking behavior :

The above data (Table 1) on Crop-wise Agro-advisory information seeking behavior showed that paddy ranks first due to majority (50.7%) of the farmers seeking advice on paddy crop, as it is the major staple food crop of the district. Paddy transplantations in the district are being taken up late in the month of August in kharif season. Paddy area under rabi crop is negligible, as dependable water sources are not available in the district. Hence, most of the farmers are bestowing their attention on paddy cultivation in kharif season when compared to other crops.

On the other hand, sugarcane crops ranks third (11.1%) as it is a hardy crop with lesser susceptibility to pests & diseases, in general and the cane growers are traditional and habituated to various cultural practices. The poor purchasing capacity of small and marginal farmers does not compel them to seek advice for investing on adopting improved management practices, except looking for getting quality seed of promising varieties and also advice on recently emerged viral disease management.

The increased sought of agro-advisory in respect of Horticultural crops which ranks second (21.4%) is due to shift in cropping pattern, climate change, absent land lordism and guarantee of getting minimum economic gains with less risk and investment in case of orchard crops and more economic gains in short time with vegetable and flower crops.

Table 1 : Crop-wise Agro-advisory information seeking behavior

S.No.	Crop	No. of farmers	Frequency (%)	Ranking
1.	Paddy	178	50.7	**I**
2.	Millets	18	5.1	**IV**
3.	Pulses	11	3.1	**VI**
4.	Maize	3	0.9	**VIII**
5.	Oilseeds	3	0.9	**VIII**
6.	Sugarcane	39	11.1	**III**
7.	Horticulture	75	21.4	**II**
8.	Agro-forestry & Medicinal plants	7	2.0	**VII**
9.	Others	17	4.8	**V**
	Total	**351**		

(B) Technology-wise Agro-advisory information seeking behavior :

The visiting farmers seeking advice in the research station were grouped into five categories viz., Varieties, Crop production, Plant protection, Farm mechanization, Post harvest technology (PHT) and others (like organic farming, training programmes on agriculture & Horticultural crops, mushroom cultivation, Animal husbandry, Rodent control etc.) (Table 2).

Table 2 : Technology-wise Agro-advisory information seeking behavior :

	Varieties	Crop production	Plant protection	Farm mechanization	PHT	Others	Total
May	3	6	3	1	0	3	**16**
June	9	8	2	0	0	3	**22**
July	3	11	8	0	1	4	**27**
Aug	1	11	16	0	0	2	**30**

Sept	5	15	31	0	1	10	**62**
Oct	1	8	53	0	0	1	**63**
Nov	8	7	20	0	1	1	**37**
Dec	11	5	15	0	1	0	**32**
Jan	2	4	8	0	0	0	**14**
Feb	2	3	9	0	0	2	**16**
March	3	2	11	0	1	1	**18**
April	3	0	9	0	1	1	**14**
Total	**51**	**80**	**185**	**1**	**6**	**28**	**351**

(C) <u>Per cent frequency of farmers seeking Technology-wise Agro-advisory</u>

The per cent frequency of farmers seeking Technology-wise Agro-advisory is furnished below and ranking was given accordingly.

Table 3 : <u>Per cent frequency of farmers seeking Technology-wise Agro-advisory</u>

S.No	Area of advisory	Frequency	Percentage	Rank
1	Varieties	51	14.5	**III**
2	Crop production	80	22.8	**II**
3	Plant protection	185	52.8	**I**
4	Farm Mechanization	1	0.2	**VI**
5	PHT	6	1.7	**V**
6	Others	28	8.0	**IV**
	Total	**351**		

The above data (Table 3) in respect of per cent frequency of farmers seeking Technology-wise Agro-advisory showed that majority (>50%) of farmers are approaching the research station for getting plant protection advice compared to other technological advices, that too seeking more advice on paddy crop (Table 1). The findings are in conformity with the findings of Manisha Pandey and Dhriti Solanki (2014) and Msoffe (2015) who reported high utilization of protection related advisory by majority of the respondents when compared to other technological aspects.

Since, paddy crop is planted in the months of August-September, plant protection plays major role in raising successful crop. Hence, most of the farmers are enquiring about plant protection measures to be taken up during critical periods of crop growth (September-October). Further, the apparent attack of pests & diseases throw the rice cultivators into panic and they rush to the research stations for seeking advice to protect the crop, as it is the food crop for their livelihood. Since, farmers in the district are small and marginal, they bestow their efforts on instant sustainability of the crop rather than paying attention towards long term benefit yielding practices like soil health management, improved agronomic management practices, farm mechanization etc. Due to very small farm holdings (<0.2ha) in most cases, farmers are paying less attention on farm mechanization and further the family labour involvement in paddy cultivation does not compel them to go for mechanization, in spite of escalating labour problems.

Table 4 : Seasonal frequency of visiting farmers for getting agro-advisory :

Year	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	**Total**
2013-14	-	-	3	4	4	8	13	15	22	4	5	12	**90**
201-15	9	8	2	14	6	33	16	10	2	4	6	4	**114**
2015-16	5	8	17	9	20	21	34	12	8	6	5	9	**154**
Total	**14**	**16**	**22**	**27**	**30**	**62**	**63**	**37**	**32**	**14**	**16**	**25**	**351**

The above data (Table 4) showed that farmers are seeking agro-advisory more so on plant protection measures during September and October months due to occurrence of more of pests & diseases during peak period of crop growth in paddy. This observation prompts the resource persons offering agro-advisory to bestow their attempts on diagnostic field visits during that period to reach the needy farmers in time for getting desirable results.

II. Extension strategies proposed based on the agro-advisory seeking behavior :

Due to heterogeneous farming conditions prevailed throughout the season and locations and limited availability of resource persons, the following planned efforts are required for rapid strives in agricultural growth in Visakhapatnam district.

1. Establishing localized plant health clinics at Mandal level
2. Developing Master Trainers at village level
3. Recruiting qualified graduates in the input dealers shops
4. Organizing seasonal diagnostic field visits at cultivators holdings, besides organizing vocational training programmes at Institute level
5. Conducting polam badulu on large scale taking into consideration in the heterogeneity of crop growing conditions

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Sustainable Development Goals and Nutrition security

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Almost all the 17 SDGs shall directly or indirectly lead to nutrition and food security and better health. Nutrition security involves the availability and accessibility to a variety of foods that provide all nutrients required for a balanced diet.

A balanced diet is needed for good health and well being (SDG3). It should provide all the macro and micronutrients in the right proportion- It includes adequate physical activity and water intake. This is rarely achieved unless we consciously adhere to a planned food intake and a planned food production

Historically balanced diet would have never existed. Pre Historic man ate what was accessible and when available. There would have been phases of binge eating and times of near starvation. Human evolution and survival of the fittest would have modified the physiology and metabolism. Protein intakes were very high due to a predominantly meat based food. Fiber and micronutrients would have come through wild fruits,berries , leaves, tubers etc. Tubers, honey and natural sugars from other foods were the carb sources. Their energy needs were primarily from Fat from the animal foods and secondarily through carbohydrates. Energy needs would have been higher due to constant physical activity and only sufficient fat intakes would have sustained them. During times of plenty there would have been fat accretion and during winters when food was scarce their energy needs would have been primarily for basal metabolism and keeping warm and this would have come from body fat stores.

Agriculture and domestication of animals and a stable living in small communities had brought about significant change in lifestyle. Carbohydrates would have been the dominant source of energy in their diets along with fruits and vegetables, milk, fermented milk along with meat, fish etc. Physical activity levels would have been more uniform across the seasons.It is possible that body composition would have changed during this transition.

In this manner there would have been significant changes both in the diets as well as activity levels whenever major changes happened in human activity and way of living and food production. . Nutritional deficiencies were more common than nutrient excess. Food was processed and prepared in homes and rarely bought off the shelf except the raw and primary processed foods. Hand processed cereals had the goodness of whole grain, crude extraction of oils had all the natural anti oxidants and nutrients. Poultry were free living and hence lean. Infectious diseases due to poor hygiene which further worsened the nutritionals status was a major problem.. During the late 70’s in India the pendulum started swinging to the other end of nutritional adequacy and excess. Increased food production, better food technology, large scale processing methods, open market economy across world markets, transportation, more disposable incomes, living on credit, labor saving gadgets across all fields of activity and a fast life with less time for food processing at home.. Physical activity levels fell and energy intakes increased marginally but the sources of energy were refined carbohydrates and fat. While earlier lifestyle changes took several hundreds of years for transition, the present one has happened in less than 50 yrs. In human evolution this is almost an instant change. Unfortunately the genetic programming doesn’t change at that speed. The extra energy could not be used since physical activity came down. The overweight and obese population gradually increased initially in urban areas and now even rural and some tribal areas too. Due to better job and income options in cities and less attractive agriculture incomes , populations have migrated and they had to adapt to the wrong kind of foods compared to their traditional ones. The rapidity of transition form a low glycemic low fat food to a highly processed and exactly the opposite kind of foods have led to an explosion of Non Communicable Diseases

(NCD).

The presence of hidden micronutrient deficiencies like B12, Folic Acid, Vit D etc has added to the mishandling of these excess calories.

In the present day a balanced diet has to be consciously achieved and this requires commitment on the part of individuals and they need to inculcate these foods habits in their families. Agriculture should be better managed and made as attractive as other sources of income and should be diverse to provide the whole range of nutrients and not just carbohydrates. And this has to happen in a environment of exciting food choices most of which are high sugar, Fat and salt containing ones.

Education particularly of women (SDG 4,5 and 10)is the key . It is not enough to curb bad foods but the good ones like fruits vegetables and whole grains should also be cheaper. This is possible with better productivity and good post harvest preservation and other technologies Encouragement and motivation to be physically active at home, school, offices and even in public places is sadly lacking.

Recommended dietary allowances (RDA) indicatethe essential level of nutrients required to lead a healthy life. The general population do not follow these recommendations . The doubts which arise in peoples minds can be innumerable. Dietary guidelines are meant to help these decisions. A pictorial depiction is a food pyramid. But not many of us may understand that the base of the pyramid that is the widest shows all the foods that can be consumed liberally. On the contrary since a peak is considered the height of achievement some may think that the foods in the peak are the best for you. Due to this , some countries have adopted a "Plate" for diagrammatic depiction of portion sizes. Indian guidelines should have something like a "Thali" or a banana leaf instead of a pyramid.

Eating out is increasingly common now in India .Taste and convenience take priority over nutritional quality in the foods served. They have no idea how much is sat fat / sugar / salt content leave alone the glycemic index. Some eateries display only the calories present . Hence a balanced diet is turning out to be an abstract entity. Very motivated individuals alone can plan and follow a balanced diet. Dietary guidelines, pyramids and Plates will provide a broad concept of which are very good to eat , good and not so good to eat .

People who already have a disease need to modulate their diets over and above the balanced diet concept. Portion control in itself is a good step to regulate diets. Eating small portions, chewing slowly, eating with the family have all been known to contribute to good eating habits and thus good health.

Protein foods like egg whites, lean meat, fish , pulses and legumes preparations produce a sense of fullness and satiety. Similarly salads with a combination of lean meet, green leafy vegetables and other vegetables and fruits are healthy and filling components of a meal. Small frequent meals are recommended but invariably these are unhealthy snacks rather than healthy options

Vegetables are always good and there is no restrictions on the quantity except for potatoes and other starchy tubers which are not to be considered as vegetables at all.

Fats are responsible for making processed and other foods energy dense. But they also impart taste to foods. Saturated fats are not as good as unsaturated however the energy content of fats are the same whether it is 5 G of Ghee or 5 G of Olive oil. The negative effects of fat on health were more due to saturated fats and Trans fats. Exclusive omega 6 Unsaturated fats are also not advisable unless 20% of the fat also contains Omega 3 or the diet is balanced with adequate fish intake. Our oil seeds production should be encouraged to produce those with a balance of mono unsaturates, n6 poly and n3 polyunsaturated fatty acids through the use of appropriate technology.

Foods which leave a visible amount of fats on our plates at the end have a higher than required amount of fat in them. Another method of balanced fatty acid intake is to rotate the kind of oils we use between saturate, Mono unsaturated, PUFA n6 and PUFA n3. The total recommended intake of fats is 25 G of visible fat per day and the total energy of 30% of our calories could be from fat. While all fats are good in moderation, partially hydrogenated vegetable oils and the products thereof are to be avoided. Most bakery and snack foods may contain trans fat.

Cholesterol comes only from animal sources of fat eg Ghee, butter. It was till recently a highly restricted commodity considering the risk of cardio vascular disease. But recent evidence shows that CVD risk are not directly related to cholesterol and definitely not related to dietary cholesterol and restricting dietary cholesterol does not alter blood cholesterol levels since the body would anyways produce the cholesterol. It is prudent however to limit to the RDA of 300mg per day and if blood levels were to be high then resort to pharmacotherapy if found necessary.

The present villain in our diet is not fat but sugars particularly the added sugar in processed foods. These include sugars in all forms like sucrose, glucose, high fructose syrup, honey, jaggery etc.. The entire day's allowances of sugar from all sources includes the sugar we add to tea or coffee shall not exceed 6 tsps for women and 9 tsps for men . Fruit juices if 100% with no added sugar are better than juices with water and sugar added. A whole fruit is better than only the juice of that fruit. A whole fruit also provides several other good nutrients, anti oxidants, fiber, water and electrolytes etc. The thumb rule is to avoid or limit any food to which sugar has been added.

Salt is another ingredient that is essential particularly in tropical climates. But salt beyond 5 to 6 gm in a day would contributeto the risk of developing high blood pressure. Salt loss even during warm and humid conditions can be balanced with a 5- 6 G daily consumption. Salt and sweet taste are acquired and it will be good to keep them to the minimum and train the tongues right from 6 months of age. Sufficient fruit intake can also enhance sodium elimination from the body due to their high potassium content.

Proteins:

Lean meats like poultry and fish along with eggs and milk are good sources of protein of good quality. Pulses and legumes contain a good amount of protein . Cereals have less protein but due to the large quantities eaten they do contribute significantly to our protein intakes. Vegetarian sources of protein are relatively of poorer quality both due to missing essential amino acids as as well as a low digestibility. A combined cereal and pulse based diets supplemented with milk in a vegetarian diet should provide all the amino acids required for growth. Low fat 1% milk is good for protein and yet safe on the fat content. The average requirement of protein is 1Gm/ Kg Body weight . High protein diets are to be avoided in persons with compromised kidney function. High proteins even in infants and young children is not a good thing. There needs to be a balance between protein and energy intakes for effective utilization of the protein in the body.

Micronutrients: These are available in adequate amounts through fruits and vegetables and other natural foods. Supplements are generally not required. A diverse diet will provide all of them. Fortified foods also are sources of micronutrients. Our body with sunlight exposure synthesizes Vitamin D . Excessive intakes of vitamins and minerals do not give any added health advantage. Some of them like Vitamin A, D, Calcium, iron, Zinc, iodine could cause harm if constantly consumed in high quantities.

Iron deficiency is a major problem due to low iron content and low bioavailable iron in vegetarian foods. There has to be better varieties identified which can circumvent this problem through farming practices. Zn is also inadequate in our foods and attention to soil nutrients to improve crop micro nutrient is a critical area for research and extension.

Moderation is the key to good health. One should eat only if there is hunger and have smaller and more frequent meals and stop just before a feeling of fullness perceived. In between snacks could be fruits rather than energy dense snacks.

Physical activity is an inherent part of good nutrition. Regular monitoring of body weights, waist circumference, fasting blood glucose once in 3 months, blood pressure once in 3 months, a general health check once a year along with a set of basic investigations including liver and kidney function are essential and a worthwhile investment for good health. Good health and well being of the farmers will indirectly improve farm output and better livelihood.

The quality of our lives depends on how much care and attention we give to it..Primary prevention is much more economical in all respects than secondary. Scientists, health professionals and nutritionists provide general guidance, whichmay or may not apply to some. Individualized nutrition planning is required for maximum benefit.

Recommended reading

1. Recommended dietary allowances for Indians- NIN ICMR 2010
2. Dietary Guidelines, NIN ICMR 2010
3. WHO – global strategy on diet and physical activity
4. Dietary Reference Intakes IOM.
5. Food based dietary Guidelines in Europe (EUFIC)
6. Authentic sources of information from University websites, Peer reviewed articles from reputed journals, International regulatory bodies like USFDA, USDA, EFSA, FSSAI , FSANZ

AGRI-CLINICS &AGRI-BUSINESS CENTRES AND ITS SERVICES FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURE, IT'S ALLIED ACTIVITIES AND GROWTH OF FARMING COMMUNITY FROM MICRO-LEVEL

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Introduction

For the food of all and sustainable development we need to develop a true human being with knowledge keeping in view that the evils of caste, creed, and religion which has plagued the entire society. We have to teach the real karma, dharma and religion also along with sustainable knowledge.

1. Moral, social, cultural upliftment of the human beings can cure and eradicat many diseases.

2. Primary and youth education, family and surrounding environment decides the faith and way of living of a human being and the progress of a nation.

3. Nature (Prakriti) and human beings are eternally same and are interdependant.

To begin with Programme planning and project, its success is in the essence that with what dedication you are using your intelligence and experience.

We need to go back to the basics; awareness, understaning and meditations. It is time mankind matures into being truly human. The maximum survival of the fittest is no longer valid and is not capable of meeting the evolving pluralistic, democratic aspiratikns of mankind today. We have no choice but to grow into realising what Jonas Salk said "Survival of the wisest".

Our duty at present is to go from village to village and make the people understand that mere sitting about idly won't do anymore. Make them understand their real condition and say,"Oye brothers and sisters, all arise, awake how much more longer would you remain asleep"…...... also we have to teach and instruct them, in simple words about the necessities of life and in education, trade, commerce, agriculture etc. We should also educate the real culture and religion and the way to live and let others to live.

Every improvement in India requires first of all an upheaval in religion. The purpose of every religion is to eliminate the ego sense so that we can love the whole of humanity as we love our own family. Therefore, this clash, dissension and chaos in the name of religion are nothing but madness.

CHRIST said "Love thy neighbor as thyself". In the Hindu scripture it is said “See God in all beings and love them". Mohammed preached universal brotherhood. He said “You are all children of one parent and therefore must live with each other like brothers and sisters". These great teachers/saints taught us the same truth, but forgetting that, we have formed many distinctions and barriers amongst ourselves and have started hating each other. There is discard instead of unity and hate instead of love.

Therefore, the time has come to develop and deploy an army of technically qualified extension workers with human mindset. Therefore, let us work for that knowledge which will bring the feeling of sameness towards all mankind which will lead us to a real progress and prosperity.

Agri-Clinics & Agri-Business

We have conducted our Agri-Clinics & Agri-Business Training Programme (ACABC) with missionary zeal and have tried to develop trained entrepreneur/extension workers who can transfer the sustainable technology and knowledge with human mindset.

We have around 6000 Blocks in the country and a vast potential of unemployed Agriculture Graduates and skilled, dedicated and systematic application of their potentiality and services can address all the issues including the present scenario of global warming and climate change, and its impacts on Agriculture.

In the present farmer, farming and agriculture scenario, if we are able to provide all the infrastructure facilities and inputs from soil water quality testing to quality produce and value addition, post harvest Management technologies, and application of marketing network through farmer centered, participatory approach and application of information technology, we can bring evergreen revolution in all the fields of intensive agriculture from micro-level in the years to come.

In the past three decades. One third of the planet's natural wealth has been consumed. As India tries to accelerate its economic growth. It becomes even more important to understand how this growth will impact the human and physical environment. Sustainable development can be achieved only when economic growth benefits the poor and underprivileged who live on the fringes of society. A majority of these poor are in rural India. Sustainable development also similarly requires continuous replenishment and enrichment of environmental capital, which is getting alarmingly eroded today.

Today the whole world is trying to address the critical issue of sustainability. All organs of society therefore need to work together in mutual partnership in a collective endeavor to achieve economic growth along with social development and environmental enrichment. Development of technologically expert agricultural extension system with a mandate and mission is the need of the hour. The corporate sector has special responsibility to contribute this larger mission while achieving its business objectives. The Indian corporate sector, while generating economic surplus, needs to sharpen its focus on replenishing natural capital and on eliminating poverty, participation and linking of private extension system and its services with corporate sector and financial institution will generate all the infra-structural facilities and inputs from soil water and input quality testing lab to quality produce, post harvest management technologies and marketing network through farmer centered, participatory sustainable development approach and application of information technology.

To feed India's burgeoning population and effectively ensure long-term food and nutritional security, new policy initiatives are a must. India is challenged by declining per capita availability of arable land, low productivity levels, heavy production losses due to biotic (insects, pests, weeds etc) and a biotic (salinity drought, flood etc) causes, heavy crop losses during storage, absence of profitable & ensured marketing infra-structural system and facilities from micro-level and transportation and declining availability of water as an agricultural input. The way out of this dilemma is technology and development of systematic infra-structural facilities.

Business houses and corporate sector (coming in a big way in the field of agriculture) are and will be in need of quality produce with quantity and their requirement (which will increase and multiply in many-many folds) is presently compensated by many middle men whom they also pay commission and the negative points is that these middle men are not technically qualified and there is always a hidden risk of quality produces. And added advantage with technically expert Agri-preneurs to them are that they will be able to plan their future marketing strategies with quality and quantity in domestic as well as in international markets.

Most of the agri-business suffered from the non-availability of quality raw material at acceptable price. Indian agriculture is characterized by the preponderance of small and medium sized land holdings, which are not cost effective to serve the industries requirements. This scheme can fill this gap of scarcity and can become the market hub and the tool of development to balanced nature and remarkable example of private-public partnership from micro level, which will ultimately open many gates of social, economic and cultural activities in the country.

After quality training and entrepreneurial skill development Agri-Clinics & Agri- Business Centers are established at Nyay-Panchayat level. Keeping in view that all the services required to farmers for sustainable development of Agriculture by adopting ecologically friendly measures from soil test to post –harvest management including value addition are available at their door-step.

Projects are established in phases:

1st Phase with the dealership of inputs-seeds, fertilizers, pesticides (bio-control agents)

SERVICES:

(a) Awareness towards latest emerging technologies and field practices through contacts, meetings/kishan gosthies etc.

b. Extension and supervisory services as per need of the soil, irrigation facilities and climate.

c. Awareness towards the impacts of climatic changes, Soil health care, Water harvesting, conservation and management, Integrated nutrient and pest management, Energy conservation and management, Post harvest technology and management, Integrated Crop/livestock systems with value addition, Need of the information management and network systems.

d. To provide appropriate quantity and quality inputs as per need of the soil, irrigation facilities etc.

e. To provide extension supervision and monitoring services throughout the crop/plant period.

2nd Phase: After the success of 1st phase they will go for the 2nd Phase with value addition, animal husbandry and other allied agri-industrial (including storage, cool chain etc.) Because continuous quality extension and consultancy services with quality inputs as per need of the crops and animal husbandry with production technology and management of the 1st Phase will establish the credit of ACABC in their area of operation and thus the failure for 2nd Phase project becomes negligible.
Continuous capacity building, reorientation and retraining towards weaknesses, monitoring and supervision is additionally provided to ACABC to achieve result oriented viability by the organization, but not up to our satisfactory limits of its requirements as these areas lack optimum funding.

Hand holding facilities:-

We have permanent monitoring, supervision cell. Experts have also been engaged on contract basis to facilitate agri-preneures queries if there are any.

Continuous monitoring, supervision, capacity building, reorientation and retaining towards weaknesses are additionally provided to ACABC to achieve result oriented viability by the organization.

Agri-Clinics and Agri- Business entrepreneurs associations have been formed in the year 2004. Six Monthly meetings of the trained agri- preneurs at the institute and Kisan Goshtis etc. at Agri-Clinics centers are continuous activities, for evaluation and awareness.

Now we have started farming Agri-Clinic and Agri-Business sub-association committee at district level. Meetings are scheduled on first day of every month at Vikas Bhawan/Lead bank Office/Krishi Vigyan Kendra. Participants are LDM and Bank representatives; DAO-Krishi Vigyan Kendra and DDM of NABARD.

We have established 2500+ ACABC Centers covering every district in U.P. till date. Two months training is a continuous process. Every month around 25 new ACABC Centers are established.

Organization’s financial resources are limited and are not able to fully add the visions of sustainability.

Aim:

1. To make aware and provide existing and latest technological development practices of sustainable agriculture practices and management through contact, meetings and visual aids etc.
2. To avoid middlemen and distress sale: - Development of ACABC center as a place of storage and market hub for the farmers produce and value addition etc.
3. To provide production strategies, consultancy and management technology based on the geographical and climatic conditions of the regions as per need of domestic and world market.
4. To develop ACABC as a place for dissemination of knowledge and social values.

5. As a place of credit facilities to farmers as per their need involving commercial and private banks. (ACABC should monitor and supervise the actual need of credit, use and recovery.
6. ACABC is an ideal place for Market Information Services.

We are of the considered view as per our experiences that the ACABC can become a model tool of sustainable development of agriculture and it's market, and they must be provided supporting facilities and assistance in the interest of nation because no growth can be sustainable if it does not benefits the poor and underprivileged and also if it disrupts and destroys the basic eco-system for the sale of short term gains.

But success not lies in the training and production of trained entrepreneurs, because it is the proper, smooth and systematic performance and establishment of ACABC which matters and to achieve greater success rate, many gaps and arms are still to be addressed to achieve the logical end in the interest of the country, which are as under according to our experiences.

Financial Assistance and Support: After all the quality training and efforts, the honest support and cooperation of the financial institution from top to micro level is more important for the success of any scheme in national interest.

The attitude of financial institutions/commercial banks is not encouraging and the Bank Branch Manager knowingly creates many hindrances

Information Technology in Agricultural marketing:

Boosting agriculture and its allied activities with quality produce and value addition and it's national and international networking for the benefits of the farmers at micro-level institutional/organizational infrastructure should be developed/established to provide latest technological developments, advance weather information, need and requirements of the Agricultural commodities of domestic and global markets having different geographical situations. These institutional infrastructures should be developed or established at regional level based on the soil and climatic conditions of the region.

Internet facilities and linking of Agri-Clinics with such institutional arrangements and with AGMARKNET will help the Agri-Clinics and Agri-Business centers to plan and implement the Agricultural production strategies of the area by providing consultancy, inputs, production and post-harvest management technologies to farmers as per need of the domestic and world market based on agro-climatic conditions.

ACABC will nullify the role of middle men and will ensure that the quality produce, processed and value added products are profitably marketed (domestically and internationally) and if need scientifically stored and pledged for financing and marketing credit to avoid distress sale or to fetch good market price to provide small farmers the economic strength to retain the produce with themselves till the market prices are favorable.

Future Trading:

Needs for the prosperity of rural India:

a. To eliminate the role of middle men and rural money-lender (Mahajan)-As explained above ACABC can act as a service provider for the viability of the credit made available by the commercial or private banks for the production, storage and marketing.
b. Direct participation of farmers from micro-level in the Purchase and Sale of the commodities at every stage of the market.
c. Participation and linking of ACABC and its services with domestic market, export houses and financial institution will generate all the infrastructure facilities including marketing network through farmers centered, participatory approach and application of information technology.

Therefore, all organs of society need to work together in mutual partnership in a collective endeavor to achieve economic growth along with social development and environmental enrichment. The Corporate sector has special responsibility to contribute to this larger mission as a humble service of the nature while achieving its business objectives. The Indian corporate sector while generating economic surplus needs to sharpen its focus on replenishing natural capital and on eliminating poverty.

National Food Security Mission (NFSM) - An Overview

Dr. B. Rajender

1. Background:

1.1 The agriculture and allied sector had been facing numerous challenges. Even as the country has made large strides in increasing food production and achieving food security through green revolution, the sector remain constrained by low productivity, excessive dependence on monsoon and weather conditions, continuing fragmentation of land and preponderance of fragmented markets. As a result, the Government has engaged in fresh thinking on the development of the agriculture sector. The multi-pronged strategy for agricultural development now focus on agricultural growth through sustainable use of natural resources such as soil and water and at the same time taking steps for improving the socio-economic conditions of farmers.

1.2 The National Development Council (NDC) in its 53rd meeting held on 29th May, 2007 adopted a resolution to launch a National Food Security Mission comprising rice, wheat and pulses to increase the annual production of rice by 10 million tons, wheat by 8 million tons and pulses by 2 million tons by the end of the Eleventh Plan (2011-12). Accordingly, a Centrally Sponsored Scheme, 'National Food Security Mission' (NFSM), was launched in October 2007. The Mission met with an overwhelming success and achieved the targeted additional production of rice, wheat and pulses. The Mission remain continued during 12th Five Year Plan with new targets of additional production of 25 million tons of food grains comprising 10 million tons rice, 8 million tons of wheat, 4 million tons of pulses and 3 million tons of coarse cereals by the end of 12th Five Year Plan. Based on past experience and feedback received from the States changes were made in approach, rate of financial assistance and programme implementation during 12th Five Year Plan. The National Food Security Mission (NFSM) during the 12th Five Year Plan had five components (i) NFSM-Rice; (ii) NFSM-Wheat; (iii) NFSM-Pulses, (iv) NFSM-Coarse cereals and (v) NFSM-Commercial Crops.

2. Objectives:

2.1 Increasing production of rice, wheat, pulses and coarse cereals through area expansion and productivity enhancement in a sustainable manner.
2.2 Restoring soil fertility and productivity at the individual farm level.
2.3 Enhancing farm level economy (i.e. farm profits) to restore confidence amongst the farmers.

3. Strategies:

Strategies include focus on low productivity and high potential districts including cultivation of food grain crops in rainfed areas; implementation of crop centric interventions; agro-climatic zone wise planning, cluster approach for crop productivity enhancement; utilization of rice fallow and rice bunds for pulses; inter-cropping of pulses with coarse cereals; oilseeds and commercial crops (sugarcane, cotton, jute), Promotion and extension of improved technologies i.e., seed, integrated nutrient management (INM) including micronutrients, soil amendments, integrated pest management (IPM), input use efficiency and resource conservation technologies.

4. Area coverage:

Three components of NFSM namely NFSM-Rice (144 districts of 16 states), NFSM-Wheat (142 districts of 9 states) and NFSM-Pulses (468 districts of 16 states) were implemented during 11th Five Year Plan. Six NE states namely Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Sikkim and two Hill states, viz., Himachal Pradesh and Uttarakhand were included under NFSM-Rice from 2012-13. From the year 2016-17, NFSM is implemented in 638 districts of 29 states. NFSM-Rice is being implemented in 194 districts of 25 states. NFSM-Wheat is being implemented in 126 districts of 11 states. NFSM-Pulses is being implemented in 638 districts of 29 states and NFSM-Coarse cereals is being implemented in 265 districts of 28 states. The state wise number of districts covered under each of the components of NFSM during 2016-17 is appended**.**

5. Interventions:

Interventions includes cluster demonstrations with latest crop production technologies such as timely sowing, seed rate, recommended package of practices, promotion of newer varieties/hybrids, stress tolerant varieties, assistance ons integrated nutrient management for maintaining soil health and to improve yield and integrated pest management to protect the crops from insects, pests and diseases, promotion of improved farm machineries for timely completion of agricultural operations and reduction in cost of cultivation, water saving devices like sprinklers, rain-gun and water carrying pipes to save precious water and avoid to flooded irrigation; Cropping system based trainings to farmers for updation of their knowledge and capacity building.

6. Additional Area coverage:

Additional Area coverage programme for increasing pulses production was started during Rabi/Summer 2015-16. This programme includes cluster demonstration and seed distribution of newly released varieties. The programme continued during 2016-17 with change of funding pattern from 100% to 60:40 sharing between Centre and States under general category and 90:10 for North-eastern & Hilly states.

7. Research Support:

National Food Security (NFSM) also provide assistance for conducting strategic adaptive research, addressing various research issues and yield gaps to State Agriculture Universities (SAUs), National and International Research Organizations.

8. Training:

National Food Security Mission (NFSM) provides assistance for organizing training of trainers/farmers, which plays crucial role in speedy dissemination of improved crop production practices. Based on cropping system approach, four sessions of each training are organized one at the beginning of Kharif and Rabi season, one each during Kharif and Rabi season. The training will be imparted by crop/subject matter specialists of ICAR institutes/SAUs/KVKs and will involve management (agronomic and plant protection practices) including primary processing of produce, storage etc.

9. Other initiatives:

9.1 Support for specialized projects for high productivity areas such as reclamation of problematic soils, development of water-logged areas and mitigation of adverse impact of climate change.

9.2 Support to institutes/organizations including NGOs in remote areas to suitable institutes/organizations including NGOs for undertaking clusters demonstrations.

9.3 Support for formation and strengthening of Farmer Producer Organizations (FPOs) for value chain integration of small producers.

9.4 Assistance to small land holders for hiring of machines from custom hiring centres for farming operations.

9.5 The support for value addition and marketing in pulses and millets includes establishment of mini dal mills by farmers/ farmer groups /registered FPOs; branding and marketing of milled pulses or millets; marketing support to un-registered farmer groups; SHGs, SHG federation etc. for local marketing of pulses and millets; support to registered FPOs to set up and equip procurement centres to grade and process pulses and millets.

9.6 To enhance pulse production, 150 seed hubs are being supported. Breeder seed production programme at ICAR institutes including SAUs is being strengthened. Central Seed Agencies like NSC, KRIBHCO and HIL are involved in seed production programme for increasing availability of seed and supply of free seed minikit of pulses. Pulses are also being promoted under 'Targeting Rice Fallow Areas in Eastern India', a sub-scheme of RKVY in the states of Assam, Bihar, Chhattisgarh, Jharkhand, Odisha and West Bengal.

10. Monitoring:

Implementation of National Food Security Mission (NFSM) has inbuilt provision for monitoring at National Level by General Council of National Food Security Mission-(NFSM-GC), under the chairmanship of Union Agriculture and Farmers Welfare Minister; State Level by State Food Security Mission-Executive Committee (SFSM-EC) and at District Level by Agricultural Technology Management Agency (ATMA). Apart from these, Project Management Team (PMT) are also created at National, State and District level to guide in organizationa/ technical matters, implementation and monitoring.

11. Outcome:

Implementation of NFSM coupled with good monsoon have resulted in ever highest estimated **food grain production** of 271.98 million tonnes during the 2016-17 as against the previous highest production of 265.04 million tonnes during 2013-14 (a good monsoon year). Special focus given on increasing the pulses production has also shown an excellent growth in pulse production from 19.25 million tonnes in 2013-14 (a good monsoon year) to 22.14 million tonnes in 2016-17. The Plan and crop wise targets and achievements are given in Table-1 & 2 respectively.

Table:-1 Crop-wise targets and achievements during XI Plan

Component /Crop	2006-07 (base year)	Targeted addl. production by end of XI Plan	Achv. for Terminal year of XI Plan (2011-12)	% increase over base year (2006-07)
1	**2**	**3**	**4**	**5**
NFSM-Rice	93.36	10	105.30	12.79
NFSM-Wheat	75.81	8	94.88	19.90
NFSM- Pulses	14.20	2	17.09	20.35
Total Food grain	**217.29**	**20**	**259.29**	**19.33**

Table:-2 Crop wise targets and achievements during XII Plan

Component / Crops	2011-12 (base year)	Targeted addl. production by end of XII Plan	2016-17*	% increase over base year (2011-12)
NFSM-Rice	105.30	10	108.86	3.38
NFSM-Wheat	94.88	8	96.64	1.85
NFSM- Pulses	17.09	4	22.14	29.55
NFSM-CC	42.01	3	44.34	5.55
Total Foodgrains	**259.28**	**25**	**271.98**	**4.90**

* 2nd advance estimates

Appendix

State wise number of districts covered under National Food Security Mission (2016-17)

Sl. No.	State	Number of Districts covered under			
		NFSM-Rice	NFSM-Wheat	NFSM-Pulses	NFSM-Coarse Cereal
1	**2**	**4**	**5**	**6**	**7**
1	Andhra Pradesh	5	-	13	6
2	Arunachal Pradesh	10	-	17	17
3	Assam	13	-	27	4
4	Bihar	15	10	38	11
5	Chhattisgarh	13	-	27	9
6	Goa	-	-	2	-
7	Gujarat	2	5	26	8
8	Haryana	-	7	21	5
9	Himachal Pradesh	2	11	12	12
10	Jammu & Kashmir	8	8	22	22
11	Jharkhand	4	-	24	11
12	Karnataka	7	-	30	11
13	Kerala	1	-	14	1
14	Madhya Pradesh	8	16	51	16
15	Maharashtra	8	3	33	8
16	Manipur	9	-	9	9
17	Meghalaya	7	-	11	11
18	Mizoram	6	-	8	8
19	Nagaland	11	-	11	11
20	Odisha	8	-	30	6
21	Punjab	-	12	22	3
22	Rajasthan	-	14	33	12
23	Sikkim	2	-	4	4
24	Tamil Nadu	8	-	30	10
25	Telangana	4	-	9	6
26	Tripura	8	-	8	8
27	Uttar Pradesh	23	31	75	20
28	Uttarakhand	5	9	13	13
29	West Bengal	7	-	18	3
	Total	**194**	**126**	**638**	**265**

INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE DEVELOPMENT WITH FOCUS ON AGRICULTURAL EXTENSION

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In the newly carved state of Telangana, 85% of the farmers are depending on marginal land holdings for their livelihoods. The number of land holdings in state has increased from 48.28 lakhs in 2005-06 to 55.54 lakhs during 2010-11 due to increased population and fragmentation of holdings. During these years the average land holding size in the state has shrunk marginally from 1.30 to 1.11 ha. This lower land holding size is uneconomical to operate and farming is not sustainable. These small holder farmers having less than /up to 2 ha land, although contributing significantly to the states' food grain basket, are unable to generate sufficient income to meet their family requirements / needs. Farmers are realizing meager income from cultivating crops under limited water resources through open and bore wells. Further, our soil are over exploited by growing the crops season after season and often putting pressure on the soil to produce more even by intercropping. The soil available reserves of the nutrients are shoveled heavily. The organic carbon reserves are depleting fast. The addition of organic sources to amend the soils physical properties and addition of small amounts of nutrients in the bygone days has become a casual practice. The high imbalance in nutrient application emerged as the major impediment to bountiful crop production. The ill effects are more pronounced in the context of changing climate. Effective use of all the farm resources makes it possible to increase the productivity and income in small farms. Integration of a diverse range of crops for food, fodder, vegetables and fruits, livestock for milk and birds for eggs and meat will help in achieving the food and nutritional security of farm households in addition to creation of an opportunity of year round employment on the own farm. The farming systems approach is the need of the hour and the system mainly works on the principle of recycling where in the output or waste from one component serves as input for other component of the system with less dependence on external inputs. Inclusion of wide range of allied enterprises along with cultivation of crops assures the farmer year round income and employment with higher productivity.

The outcome of a study on farming system model developed for improving livelihoods of peri urban farmers conducted during 2015-16 at the main farm, Agricultural research institute of Professor Jayasanker Telangana State Agricultural University, Rajendranagar are encouraging which is discussed here under.

Methodology

The model occupied 1.0 ha of land with crop +fodder + horticulture + livestock + recycling unit. To address and assure various needs of farm family like food, vegetables, milk, meat and fodder for live stock and manure for soil, the area is divided into 5 blocks viz., cropping unit, horticulture block, fodder Block, livestock unit and recycling unit.

The first block of cropping system was involving rice-sweet corn- dhaincha on 0.20 ha. A newly released fine grain rice variety, RNR 15048 and popular hybrid of sweet corn Sugar 75 were used in the study. Dhaincha was grown with 10 kg seed. The heavy seed rate was to occasionally collect the foliage of this legume as green fodder until it was incorporated in the soil *in situ* at flowering stage of the crop.

The horticultural unit was comprising of banana garden in 0.15 ha with variety Grand 9 at a spacing of 1.8 x 1.8 m with 525 plants. Another 0.2ha of land was dedicated for cultivation of vegetables like brinjal (variety Shyamala) and tomato (hybrid Vishwanathan) during kharif and rabi respectively. Vines of bitter gourd, bottle gourd and cucumber were trained on a pandal of 400 m^2 or 4300 sq ft i.e. 0.04 ha. Bitter gourd was grown on bunds over 360 ft length, bottle gourd on 230 ft and cucumber on 66 ft running length. Thus a total of 0.6 ha is allocated to food grain, fruit and vegetable crops.

In fodder block, green fodder crops were raised on 0.38 ha. Annual fodder Jowar variety CSH 24 MF was raised in an area 0.06 ha during kharif and African tall variety of maize in *rabi* seasons. The perennial hybrid napier was grown on another 0.20 ha with 2 varieties Co 4 and Co 5 on 0.10 ha each in the *kharif* season. Another 0.12 ha of land was ear marked for cultivation of leguminous fodder Lucerne.

A low cost shed was constructed in 0.02 ha area admeasuring 75x25 fts and it was made into 7 compartments so as to rear Quails, Rabbits, Desi Poultry, Sheep, Dairy in 5 compartments and two for family and store room. Five batches of quails having 1000 in each, 20+4 (Female+male) rabbits, 100+10 (Hens+Cocks) desi poultry, twenty ram lambs in batches and two dairy baffaloes are reached as viable components in the study. Establishment cost of the unit is indicated below.

Table -1: Establishment cost of shed and livestock.

S.No	Particulars	Cost (Rs.)
1.	Four Graded Murrah buffaloes @ Rs. 1,00,000 each	2,00,000
2.	Goats/sheep (20 Nos @ Rs.3500 each)	70,000
3.	Quails (1000 Nos. @ Rs. 6 each and 7 batches	42,000
4.	Rabbits (20+2 @ Rs. 300 each)	6,600
5.	Desi poultry (100+10 @ Rs.300 each)	33,000
6.	Shed cost	2,50,000
7.	Vegetable Pandal System	22,000
8.	Incubator	50,000
	Total	6,73,600

For recycling of wastes and residue from the unit a pit measuring 6x6x3 m is dug to collect the animal dung for composting as farmyard manure. Another small pit is dug, lined with stones and cement. The urine and water after washing the animal sheds pass through the slope and directly collects in this pit. This is recycled by pumping to compost pit and enriching with nutrients. A vegetable pandal is established in front of the cattle shed in an area of 0.04 ha and vine vegetables viz., Beans, Bottle gourd, Bitter gourd were grown. Twenty coconut plants of Godavari Ganga hybrid were planted on field bunds. Similarly another twenty moringa plants were grown around the shed.

Results:

Gross and net income realised from crops, quail, rabbit, desi poultry, sheep and dairy units are given and discussed separately with an initial establishment cost of Rs.6.73 lakhs and running cost of Rs.5.58 lakhs, the system generated 4.70 lakhs net income which spread over uniformily generating monthly required income to the family. Among the various components, 25.5 % net income realized from crops. Similarly10.6%, 3%, 22%,12%, and 24% of income was realized from Quail, rabbit, poultry, sheep and dairy units respectively. The IFS model under review could generate 878 employment man days per annum out of which 528 employment man days are exclusively for the maintenance of livestock units. Marketable surplus production is obtained with respect to cereals, vegetables, fruits, meat and milk. Nevertheless, required pulses and oil seeds could not be accommodated as most remunerative cropping systems are chosen / preferred suitable to peri urban / urban areas. All the bunds area which is 500 running metres in 1 ha area is utilized for the cultivation of vine vegetables and produced Rs.15,300/- worth vegetables. One hectare IFS model demands 300 kg N, 120 kg P_2O_5 and 80 kg K_2O for its crops and fodder production and the model under review could able to supply 125 kg of N, 100 kg P_2O_5 and 100 kg K_2O which is 40-45% of the system requirement from within the system. Margins in net income would be higher when one do marketing on his own. Urban areas having more purchasing power offers good source for own marketing. Some of the young and educated skilled professionals are using ICT tools viz whats App, Face book SMS and special apps for marketing the produce. Unlike the mono crop cultivating farmer, the IFS practicing farmers must have expertise of crops and livestock cultivation as well as marketing strategy. Detailed income generated from each component is given below.

Table – 2: Yields and economics of cropping system from 0.55 ha area

Sl. No.	Crop	Area (ha)	Yield (t)	Market price (Rs.)	GR (Rs.)	COC (Rs.)	NR (Rs)
1	Paddy (K)	0.2	1.4	15000	21,000	12,00	9000

						0	
	Sweet corn (R)		12,400	3	37,200	10,500	26,700
	Sunhemp(S)		12.3	-	-	3,000	-3000
2	Banana	0.15 (525 plants)	10.5	8	84,000	34,900	49,100
3	Brinjal (K)	0.2	5.3	5	26,500	13,300	13,200
4	Tamato (R)		4.6	5	23,000	12,900	10,100
	Sub Total	**0.55**			**1,91,700**	**86,600**	**1,05,100**
5	Vegetables grown on pandal & bunds	0.04					
	Beans		1.5	10	15,000	4200	10800
	Bottle gourd		300	5	1500	500	1000
	Bitter gourd		0.26	15	3900	1200	2700
	Drumsticks		400 No	2	800	--	800

			s				
	Vegeta bles				**21,200**	**5,900**	**15,300**
	Sub Total				**2,12,900**	**92,500**	**1,20,400**

Table - 3: Fodder production from different sources.

Sl. No.	Roughage	Area (ha)	Yield (tones)		Cost of Production (COP) (Rs.)
			Cereals	Legumes	
1	Paddy Straw	0.2 (K)	1.6 dry	--	--
	Sweet corn Straw	(R)	6.0	--	--
	Sunhemp	(S)	--	--	--
2	Fodder Jowar Green CSH-24MF two cuttings	0.06	(2+2=4)	-	2,800/-
	Fodder – Maize (R&S)	--	(2+2=4)	--	2,800/-
	Hybrid Napier (Co-4)	0.10	12	--	3,000/-
	(Co-5)	0.10	12	--	3,000/-
	Legume fodder (Lucerne)	0.12	4.6	10	3,500/-
	Total	**0.58**	**38**	**10**	**15,100/-**

Table - 4: Fodder requirement and availability:

S l	Liv est	Dry fodder (Tonnes) / Annum			Green fodder (Tonnes) / Annum	
		Requi	Avai		Requirement	Availability

. No.	ock	rement	lability					
					Cereals	Legumes	Cereals	Legumes
1	Buffaloes 2 Nos @ 4 kg dry, 30 kg green / day per animal	2.9	1.6	-1.3	22.0	3.0	23.4	4.2
	2 calves @ 5 kgs per animal / day	--	--	--	3.60	0.5	3.60	0.5
2	Sheeps 10	--	--	--	11.0	1.8	11.0	1.8

	Nos. @ 3kg green fodder per day per animal							
3	Rabbits 24 Nos. @ 0.4 kg / day / animal	--	--	--	--	3.5	--	3.5
	Total	**2.9**	**1.6**	**-1.3**	**36.6**	**8.8**	**38.0**	**10.0**

Economics of Dairy:

An annual expenditure of Rs. 1,26,060 as detailed in table was incurred on dairy unit during the study period and a returns of Rs 2,19,000 from sale of milk (3650 litres @ Rs. 60/litre) resulting in net return of Rs. 92,940/- in addition to Rs. 20000 per annum from Additional appreciation from calves. 16 – 18 tonnes/annum of manure worth of Rs. 4000 - 4500/annum was produced from the unit.

Table – 5: Details on costs and returns from dairy unit

S.No	Product	Quantity/yr (tonnes)	Cost of Production

Costs			
1.	Green fodder (cereals)	26	11,500
2.	Green fodder (legumes)	3.6	3,600
3.	Concentrate feed Cotton cake(@ 4 kg for each animal/day)		43,800
4.	Tuar husk (@ 3 kg for each animal/day)		67,160
	Total		1,26,060

Returns

1.	Milk yield (Market price Rs. 60/litre)	3650 litres	2,19,000
2.	Manure from dairy unit	18 tonnes/annum	4,500
3.	Additional appreciation from calves		20,000
	Total gross returns		**2,43,500**
	Net returns		**1,17,440**

Economics of Sheep

An annual expenditure of Rs 95,540 as detailed in table was incurred on sheep rearing during the study period and a returns of Rs 1,54, 780 were realised from sale resulting in net return of Rs 59,240/-

Table – 6 : Details on costs and returns from sheep unit

S.No	**Product**	**Quantity/yr**	**Cost** Rs.
Costs			
	Cost of the Ram lambs @ Rs. 3500 X 20		70,000/-
1.	Green fodder (cereals @ 3 kg/animal)	11 **tonnes**	--
2.	Green fodder (legumes @ 1 kg/animal)	3.6 **tonnes**	
3.	Concentrate feed Rice/wheat bran (@ 150 g for each animal/day)	0.5 **tonnes**	9,300/-
4.	Soybean cake (@ 100g for each animal/day)	0.3 **tonnes**	12,400/-
5	Cost of health management (vaccinations + liver tonic + deworming)		5,000/-
	Total Cost of production		96,700/-
Returns			
	Each sheep attained 35 kg in 6 months Meat yield for 20 sheep/365 days = 700 kg/yr (Market price Rs. 220/kg)		1,54,000/-
	sheep manure of 3 tonnes		780/-
	Total returns		1,54,780/-
	Net returns		58,080/-

Economics of quails

The low fat, high protein white meat of these Japanese birds is a delicacy and pleasure to eat for its taste. Quails egg weighs 7-15 grm with less fat (2.47 less than chicken) and contains more protein P, Fe, Vit-A, B1 & B2, easily digestable and good for BP, biabetic patients. In per urban the demand for quails is ery good . The birds grow well in a cool and warm weather. They are robust to diseases and do not require any vaccination. Quails attain live weight of 160-180 grams in 35 days and are ready for marketing.

Table – 7 : Details on costs and returns of quail per batch.

S.No	Product	Quantity	Cost (Rs)
1.	Chick Cost @ Rs.6 /-	1000 chicks	6,000/-
2.	Feed Cost (600 gms/bird) for 600kg	600 kg	12,000/-
3.	Mortality @ 5%	30 birds	600/-
	Total Cost of production		**18,600/-**
Returns			
1.	Sale of birds (Market price Rs. 29/bird)	1000 birds	28,130/-
2.	manure	200 kg	525/-
	Total returns		**28,655/-**
	Net returns		**10,055/-**

<u>Economics of Desi Poultry</u>

Desi poultry is known for its typical taste. Increasing demand is being noticed for its meat at Hyderabad and other urban areas. In view of this a unit consisting 100 hens + 10 cocks was started with best available local breed. Birds were grown on semi intensive system and use to got 10 eggs every day from the unit. These eggs were put to machine for incubation for hatching where 60 to 80% of eggs could hatched. The details are as below.

Table – 8 : Details of chicks production

S. No	Particulars	No. of chicks	After 10% mortality
1.	Chicks produced per month @10 eggs / day (300 eggs / month) and 60% hatching	180	160
	Per Annam	2160	1920

Chicks attains 1kg wt in 6 months period by consuming 4-5 kg feed. Own feed was prepared @Rs.25 per kg. About 1000 kg (live weight) of meat was produced per annum and sold @ Rs.250 per kg live wt.

Table – 9 : Details on costs and returns of Desi poultry per annum.

S.No	Particulars	Unit cost	Total cost	Returns

1.	Birds live wt 1000 kg	250	--	2,50,000/-
2.	Feed Cost @ 5 kg / bird @ Rs.25/- per kg.	125	1,25,000/-	
3.	Vaccinations, medicines@ Rs.5 per bird (5x1920)	5	9,600/-	
4.	Electricity @ 1000 per month (1000x12=12,000)	1000	12,000/-	
	Total cost of cultivation		1,46,600/-	
5.	Net income 2,50,000-1,46,600=1,03,400/-			

Economics of Rabbit:

Rabbits are grown for meat as well as to sale as pet animals. Unit consisting of 20 females and 4 males was maintained as component in IFS system.

S.No	Rabbits productions	Market Price (Rs.)	Gross Returns (Rs.)	Cost of Production (Rs.)	Net Returns (Rs.)
1.	80 Rabbits @ 1.5 kg each = 120 kg	150	18,000/-	3,680/-	14,320/-

Lucerne and sweet corn green fodder that was available in the system was feed to rabbits @ 500 gms per rabbit / day. Similarly the concentrate feed which was prepared for desi poultry was supplied to them @ 25 gms per day per rabbit. In addition to income, manure @ 1 quintal is obtained from this unit.

Table -10: Gross Returns, Cost of Cultivation, Net Returns and Percentage of component contribution in 1 ha IFS Model.

Sl. No.	IFS Component	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	Percent of contribution to the system
1	Crops	2,12,900	92,500	1,20,400	25.5%
2	Quail	1,43,275	93,000	50,275	10.6%
3	Rabbit	18,000	3,680	14,320	3%
4	Desi Poultry	2,50,000	1,46,600	1,03,400	22%
5	Sheep Unit	1,54,780	96,700	58,080	12%
6	Dairy Unit	2,43,500	1,26,060	1,17,440	24%
7	Income from manure	6,785	--	6,785	
	Total	**10,29,240**	**5,58,480**	**4,70,700**	
Fixed cost for IFS establishment is Rs.5,00,000/-					
			Depreciation per annum	50,000	
			Interest on working capital	35,6	

	25	
Net returns realized from the system	3,85, 075	

The best possible components practicable in 1 ha area is evaluated as above. Individual are combination of components can be practiced based on the resource availability and marketing opportunities.

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ORGANIC FARMING FOR SUSTAINABLE AGRICULTURE WITH FOCUS ON AGRICULTURAL EXTENSION STRATEGIES FOR MOTIVATING FARMERS TOWARDS ORGANIC FARMING

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Introduction

Agriculture, the leading economy of the nation, is taking part in a momentous responsibility in the overall socio-economic fabric of the country accounting for 17.9% of the GDP in 2015 and about 50% of the workforce (Mahapatra *et al.,* 2016). It must meet the challenges of feeding the growing population while simultaneously minimizing its environmental ill impacts. Energy intensive conventional agriculture boosts the productivity in terms of jeopardizing the natural resources vis-à-vis overall ecological balances. Hence, there is need to focus on more environment friendly and sustainable approach to increase the agricultural production. One such alternative approach is organic agriculture that uses bio-fertilizer, bio-pesticides, green manure, compost etc. which do not harm environment and provides sustainable yields. Thus, the major aim of organic agriculture is to augment ecological processes that foster plant nutrition yet conserve soil and water resources. Therefore, besides targeting the productivity of the crops alone, efficiency vis-à-vis resource input of different organic agriculture production systems and their comparative study with conventional farming systems and technology generation is the need at this hour.

Statistics:

As per the statistics compiled by the IFOAM and FiBL (Anonymous, 2016) world over 43.7 million ha land (1% of total agricultural land) is being managed organically by 2 million producers in 172 countries. Besides this, there is another 37.6 million ha being certified for wild harvest collection. Global sales for organic products have reached 80 billion US$ with US and Europe being the largest consumers. As on March 2016, India has brought 57.0 lakh ha area under organic certification process, which includes 14.8 lakh ha cultivated agricultural land and 42.2 lakh ha of wild harvest collection area in forests.

During 2015-16, India exported 2.64 lakh MT of organic products belonging to 135 commodities valuing at US$ 285 million (approximately INR 1900 crore). The major share of exports was oilseeds, cereals and millets and processed foods with a combined share of around 91%. In the oilseeds category, soybean with exports of 1.26 lakh tons during 2015-16

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had a share of about 95% among total oilseeds. In cereals and millets category, rice, maize, wheat and coarse millets are being exported. In the rice category, the quantity of basmati rice exported was around 10300 tons. Domestic market is also growing at an annual growth rate of 15-25%. As per the survey conducted by ICCOA, Bangalore, domestic market during the year 2012-13 was worth INR

600 crore which has now grown to more than 1000 crore during 2014-15 9 (ICCOA, 2014). Among all the states, Madhya Pradesh has covered largest area under organic certification followed by Himachal Pradesh and Rajasthan respectively.

Organic agriculture and productivity

Since the advent of organic farming in the recent years there had been concerns on the production potential of the system. But the results of long term experiments released during the last 10 years from world over have eliminated all fears. Under irrigated conditions organic farming may be yielding 5- 12% less than their conventional counterparts but under rainfed and water deficit conditions organic system yields 7 to 15% more. Six years experimenting, comparing two models of organic management with only chemical input and chemical + organic under 4 crop husbandry systems at ICRISAT (Rupela, 2006) revealed that organic systems were at par with integrated and higher then chemical fertilizers in all the years from second year onwards. Reviewing 154 growing seasons' worth of data (Halwell, 2006) on various crops grown on rain-fed and irrigated land in the United States, it was found that organic corn yields were 94 percent of conventional yields, organic wheat yields were 97 percent, and organic soybean yields were 94 percent. Organic tomatoes showed no yield difference. More importantly, in the world's poorer nations where most of the world's hungry live, the yield gaps completely disappear. Research findings released from UAS, Dharwad, Karnataka under Network Project on Organic Farming (ICAR) reported that under rainfed systems organic management yields much higher productivity then conventional (UAS Dharwad, 2011).

Organic agriculture and profitability

Recently a study was conducted in Maharashtra to study the impact of organic farming on economics of sugarcane cultivation in Maharashtra (Kshirsagar, 2007). The study was based on primary data collected from two districts covering 142 farmers, 72 growing Organic Sugarcane (OS) and 70 growing Inorganic Sugarcane (IS). The study finds that organic cultivation enhances human labour employment by 16.90 per cent and its cost of cultivation was lower by 14.24 per cent than conventional farming. Although the yield from organic was 6.79 per cent lower than the conventional crop, it was more than compensated by the lower cost and price premium received and yield stability observed on organic farms. The organic farming gives 15.63 per cent higher profits and profits were also more stable on organic farms than the conventional farms.

Tej Pratap and Vaidya (2009) in a nationwide survey of organic farmers suggest that "The cost-benefit analysis indicates favourable economics of organic farming in India. Farmers in 5 out of 7 states are better placed, so far as organic farming is concerned. The returns are higher in Himachal Pradesh, Uttaranchal, Karnataka, Maharashtra and Rajasthan. In Karnataka organic farmers had 4-35% higher returns than inorganic farmers. In Kerala the differentials ranged between 4-37% in favour of inorganic farmers. In Maharashtra the difference in net profit was more than 100% in case of organic soybean. Organic cotton farmers were enjoying comfortable profit margin. The profit differential in Rajasthan ranged from 12-59% in favour of organic farmers. In Tamil Nadu organic farmers were better placed with two crops, while inorganic farmers were at slight advantage in other two crops. Comparative economic analysis with four cropping systems at UAS, Dharwad also indicates the promising potential of organic farming systems (Babalad, 2016).

Organic agriculture and soil health

Long term experiments comparing productivity and soil health parameters at ICRISAT have demonstrated that organic practices produced yields comparable to conventional plots, without receiving any chemical fertilizer; they actually showed increase in the concentration of N and P compared with conventional. In another similar study conducted under Network Project on Organic Farming of ICAR, (Gill and Prasad, 2009) showed Improvements of different magnitudes in respect of soil organic carbon, available-P, available-K, bulk density, and microbial count under organic systems as compared to chemical farm. Ramesh *et al*., 2010) reported that the bulk density of soil is less in organic farms which indicates better soil aggregation and soil physical conditions

Pest management in organic farming

The impact of pests, diseases and weeds on food supply is high that they reduce production by at least one-third despite using pesticides worth about $38 billion. In the past 50 years, pesticides use has increased tenfold, while crop losses from pest damage have doubled. Detrimental upshot of indiscriminate use of agro-chemicals to manage pests is well evident in crop ecosystem. As a result of growing concerns about health and environmental problems associated with pesticides, there are accelerated efforts from scientists for organic production. The focus in crop production is now gradually shifting towards on food quality and environment safety. In organic production the insect pests and diseases can be managed by using biological viz., plant extracts, micro-organisms or minerals and cultural pest control techniques like crop rotation, mixed cropping, ground covers, field fallowing and other vegetation, encouraging biodiversity to boost soil organic matter levels and to provide shelter and food for natural enemies of crop pests and diseases although approved organic pesticides may also be used when necessary. Their aim is to support the diversity and activity of natural enemies (Kristiansen, 2006). Thus, not only the quality of produce that will come through organic mode, but also will be free from toxins and pollutants which can be supplemented with higher resource use efficiency of crops for sustainable agriculture.

Extension strategies to encourage farmers towards organic farming

In India, 70% of the cultivated area is under areas receiving low rainfall. (Yadav *et al*., 2016) reported that under rainfed, water stressed conditions and in marginal land areas it is 7-15% higher yielder. Hence, organic farming it India has tremendous scope to increase its area under dryland farming. Even though India has vast potential for organic production and marketing, its achievement on production, certification and export is low due to various reasons. Lack of sufficient education on production with specific standards, lack of easy accessible information on organic methods, market facilities for interested farmers, lack of good consumer information on organic farming and organic food, high distribution cost, lack of effective demonstration of research results among farmers and advisors are some among the problems. To tackle the problems we need to focus on suitable strategies to encourage farming community towards organic farming.

1.Capacity building

Trainings and demonstrations should be organized for knowledge and skill up gradation. Trainings should be imparted to farmers on organic farming with various topics like soil fertility management, principles and practices of organic farming, organic input production technologies, use of natural resources and ITK, documentation in organic farming and certification, post harvest techniques.

2.Supply of inputs in time and quantity

The availability of bio-fertilisers and bio pesticides was also a problem for farmers. Intial supply of these inputs will encourage farmers to initiate organic farming. The inputs namely bio-fertilizers (Azolla, Azospirillum, Phosphobacteria), Bio-pesticides (Pseudomonas & Trichoderma), green manure (Sunhemp, Dhaincha, Calotropis) can be supplied ti the farmers.

3. Spread of Awareness:

Exhibitions, mass media programmes and exposure visits were organized to create awareness on larger scale. Through this exhibitions, awareness on organic products and market channels can be created that can divert their interest to organic farming. Similarly mass media like TV, radio and news papers can be utilized for wider reach. Publications in the form of folders, booklets and manuals can be bought out on organic production practices and need based information to the farmers.

4.Increasing self reliance

Most of the organic inputs were produced locally reducing dependence on external inputs. Training on the most widely used inputs like farmyard manure, vermicompost, panchagavya, neem based insect repellents can reduce cost of cultivation. This may attract small and marginal farmers towards organic farming. This practice not only reduces input cost but also fetch more price for organically grown produce.

5.Linking producers and consumers

To create awareness among consumers, exhibitions can be organized where farmer come in direct contact with the consumers. This will facilitate the farmers to know the consumer demand and provide direct linkage to consumers.

6. Wide publicity about Success stories:

Krishi Vigyan Kendra, Karur have developed various extension strategies to attract farmers towards organic farming. They have trained around 3402 farmers on organic farming.14 exposure visits to the nearby successful organic farmer fields and conducted 21 exhibitions. An impact study was conducted at karur village indiacted that 85% of the respondent were adopted organic farming practices.

The Government of Orissa has pooled resourced from the State Plan and various central schemes like, Horticulture Mission in North East (HMNE), Macro Management in Agriculture (MMA) and RashtriyaKrishiVikasYojna (RKVY). As on date, Sikkim, with only 0.2 % of the geographical area of the country, has accounted for more than 12% of the total organic area in the country (76,000 ha out of 6,20,000 ha). From the year 2016-17, the Government of Sikkim is implementing the Centrally Sponsored Scheme, “Mission Organic Value Chain Development for the North Eastern Region (MOVCD-NER)”. The scheme aims at developing certified organic production in a value chain mode to link growers with consumers through an integrated and concentrated approach with end-to-end facilities for production, processing, storage and marketing (Anbalagan, 2016).

Conclusion:

Organic farming is a science based intensive cropping system based on efficient management of resources, soil health, sun energy harvesting and judicious use of natural resources. Under irrigated and intensive cultivation conditions, organic farming may be 5-12% less yielder but under rainfed, water stressed conditions and in marginal land areas it is 7-15% higher yielder. Organic farming in its modern version, equipped with local resources, strengthened with modern science and supported with mechanization is ready to take challenges in the field of environment preservation; resource optimization, comparable productivity and soil health build up. Besides, the adoption of organic farming in group and desire of the organic farmers to enter into direct trade as entrepreneurs is also contributing to social, physical and financial capital build up.

India has the potential to become a major organic producing country given the international demand for our farm products, different agro-climatic regions for the cultivation of a number of crops, the size of the domestic market and above all the long tradition of environment friendly farming and living. Therefore strong national organic policy is main need of the current position which will give an important place to organic farming addressing the current issues and obstacles. . An action plan for the organic sector should be developed based on the analysis of the state of the sector, participatory consultations, a need evaluation and proper sequencing of the actions.

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Theme III Sustainable Livelihoods

FARM AND HOME TECHNOLOGIES FOR WOMEN LIVELIHOOD PROMOTION – A CASE OF KVK, RUDRUR, NIZAMABAD, TELANGANA STATE

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ABSTRACT

Women at Farm and Home contribute to economic growth in developing countries and clearly represent an untapped potential. When women adopt gender sensitive practices they can empower themselves, voice and represent decision making, provide business network, enhance access to market services and facilitate *economics of scale. In this connection Krishi Vigyan Kendra, Rudrur conducted On Farm Trials on Farm and Home technologies for women in adopted villages to assess and refine for further demonstration. For wider dissemination of these technologies and for the promotion of livelihood opportunity for the women, the present study was undertaken with the objectives 1. To Document consolidate feedback of beneficiaries on the results of On Farm Trials (OFT) on Farm and Home technologies as* **Success Stories** *for wider dissemination and 2. To propose a strategy for market promotion of Farm and Home technologies as Sustainable women livelihoods. Qualitative feedback was explored and consolidated from the year of inception of the OFT through Focus Group Discussions, frequent Monitoring Visits and Observations. The beneficiaries include 70 Farm and Home women from 9 KVK adopted villages and 40 adolescent girl students of Seed Technology Poly technique College, Rudrur thus totaling to 110. The Farm and Home technologies were obtained from All India Coordinated Research Project, Home Science, Professor Jayashankar Telangana State Agricultural University, Rajendranagar. Extensive village visits with the help of success stories on Farm and Home technologies resulted in identification of interested and needy women and development of strategy for the promotion of women livelihoods by linking to ATMA, Nizamabad under Support to State Extension Programme in Extension Reforms for financial aid and Certified input dealers and Integrated Child Development Services (ICDS), Nizamabad for facilitating marketing opportunity.*

INTRODUCTION

Women at Farm and Home contribute to economic growth in developing countries and clearly represent an untapped potential. For many rural women, entrepreneurship is a part of broader livelihood strategy often undertaken partially where it is difficult to separate production and reproduction tasks and market and non- market work. When women adopt gender sensitive practices they can empower themselves, voice and represent decision making, provide business network, enhance access to market services and facilitate economics of scale. (FAO, 2010)

Swamy Vivekananda said "*Just as a bird could not fly with one wing only, a nation would not march forward if women are left behind*". Women population constitute half of the total population i.e. 48.5 percent which indicates potential strength of women in the total human resource in the country. Although women contribute much time and energy to the nation growing their contribution is highly appreciated and scarcely recognized. Money in the hands of men spend quite differently from money in the hands of women. Cash in the hands of women, often means more nutrition and education for children. Therefore a women controls the household income the family get benefits hence their economic independence is the need of the hour.

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The women population in Nizamabad district dominates men with 51 percent, that shows more strength in terms of district human resource but literacy percentage of 52.33 emphasize the need for education and economic empowerment.

In this connection Krishi Vigyan Kendra, Rudrur conducted On Farm Trials on Farm and Home technologies for women in adopted villages to assess and refine for further demonstration so as to promote their livelihood opportunities for sustainable development.

As a technology development process On Farm Trial is conducted for 3 years so as to move through assessment, refinement and demonstration stages and while making modifications some technologies get accepted / rejected at assessment stage while some at refinement and does or does not move to demonstration stage. But the On Farm Trials on Farm and Home technologies conducted by KVK Rudrur got acceptance for adoption while in the assessment and refine stage itself. Hence for wider dissemination of these technologies and to promote livelihood opportunity for the women, the present study was undertaken with the following objectives.

1. To document consolidate feedback of beneficiaries on the results of the On Farm Trials (OFT) on Farm and Home technologies as success stories for wider dissemination.
2. To propose a strategy for market promotion of Farm and Home technologies as sustainable women livelihoods.

II.METHODOLOGY:

Qualitative feedback was explored and consolidated from the year of inception of the OFT through focus group discussions, faculty frequent monitoring visits and observations. The beneficiaries include 70 Farm and Home women from 9 KVK adopted villages and 40 adolescent girl students of Seed Technology Poly technique college, Rudrur thus totaling to 110. The 9 adopted villages comprises Jalalpur, Laxmapur, Sankora from Varni Mandal, Suddulam, Rampur from Kotagiri Mandal and Kistapur, Thimmapur, Mirzapur, Chincholi from Birkur Mandal of Nizamabad District. The Farm and Home technologies for the On Farm Trials include 1. Rolling brush stem applicator in cotton for the management of sucking pests 2. Use of Protective clothing while spraying chemicals in the field 3. Supplementation of Pusthi weaning mix to infants of 6 months to 2 years and 4. Improvement of hemoglobin through supplementation of Raagi laddu and Drumstick leaf powder among adolescent girls which were obtained from All India Coordinated Research Project, Home Science, Professor Jayashankar Telangana State Agricultural University, Rajendranagar.

Extensive village visits were made and motivated women for the use of these technologies with the help of documented success stories. Identified needy and interested women namely G.Shilpa, Ph.No: 9963698300, Suddulam Village;
Smt Shabana, Phone.No: 8886820764,Akbarnagar village; V.Padma, Phone No: 9492649293,Thimmapur village and SHG (Leader Manikyamma), Phone.No: 9989463164, Akbarnagar village to help them to promote their livelihood opportunities on these technologies and linked to Agriculture Technology

Management Agency (ATMA), Nizamabad under Support to State Extension Programmes in Extension Reforms.

Further efforts were made, identified and linked women to market Rolling Brushes and Protective Clothes to an elated and enthusiastic input dealers namely Sri. P. Srinivas, Phone No: 9440037925, Balaji Agro Agencies, Kamareddy; Sri. N. Yadagiri, Phone No: 9490806344, Sri Sai Seeds & Pesticides, Lingampet, Nizamabad; Sri. Kishan, Phone No: 9440525740, Jai Kisan Seeds & Pesticides, Lingampet, Nizamabad; Sri. Saya Goud, Phone No: 9848913098, Uma Maheshwara Fertilizer, Nagireddypet, Nizamabad presently undergoing a Training Programme on Diploma in Agriculture Extension for Input Dealers (DAESI) 2016-17 at KVK Rudrur who come forward voluntarily to facilitate them for marketing without expecting a single rupee in return.

Similarly linked to Integrated Child Development Services (ICDS), Nizamabad to market Raagi laddu, Drumstick leaf powder and Pushti weaning mix as business facilitators.

III. 1. PRESENTATION OF SUCCESS STORIES

III. (1.1) FARM TECHNOLOGIES

SUCCESS STORY -1

SUCCESSFUL ON FARM TRIAL ON ROLLING BRUSH FOR STEM APPLICATION IN COTTON

Cotton is grown in Nizamabad district as commercial crop, which is attacked by a number of pests out of which sucking pests cause considerable damage in the initial stage and bollworms in the latter stage of the crop growth. For the control of sucking pests, farmers are spraying huge chemical pesticides in more dosage at more intervals and incurring more cost.

With a gender mainstreaming perspective in agriculture men and women farmers need to be focussed and involved equally in all the farming operations. Spraying operation by men farmer involves more drudgery for women farmer to carry as it is. All India Co-ordinated Research Project (AICRP) FRM department, PG & RC, PJTSAU, Rajendranagar designed Rolling brush for stem application in cotton for the control of sucking pests as a drudgery reduction technology for both men and women on which KVK, Rudrur conducted On Farm Trail during 2015-16.

Table No.1 Consolidated feedback of Beneficiaries on the use of Rolling brush for spraying chemical

S.No	Parameters			Result
	Time required to spray chemical and no. of labour	Chemical dosage	Labour charges	

Rolling Brush method	Less time (6 hours / day- one labour- 3 times in a crop season= 6 hours X 1 X 3 = 18 hours	250 ml Monocrotophos/ L/ acre	Rs.1500/ acre	• Less time • Less chemical dosage • Less no. of labour • Less investment • No environment pollution • Only harmful insects getting killed • Physical stress reduction
Farmer's normal practice of Spraying	More time (3 hours)- 2 labours- 5 times in crop season= 3h X 2 X 5 = 30 hours	1 L Monocrotophos /200 L water / acre	Rs.2500/ acre	• More time • More chemical dosage • More no. of labour • More investment • Environment pollution • Both beneficial & harmful insects getting killed

Basing the feedback from men and women farmers that, women experienced safe and smooth performance while spraying chemical for the control of sucking pests in cotton and also seeing and observing the benefits as furnished in the table, Krishi Vigyan Kendra, Rudrur believed in the success of the technology and identified Smt. G. Shilpa, the most needy, economically poor and interested farm women to start entrepreneurship on Rolling brush marketing for her livelihood promotion.

Skill teaching on Use of Rolling brush for stem application for control of sucking pests in Cotton

SUCCESS STORY -2

PROTECTIVE CLOTHING PROTECTS FROM HEALTH HAZARDS

Exposure to chemical pesticides while spraying in their field has become a major health problem for farmers in Telangana state with a special mention to Nizamabad district. Though there is no serious pest attack in the field, the farmer in order to reap riches have been using pesticides extensively and as a result is suffering from various ailments. The death case of Y. Venugopal, 22 year old son of Y. Satyanarayana, Retired Senior Assistant of our own Regional Sugar Cane & Rice Research Station (RS&RRS), Rudrur after inhaling the vapor while spraying chemicals Nuvacron + Dithane M 45 + Baviston in his field is pinching to remember even today.

Majority of the farmer suffer from various ailments due to spraying of such pesticides such as nausea, vomiting, headache, skin disorders, digestive problems and breathing problems. They spray chemicals without taking basic safety precautions such as wearing masks and gloves. Many a times they inhale the pesticides while spraying it against the wind direction.

Expressing a concern over farmers, not following minimum safety precautions while spraying pesticides, Krishi Vigyan Kendra, Rudrur conducted On Farm Trial on Protective clothing. Home Scientist, received this technology from Home science, All India Coordinated Research Project (AICRP) Textiles department, Post Graduate & Research Centre, Rajendranagar. Assessing, and refining of any technology requires three years so as to move to next stage i.e Demonstration (FLD) but Protective Clothing got acceptance from farmers during assessment stage itself.

Seeing and believing the benefits of protective clothing like

▪ Getting rid of vomiting & nausea sensation
▪ Head ache
▪ Skin problems
▪ Burning sensations

as experienced by five farmers namely Gajanand, K. Srinivas Reddy, Sailu, G. Vittal and T. Laxman in all the crops while spraying the chemicals, the neighboring farmers got attracted and gone for protective clothing from Kharif 2016 which includes

▪ Gloves,
▪ Mask,
▪ Apron (white cotton shirt)
▪ Cap
• Sun glasses (Farmers Refinement) with their own expenditure.

This technology proved technologically feasible, economically profitable, ecologically sustainable and culturally compatible with little refinement by the farmers in adding sunglasses.

III. (1.2) HOME TECHNOLOGIES

SUCCESS STORY -3

PUSHTI - A SECRET OF SHAKTI

A needy woman once upon a time, owns the small entrepreneurship now for selling Pushti weaning mix earning Rs.5000/- per month.

This is the success story of Smt. K. Padma, mother of infant beneficiary of Pushti weaning mix from Kistapur village, Birkur Mandal, Nizamabad district. Pushti weaning mix is a supplementary food consisting roasted wheat ravva, roasted soya dal and jaggery with following nutritive values and child health benefits.

Pushti weaning mix

Table no.2 Nutritive values and health benefits of Pushti

S. No	Nutritive values in 100 gms of Pushti
1	Calories- 363
2	Protein - 18.1g
3	Iron - 6.3 mg
4	Carotene – 136

S. No	Child Health benefits
1	Good physical development
2	Cognitive development
3	Psycho motor skill development
4	Social development

The Home Scientist conducted 3 On Farm Trials during 2011-14 in KVK adopted villages which has gone to Front Line Demonstration during 2014-15 that improved the health of the infant child significantly after four months of feeding in terms of gaining body weight of 1.25 kgs compared to child fed with normal weaning mix.

Distributing pushti at Anganwadi center

Table No. 3 The economics of preparation of Pushti weaning mix

The economics of Pushti weaning mix	During 2015-16

Required Ingredients	Cost per kg	For 1 kg pushti preparation on required quantity	Cost of each product for 1 kg pushti	Invested Rupees for the preparation of 5 kgs pushti	Initial earnings during March 2014 With 5 kg Pushti @ 40/- per 100 pkt	Increased earnings by March, 2016 by selling 10 kgs
Wheat rava	Rs 55/-	667 gms	Rs 37/-	Rs. 185/-	• 50 pkt x40/- = Rs. 2000/- • Packing & other charges = Rs.100/-	Due to the demand of the product she has increase the cost of packet from Rs.40 to Rs.60/- • 100 pkt x 60/- = 6000/- • Packing & other charges = Rs.200/-
Soya dal	Rs 140/-	166 gms	Rs 23/-	Rs. 115/-		
Jaggary	Rs 65/-	167gms	Rs 11/-	Rs. 55/-		
Total			**Rs. 71/-**	**Rs. 355/-**	Gains = Rs. 2000 – 355 + 100= Rs.1545/-	Gains = Rs. 6000 – 710 + 200 = 5190/- *with in 2 yrs she could gain the difference of Rs.3645/-

The child health benefits of the Pushti on her own son and other neighbouring infant beneficiaries motivated Padma positively and drove her to start her own selling unit of Pushti at her residence with no extra infrastructure.

Smt. K. Padma, mother of
Infant beneficiary of Pushti weaning mix

Durga prasad

Beginning with selling of 5 kgs of Pushti weaning mix in 100gms packet @ 40/- each she has now rose to the occasion to earn income of Rs.5190/- per month by selling 10 kg pushti and she quotes **PUSHTI - *A SECRET OF SHAKTI.***

As her family is in view of migrating to Maharashtra State, Krishi Vigyan Kendra, Rudrur identified V. Padma to start this entrepreneurship.

SUCCESS STORY -4

RAAGI LADDU AND DRUMSTICK LEAF POWDER EMPOWERED KAMALA

A passionate mother, Kamala, Rudrur Village who believed the success of On Farm Trial conducted by Home Scientist KVK Rudrur on Improvement of haemoglobin level among adolescent girls through Raagi laddu, Drumstick leaf powder and Iron tablets on her own daughter Supriya, became an entrepreneur by selling Raagi laddu and Drumstick leaf powder earning 2600/- per month.

During 2013-15 the Home Scientist conducted 3 On Farm Trials on Improvement of haemoglobin level among adolescent girls through Raagi laddu, Drumstick leaf powder and Iron tablets on STP adolescent girls which has gone to Front Line Demonstration during 2016-17. These trials resulted in improvement of haemoglobin levels and Body Mass Index (BMI) significantly after four months of feeding along with normal diet.

Raagi laddu is supplemented for control of anemia with following nutritive values and health benefits.

Table no.4 Nutritive values and health benefits of Raagi laddu

S. No	Nutritive values in one (33 gm weight) Raagi laddu
1.	Calcium – 57.4mg
2.	Calories – 23.46
3.	Protein - 1.05g
4.	Iron – 1.425 mg
5.	Beta carotene - 7.01μg
6.	Total folic acid – 3.05mg
7.	Fat – 1.67 gms

S. No	Health benefits
1	Preventing malnutrition and anemia
2	Maintaining bone density and health
3	Prevalence of diabetes
4	Accelerating wound healing among diabetics
5	Anti- microbial property
6	Anti – cancer potential
7	Preventing ageing
8	Reduces “bad” cholestrol, prevents cardiovascular disease

Drumstick leaf powder is supplemented for control of anemia with following nutritive values and health benefits.

Table No. 5 Nutritive values and health benefits of Drumstick leaf powder

S. No	Nutritive values in 100 gms of drumstick leaf powder
1.	Calcium – 2,003 mg
2.	Calories- 205

S. No	Health benefits
1	Control blood glucose levels
2	Control blood cholesterol levels

3.	Protein – 27.1 g
4.	Iron – 28.2 mg
5.	Vitamin A- 18.9 mg
6.	Vitamin C- 17.3 mg
7.	Riboflavin (B2)-20.5 mg
8.	Carbohydrates- 38.2 g
9.	Potassium – 1,324 mg

3	Prevents constipation
4	Rich in antioxidants
5	Anti- inflammatory properties
6	Relieve from menstrual pain
7	Natural detoxifier
8	Beneficial for skin, hair and bones
9	Natural energy booster

Kamala, realizing the health benefits started her own enterprise on making and selling of Raagi laddu and drumstick leaf powder earning Rs. 2600/- per month.

Table No. 6 The economics of preparation of Raagi laddu

S.No	Required Ingredients	Cost per kg	For 1 kg raagi laddu preparation required quantity	Cost of each product for 1 kg raagi laddu	Invested Rupees for the preparation of 5 kgs Raagi laddu	Earnings by selling 5 kgs of Raagi laddu @ 15/- per laddu (30 laddu in 1 Kg – 150 laddu in 5 kg)
1.	Raagulu	Rs 35/-	500g	Rs. 17.50/-	Rs. 88/-	Gains =150 X15 /- = 2250 – 503 = 1747/-
2.	Ground nut	Rs 120/-	125g	Rs. 18/-	Rs. 90/-	
3.	Jaggary	Rs 65/-	375g	Rs. 25/-	Rs. 125/-	
	Total			**Rs. 61/-**	**Rs. 303/-** Making, Packing & other charges = Rs.200/-	

Table No. 7 The economics of Preparation of Drumstick leaf powder

S.No	Required Ingredients	For 1 kg powder preparation required quantity of drumstick leaves	Earnings from March 2016 With 1 kg drumstick leaf powder @ 50/- per 50gms 20 pkts
1.	Drumstick	10kgs	• 20 pkt x 50/- = Rs. 1000/-

	leaves		• Packing & other charges = Rs.100/-
		Total	Gains = Rs. 1000 –100= Rs.900/-

"She says this small enterprise economically empowered me to support my family income", while expressing in her inability to continue this business due to personal reasons. Hence, Krishi Vigyan Kendra, Rudrur identified Self Help Group, Akbarnagar to promote this technology.

III. 2. STRATEGY FOR MARKET PROMOTION OF FARM AND HOME TECHNOLOGIES AS SUSTAINABLE WOMEN LIVELIHOODS

III. (2.1) Programme Coordinator along with Home Scientist extensively visited the villages to motivate Farm and Home women on the above technologies with the help of success stories and identified few interested and needy women to start entrepreneurship by themselves as their livelihood promotion as shown in the below table.

S.No	Name of the technology	Name of the identified women	Details of strategy	Cost of one unit	Cost of total unit	Expected Income
1.	Rolling brush	G. Shilpa W/O G.Gaganan Suddulam, Village, Kotagiri mandal ,NZB ,Dist **Ph.No: 9963698300**	Imparted training on preparation of Rolling brush and obtained the making cost of rolling brush.	200 Rolling Brushes @ Rs. 250/- per brush	50,000.00	Rs. 6,000.00
2.	Protective clothing	Shabana. Akbar nagar, Rudrur mandal, NZB	Imparted training at KVK Rudrur on the preparation of	Rs. 500/- (50 sets)	25,000.00	Rs. 5,000.00

		Phone.No: 8886820764	Protective clothing and obtained the cost of making a set of protective clothing			
3.	Pushti weaning mix	V. Padma, Daughter of Satyanarayana Thimmapur, Birkur Mandal **Phone No: 9492649293**	Imparted training at her home on the preparation of Pushti weaning mix and obtained making charges for 10 kg product for 2 months	500 Pushti weaning mix Pkts (100 grams each) for two months business	50,000.00	Rs. 5,000.00
4.	Raagi laddu and drumstick leaf powder	Manikyamma, Self Help group leader, Akbarnagar Rudrur mandal , **NZB** **Phone.No: 9989463164**	Imparted training to SHG on the preparation of Raagi laddu and drumstick leaf powder	50,000.00	50,000.00	Rs. 5,000.00
TOTAL					**Rs. 1,75,000**	**Rs. 21,000.00**

III. (2.2) Linked to ATMA under the component of Support to State Extension Programme in Extension Reforms for the financial support for their livelihood promotion for sustainable development.

III. (2.3) Further efforts were made, identified and linked women to market Rolling Brushes and Protective Clothes to an elated and enthusiastic input dealers namely Sri. P. Srinivas, Phone No: 9440037925, Balaji Agro Agencies, Kamareddy; Sri. N. Yadagiri, Phone No: 9490806344, Sri Sai Seeds & Pesticides, Lingampet, Nizamabad; Sri. Kishan, Phone No: 9440525740, Jai Kisan Seeds & Pesticides, Lingampet, Nizamabad; Sri. Saya Goud, Phone No: 9848913098, Uma Maheshwara Fertilizer, Nagireddypet, Nizamabad presently undergoing a Training Programme on Diploma in Agriculture Extension for Input Dealers (DAESI) 2016-17 at KVK Rudrur who come forward voluntarily to facilitate them for marketing without expecting a single rupee in return. Similarly linked Integrated Child Development Services (ICDS), Nizamabad to women to market Raagi laddu, drumstick leaf powder and Pushti weaning mix as business facilitators.

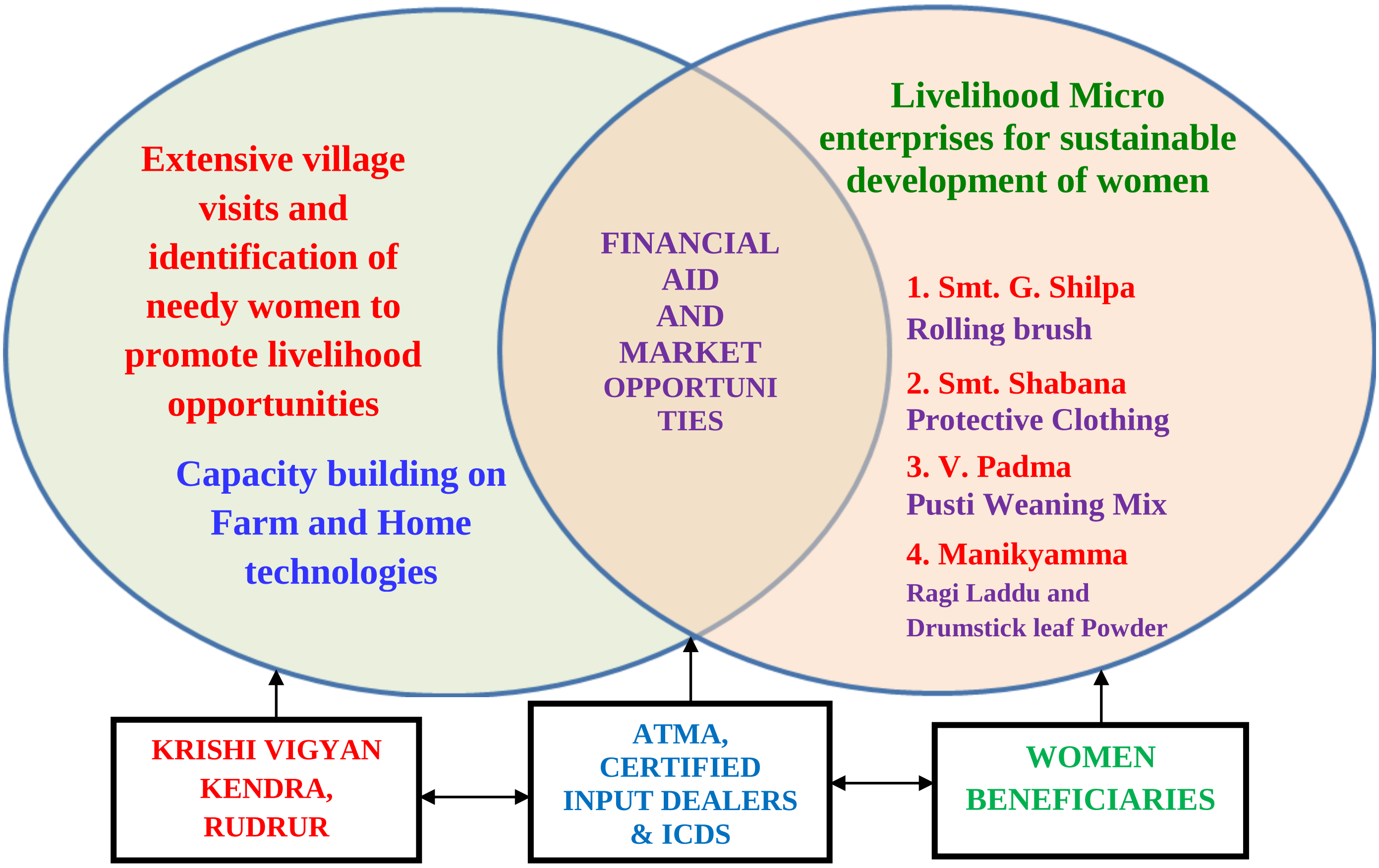

Figure 1. KVK RUDRUR STRATEGY FOR MARKET PROMOTION OF FARM AND HOMETECHNOLOGIES AS SUSTAINABLE WOMEN LIVELIHOODS

IV. CONCLUSION

Building an enabling environment for women's entrepreneurship for livelihood promotion is the need of hour. Given that, the factors limits women entrepreneurship are manifold and intertwined, integrated measures are needed to realize rural women entrepreneurs potential to promote business avenues. In this direction Krishi Vigyan Kendra, Rudrur exerted efforts to disseminate Farm and Home technologies with the use of documented success stories and integrate women livelihood promotion by technological upgradation from the Institution (Krishi Vigyan Kendra, Rudrur) and linking to ATMA, Nizamabad for financial aid and Certified input dealers and ICDS, Nizamabad for market opportunities. The study helped KVK Rudrur to emerge out with a successful model for women livelihood promotion.

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Agricultural Diversification and its Impact on Livelihood Security of Farmers

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ABSTRACT

The growth in agricultural sector has sharply decelerated from 3.2% per annum during 1980/81 to 1.1 % in 2014-15. (Economic Survey of India 2014-15). It is a matter of great concern, as nearly 70 per cent of the population lives in rural areas, and over 60 per cent of the rural population seeks its livelihood in agriculture and allied activities. (Census 2011). The poor performance of agriculture is causing distress to the farming community. Declining trend of Poverty may reverse in rural areas. There are two main reasons for such a dismal performance of the agricultural sector. First, the traditional crop sector has reached a plateau the yields and now they are in decreasing trend. Second, the production environment has deteriorated.On the demand side, sustained economic and rising per capita income, growing urbanization, and unfolding globalization are causing a shift in the consumption patterns in India. (Kumar *et al* 2003). Per capita cereal consumption has declined from 192.6 kg per person per annum in 1977-78 to 125.6 kg in 1999-2000 in rural households (CSO report 2001). India has attained self-sufficiency in food grain production but has yet to achieve nutritional security. Since we have to finding out the way for achieving nutritional security since their present consumption level is much below the recommended dietary norms (Planning commission, 2005). Alternative options need to be explored to revitalize agriculture, make it more profitable and to improve its growth performance. Agricultural diversification towards high value commodities (HVCs) is viewed as one of the most promising strategies to reverse the declining growth trend in agriculture (World Bank, 2002). This paper dealing with the extent of diversification from traditional crops to other selected sectors and its impact on livelihood security of farmers in terms of employment security, women empowerment, nutritional security and environmental security.

Keywords: Agricultural diversification, HVCs, Women empowerment, Environmental security, Employment security and Nutritional security.

Introduction

The term agriculture is derived from the latin words *ager* or *agri* meaning soils and *cultura* means cultivation. Agriculture is the art, science and business of crop production. It encompasses all aspects of crop production, livestock farming, fishery and forestry. Agriculture is the conversion of solar energy into the chemical energy. Crop production is the conversion of environmental inputs like solar energy, carbon dioxide, water and nutrients in soil to economic products in the form of human or animal food or industrial raw materials.

DIVERSIFICATION

Term 'Diversification' has been derived from the Latin word 'Diverge' which means to move or extend in the direction different from a common point (Jha, Kumar and Mohanty, 2006).Diversification in its totality is a dynamic, continuous process to adjust to changing circumstances.

Diversification is the process to take advantage of emerging opportunities created by technology, new markets, change in policy *etc*., to meet certain goals, challenges and threats to reduce risk (Chand and Chauhan, 2002).

According to Penrose (1959), diversification is:

1. It is a response to specific opportunities,
2. It is a response to specific threats,
3. It is a general strategy for growth.

Definition of Agricultural Diversification

Agricultural diversification can be described in terms of the shift from the regional dominance of one crop towards the production of a large number of crops to meet the increasing demand of those crops. (Start, 2001).

Diversification involves the use of farm resources for non-agricultural activities (Shucksmith& Winter, 1999). In the context of the present study, agricultural diversification encompasses change in production portfolio from low-value to more remunerative and high-value commodities like fruits, vegetables, milk, meat, eggs and fish that expand farm and non-farm sources of income. It not only involves production processes but also new marketing and agri-business-based industrial activities that expand the income sources of rural households and stimulate the overall rural economy. Changes in the share of different commodities in the value of agriculture are used as a proxy of agricultural diversification.

Nature and Pattern of Agricultural Diversification

Sustained economic growth, urbanization and globalization is changing the consumption pattern of Indian consumers from food grains to high-value commodities. This is occurring both in urban and rural areas as well as among rich and poor households. To meet the changing demand, production systems are gradually shifting towards HVCs, though the nature and pattern of such shifts vary markedly across regions. In this chapter, an attempt is made to map the nature and pattern of diversification in the country, with focus on Punjab and Andhra Pradesh.

DRIVERS OF DIVERSIFICATION

Diversification can be a response to both opportunities and threats.

Opportunities

- **Changing consumer demand.** As consumers in developing countries become richer, food consumption patterns change noticeably. People move away from a diet based on staples to one with a greater content of animal products (meat, eggs, and dairy) and fruits and vegetables. In turn, more dynamic farmers are able to diversify to meet these needs.
- **Changing demographics**. Rapid urbanization in developing countries has an impact on consumption patterns. Moreover, a smaller number of farmers, in percentage terms at least, has to supply a larger number of consumers. While this may not imply diversification it does require adaptation to new farming techniques to meet higher demand.
- **Export potential**. Developing country farmers have had considerable success by diversifying into crops that can meet export market demand. While concern about food miles, as well as the cost of complying with supermarket certification requirements such as for Global GAP may

jeopardize this success in the long run, there remains much potential to diversify to meet export markets.

- **Adding value.** The pattern witnessed in the West, and now becoming widespread in developing countries, is for consumers to devote less and less time to food preparation. They increasingly require ready-prepared meals and labour-saving packaging, such as pre-cut salads. This provides the opportunity for farmers to diversify into value addition, particularly in countries where supermarkets play a major role in retailing.
- **Changing marketing opportunities**. The changing of government policies that control the way in which farmers can link to markets can open up new diversification possibilities. For example, in India, policy changes to remove the monopoly of state "regulated markets" to handle all transactions made it possible for farmers to establish direct contracts with buyers for new products.
- Improving nutrition. Diversifying from the monoculture of traditional staples can have important nutritional benefits for farmers in developing countries.

Threats

- **Urbanization**. This is both an opportunity and a threat, in that the expansion of cities places pressure on land resources and puts up the value of the land. If farmers are to remain on the land they need to generate greater income from that land than they could by growing basic staples. This fact, and the proximity of markets, explains why farmers close to urban areas tend to diversify into high-value crops.
- **Risk**. Farmers face risk from bad weather and from fluctuating prices. Diversification is a logical response to both. For example, some crops are more drought-resistant than others, but may offer poorer economic returns. A diversified portfolio of products should ensure that farmers do not suffer complete ruin when the weather is bad. Similarly, diversification can manage price risk, on the assumption that not all products will suffer low prices at the same time. In fact, farmers often do the opposite of diversification by planting products that have a high price in one year, only to see the price collapse in the next, as explained by the cobweb theory.
- **External threats**. Farmers who are dependent on exports run the risk that conditions will change in their markets, not because of a change in consumer demand but because of policy changes. A classic example is the Caribbean banana industry, which collapsed as a result of the removal of quota protection on EU markets, necessitating diversification by the region's farmers.
- **Domestic policy threats**. Agricultural production is sometimes undertaken as a consequence of government subsidies, rather than because it is inherently profitable. The reduction or removal

of those subsidies, whether direct or indirect, can have a major impact on farmers and provide a significant incentive for diversification or, in some cases, for returning to production of crops grown prior to the introduction of subsidies.

- **Climate change**. The type of crop that can be grown is affected by changes in temperatures and the length of the growing season. Climate change could also modify the availability of water for production. Farmers in several countries, including Canada, India, Kenya, Mozambique, and Sri Lanka have already initiated diversification as a response to climate change. Government policy in Kenya to promote crop diversification has included the removal of subsidies for some crops, encouraging land-use zoning and introducing differential land tax systems

Facets of Agricultural Diversification

At macro level

Diversification in agriculture is moving away from agriculture to industry or service sector. (Muujumdar and Kapila, 2006)

At micro level (within agriculture)

- Shift to high value commodities/ enterprises
- Use of resources in diverse and complementary activities

Agricultural diversification towards High Value Commodities

Indian agriculture has slowed. Growth has decelerated sharply from 3.2 per cent annually between 1980/81 and 1995/96 to a trend average of 1.96 per cent subsequently. Emphasis on cereals production (especially rice and wheat) to achieve food security, which resulted in higher profitability for producers and lower output prices for consumers, is dampening agricultural growth. The food security objective has been achieved. The country has accumulated large foreign exchange reserves, if needed, to import food. Alternative options need to be explored to accelerate agricultural growth.

Agricultural diversification towards high-value commodities (such as fruits, vegetables, milk, meat, poultry, eggs and fish) is one of the most promising strategies to reverse the declining growth in agricultural sector. Demand for these commodities is growing with rising income, urbanization and globalization.

Why high-value agriculture?

The growth in agricultural sector has sharply decelerated from 3.2% per annum during 1980/81 to 1.1 % in 2014-15. (Economic survey of India 2014-15). It is a matter of great concern, as nearly 70 percent of the population lives in rural areas, and over 60 percent of the rural population seeks its livelihood in agriculture and allied activities. (census 2011). The poor performance of agriculture is causing distress to the farming community. Declining trend of Poverty may reverse in rural areas.

There are two main reasons for such a dismal performance of the agricultural sector. First, the traditional crop sector has reached a plateau; the yields of a majority of traditional crops have slowed or stopped increasing and the cost of production has risen, resulting in declining profitability. Second, the production environment has deteriorated:

(i) Ground water has fallen ;

(ii) Water logging and soil salinity have increased in surface-irrigated areas;

(iii)Imbalanced use of nutrients and excessive mining of micro-nutrients have led to deterioration in soil quality.

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On the demand side, sustained economic growth (nearly 8 percent per annum in recent years), rising per capita income, growing urbanization, and unfolding globalization are causing a shift in the consumption patterns in India (Kumar *et al* 2003). Per capita cereal consumption has declined from 192.6 kg per person per annum in 1977-78 to 152.6 kg in 1999-2000 in rural households, representing a 20.77 per cent decrease. For urban households it declined by 14.97 per cent. In contrast, the share of HVCs in total food expenditure increased from 23.8 percent in 1977-78 to 35.75 percent in 2003 for rural consumers and from 32.2 per cent to 41.55 per cent for urban consumers (NSSO 2005). The growing demand for HVCs is not only confined to rich consumers but can also be observed among poor households (Dev, Mahendra S. and Chandrashekar Rao 2004; Kumar 2003).

Alternative options need to be explored to revitalize agriculture, make it more profitable and to improve its growth performance. **Agricultural diversification towards high value commodities (HVCs**) is viewed as one of the most promising strategies to reverse the declining growth trend in agriculture. (WorldBank,2002;DFID,2002; Rosegrantand Hazell,2000, Government of India 2005).

Agricultural diversification in selected sectors

We have observed a noticeable shift in production portfolio towards HVCs in India as well as in both the food grain surplus states. But it is important to note that the shift in production portfolio is broad-based in the marginal and fragile environment (i.e., Andhra Pradesh), while the move is more towards dairy sector in well-endowed region (i.e., Punjab). In the following sections, we discuss the pattern of diversification for selected agricultural sectors.

Fruits and Vegetables

India is a major producer of fruits next to china with an estimated production of 82.631 million tons in 2013-14. (NHB report 2014). Mango and citrus are the major fruit crops, accounting for about 57 percent in the total fruit production. In vegetables, India is second to China with an estimated production of 162.89 million tons in 2013-14. At the all-India level, the share of fruits and vegetables in the total value of agricultural output increased from 14.37 per cent in 1982-83 to 32.33 per cent 2015-16. This has happened due to area expansion and productivity increase of both fruits and vegetables.

Dairy

Dairy sector in India has witnessed a steady growth in the last two decades. Its share in agricultural GDP has risen from 13.17 percent in TE 1982-83 to 33.22percent in 2013-14, primarily because of the implementation of operation flood program through the National Dairy Development Board (NDDB) under which milk collection centers and processing units have been set up countrywide by the milk cooperatives. More recently private players have also entered the dairy sector and are expected to give a big boost to it. Dairying has assumed greater significance for smallholders since it is land-saving, labour-intensive and regular-yielding activity. Milk production in the country has increased at an annual rate of 3.91 percent between 1992-93 and 2013-14. This increase was much faster than the population growth; the per capita availability of milk in India went-up to 230 gm per day in 2003- 04 from 180 gm per day in 1991. However, it is still much below the level recommended by the Indian Council of Medical Research of 250 gm per day per person. Milk production is growing at a modest growth rate of 3.9 per cent per annum (for the period 1992-93 to 2013-14). The per capita availability of milk in Punjab increased from 201.96 gm/day in 1981-82 to 321.49 gm/ day in 2003-04, which is much above than the national average as well as the recommended level. In Punjab, dairy production contributed 54.6 percent of farm business income to marginal farms and 37.4 per cent to small farms during 2002-03 (Sidhu and Bhullar, 2004).

Impact of agriculture diversification on farmers

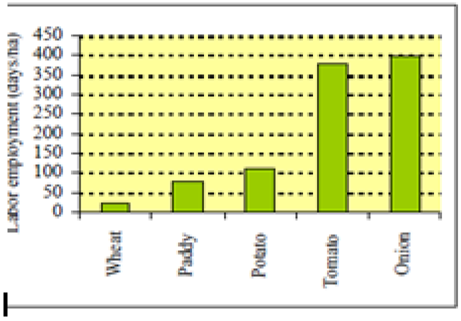
Malik (2003) has shown that the incidence of poverty is significant less in those areas of Pakistan and Punjab where agricultural activities are more diversified. And the diversification is positively correlated with the

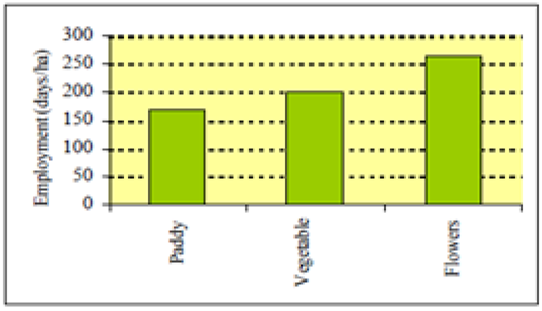
- Employment security.
- Profitability (economic security)
- Nutritional security
- Empowering women(social security)
- Sustainable use of water (environmental security)

- **Employment security**

  Agricultural diversification towards HVCs, in most instances, augments employment at the farm level as these commodities are labor-intensive. The advantage of higher employment opportunities are expected to benefit smallholders more as they possess more family labor (Ali and Abedullah, 2002; Joshi et al., 2003) The data on labor days employed in the production of various crops collected from Punjab and Andhra Pradesh tend to confirm these observations

  Fig. 1 Employment generation in important HVCs and other crops in Punjab and Andhra Pradesh





  In addition to the employment generated in production at the farm level, substantial demand for employment is expected in non-farm agricultural sector, agribusiness and agro-based industry since the HVCs require scientific pre- and post-harvest handling (Barghouti *et al* 2004). The employment involved in the entire supply chain of HVCs is high since many value-addition activities such as grading, packing, processing, cold chain management and logistics management are necessary.

EMPOWERING WOMEN

HVCs have the potential of creating increased employment opportunities and are more gender sensitive than the traditional crops. Women have better chances of being engaged in picking, sorting and grading of fruits and vegetables. About half of the total workforce in production of vegetables in Andhra Pradesh are women. In Punjab, as high as 93 percent of women are engaged in livestock. At the all-India level, more than 70 percent of the total workforce engaged in livestock production was women. Women also participate in large numbers in commercial crops, like cotton, sugarcane, groundnut, etc. Promoting high-value commodities in Andhra Pradesh and Punjab will open new avenues for women workers. Higher participation of women workforce in high-value commodities means empowering them in rural areas.

Crop group	Andhra Pradesh	Punjab	All-India
Cereals & pulses	47.2	7.1	37.1
Commercial crops	49.3	84.0	41.8
Vegetables*	50.3	39.0	45.1
Fruits	39.8	n.a.	40.0
Livestock	41.1	92.5	71.7
Forestry	46.6	n.a.	49.5
Fishing	19.7	16.5	12.5
Other activities	51.4	n.a.	40.0
Total agriculture	47.0	41.2	39.8

*Note: Includes vegetables and seeds of horticultural commodities; n.a. refers to not available
Source: NSS 55th round

Sustainable use of water

Water is a critical input in agriculture and the demand for it is rapidly growing. Both Punjab and Andhra Pradesh are encountering problems related with water in agricultural sector. The water table in these states is falling in certain areas consistently due to excessive use of ground water. Similarly in canal irrigated areas in both the states, low water rates are encouraging mismanagement and injudicious use of surface irrigation, leading to soil salinity and water logging. Approximately 1,50,000 ha in Andhra Pradesh and 6,03,300 ha in Punjab are affected by these problems. Groundwater level in Punjab has been falling due to early sowing of paddy, particularly in the Central Zone at the rate of almost one-quarter meter per year. HVCs play important role in managing water-related problems as their water requirement is lower than rice and other crops. In Andhra Pradesh, it was found that water requirement (hrs/ha) was highest for blue-water crops like paddy and sugarcane (Shiferaw *et al.* 2003). In contrast, for other crops like flowers, vegetables, cotton and chickpea, water requirement was less. The water productivity of HVCs was highest with low-water demand crops, while it was lowest for high-water demand crops like rice and sugarcane. However, rice, which occupies less than a quarter of the irrigated area, uses over sixty percent of the water .Agricultural diversification can result in improved management of water (Barghouti *et al* 2004).

CONSTRAINTS OF AGRICULTURAL DIVERSIFICATION

- High transaction costs, price volatility, lack of access to credit and information on food safety and standards.
- Most of the products are perishable and are more susceptible to production risks.
- Lack of organized supply chain result in poor mobilization of small marketable surplus that the farmers generate, resulting in low returns.

- HVCs are labour-intensive, higher wages constrained their production.

Conclusion

HVCs were a major source of agricultural growth during the decade of 1990s at all-India level. Compared to cereals, the HVCs yield higher income and generate more employment, particularly for women. The HVCs also use less water and therefore conserve that precious resource. Important factors that have contributed to promoting agricultural diversification include urbanization and per capita income on demand side and watershed programs on supply side. Growing agro-processing has impacted production of fruits. Since HVCs are labour-intensive, higher wages could constrain production. The HVCs are perishable and mostly produced by smallholders. The real challenge is to reduce their transactions costs and link them with the markets. Existing marketing channels are inefficient and fragmented. But some successful innovative institutional arrangements through farmer's markets, cooperatives, and contract farming are emerging which connect producers with agro-processors, exporters and domestic retail chains.

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AN ASSESSMENT ON ADOPTION LEVEL OF DAIRY INNOVATIONS AMONG DAIRY FARMERS IN ANDHRAPRADESH

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Dairy sector assumed a sustained growth rate for the past 5 decades and stood first in world's milk production with 146.3 million metric tonnes by the year 2014-15. Dairying ensures stable income to the farmers and plays a pivotal role in providing employment and income generating opportunities to the rural families. Dairying now, has become a commercial enterprise and needs technology adoption for higher milk yield and lower per unit costs. Various organisations like State Veterinary Universities, State Department of Animal Husbandry, Research organizations and Livestock extension services are acting at different levels to generate and transfer technologies amongst livestock farmers. Despite these efforts the adoption of recommended technologies/innovations has not been wide spread as anticipated (Lethadevi G).The need of the hour is to understand how far the existing technologies are adopted by dairy farmers and the reasons for non-adoption. The non-adoption of technologies is attributed to low extension agent to farmers' ratio of 1:1500 or farmers risk averse towards new technologies or linear top-down approach of technology development and transfer. (Andrew Hall *et al.,* 2003, The World Bank, 2006).

The linear-top-down approach of extension delivery is restrictive in nature and this hinders its ability to stimulate the much needed break through to promote innovation and adoption among farmers by disregarding other traditional knowledge sources. (Byerlee *et al.,* 2007). When technologies are developed in isolation with regard to final users, may serve as a disincentive for adoption while introduced to them. The lack of innovation spirit among farmers is generally due to asymmetry of information relating to the innovation introduced, technical know-how, market trends and infrastructural platform. The supply and demand of improved technologies involves a multifaceted interaction among all the stakeholders to trigger innovation, adoption and diffusion. (Egyir I.S *et al.,* 2011).

The acceptance or rejection of a particular technology by the farmers depends upon the characteristics of the technology, the quality and density of extension personnel, farmers' attitude towards the technology and accessibility to technical inputs and services essential for adoption of an innovation. Keeping this in view, a study was undertaken with the specific objective to study the adoption level of dairy innovations by the dairy farmers as well as the factors associated with adoption of dairy innovations in Andhra Pradesh.

METHODOLOGY

The present study was carried out purposively in three regions i.e., North Coastal, Coastal and Rayalaseema regions of Andhra Pradesh. Based on the highest cattle population and best rank in adoption of recommended dairy innovations, three districts namely Visakhapatnam, Krishna and Chittoor were selected from the North coastal, Coastal and Rayalaseema regions respectively. Three mandals from each district and two villages from each mandal, i.e., 6 villages from each district totaling to 18 villages were finally selected for the study using simple random sampling technique.

Among the selected 18 villages, a list of dairy farmers adopting recommended dairy innovations was prepared respectively in consultation with local Veterinary Assistant Surgeons, Heads of dairy co-operatives and supervisors of milk collection centres. From the list prepared, 20 dairy farmers were selected from each village through random sampling technique thus to form a sample size of 360 respondents for the study. Semi-structured interview schedule wes used to collect the data, using personal interview method.

The personal, socio-economic, psychological and communicational variables of the livestock farmers were considered as the independent variables for the study. Adoption level of the dairy innovations is the dependent variable. Package of practices for feeding and management of heifers, pregnant and lactating animals, Formulation and feeding of complete feed blocks, Feeding of area specific mineral mixture, Cultivation and feeding of hydroponic fodder, Cultivation and feeding of Azolla, Strategies for enhancement of milk yield and quality, Use of milking machine, Marketing strategies to improve milk sales and Use of information and communication technologies for adoption and diffusion of innovations were the innovations considered for the study.

A range of adoption is provided for these practices facilitating adjustments based on local conditions. An index for adoption is constructed to measure the rate of adoption using the following formula.

$$\text{Adoption quotient} = \frac{\text{No. of practices adopted}}{\text{No. of practices recommended}} \times 100$$

Each practice adopted within the range by a farmer was given a score of one. Based on the number of practices, the maximum possible score for dairy innovations was nine. An adoption quotient was computed for each farmer. Based on the adoption quotient, the respondents were categorized into 3 groups as high, medium and low level of adoption behaviour. Statistical techniques like frequency distribution, percentage, mean, standard error, correlation and multiple regression analysis were used to analyse the data.

RESULTS AND DISCUSSION

The results of the study revealed that majority of the dairy farmers adopted only half of the recommended innovations in the following rank order, such as package of practices for rearing heifers, pregnant and lactating animals (I); feeding of area specific mineral mixture (II), strategies for enhancement of milk yield and quality (III), marketing strategies to improve milk sales (IV), use of information and communication technologies in adoption of dairy innovations (V); whereas the practices like cultivation and feeding of Azolla (VI), Use of milking machine (VII), Cultivation and feeding of hydrophonic fodder (VIII) and Feeding of complete feed blocks (IX) were adopted by a very meager percent of the respondents.

Table 1:Distribution of dairy farmers based on adoption of dairy innovations

Sl.No	Practice	Adopted		Non-Adopted	
		N	%	N	%
1.	Package of practices for rearing for heifers, pregnant and lactating animals	272	75.6	88	24.40
2.	Feeding of area specific mineral mixture	261	72.4	99	27.60
3.	Strategies for enhancement of milk yield and quality	247	68.7	113	31.30
4.	Marketing strategies to improve milk sales	239	66.3	121	33.70
5.	Use of information and communication technologies to adopt dairy innovations	222	61.8	138	38.20

6.	Cultivation and feeding of Azolla	174	48.4	186	51.60
7.	Use of milking machine	103	28.7	257	71.30
8.	Cultivation and feeding of hydrophonic fodder	48	13.4	312	86.60
9.	Formulation and feeding of complete feed blocks	20	5.6	340	94.40

Package of practices for rearing heifers, pregnant and lactating animals: Three-fourths of the dairy farmers i.e., 75.6 per cent adopted the innovation Package of practices for rearing heifers, pregnant and lactating animals in which 54 percent adopted the innovation to a medium extent followed by 12.4 and 9.2 percent of the dairy farmers with high and low rates of adoption respectively. 24.4 per cent of the farmers did not adopt the innovation as they were unaware of the importance of Package of practices for rearing heifers, pregnant and lactating animals.

Feeding of area specific mineral mixture: On the whole it could be noticed that 72.4 per cent of the dairy farmers adopted the practice Feeding of area specific mineral mixture in which 52.8 per cent of the repondents adopted to a medium extent followed by 14.3 per cent of the respondents with high and 5.3 per cent of the respondents with low per cent of adoption respectively. The fact that about 27.6 per cent of the farmers did not adopt the innovation suggests that the farmers are aware of the benefits of Feeding area specific mineral mixture but expect a free cost of operation.

Strategies for enhancement of milk yield and quality: 68.7 per cent of the dairy farmers adopted the innovation Strategies for enhancement of milk yield and quality. 50.2 per cent of the farmers adopted the innovation to a moderate extent followed by 14.4 per cent with high and 4.1 per cent with low adoption which is an indication that this innovation plays a dominant role in improving production levels as well as economic returns to the dairy farmers.

Marketing strategies to improve milk sales: The results pertaining to this innovation presented in Table 1 revealed that 63 per cent of the dairy farmers adopted the innovation Marketing strategies to improve milk sales which clearly suggests that the farmers are making rapid strides towards profit maximisation and hence the above trend.

Use of information and communication technologies to adopt dairy innovations: It is evident from the results of the Table 1 that 61.8 per cent of the respondents' utilised information and communication technologies like mobile phones, multimedia modules and What's app groups to gain information regarding dairy innovations which increased their knowledge levels persuading them to adopt the innovation.

Cultivation and feeding of Azolla: The dairy farmers are aware of the innovation Cultivation and feeding of Azolla, as the State Department of Animal Husbandry, Govt. of Andhra Pradesh implemented the scheme at mandal level in all the districts.Though aware of the innovation the adoption percent is found to be only 48.4 which might be attributed to skill involvement and regular monitoring aspects involved in cultivation of azolla like cleaning of pits, change of mother culture every week, drying before feeding etc.

Use of milking machine: The innovation use of milking machine is aopted by only 28.7 per cent of the dairy farmers who are progressive in nature and maintaining milch animals over and above ten on an average. 71.3 per cent of the dairy farmers are not using milking machine owing to small herd size of 2-3 animals and misbelief that the machinery may injure the udder.

Cultivation and feeding of Hydrophonic fodder: The innovation Cultivation and feeding of hydrophonic fodder was adopted by only 13.4 per cent of the dairy farmers which may be attributed to high cost involved, infrastructure and technology required for cultivation of hydrophonic fodder.

Formulation and feeding of complete feed blocks : Formulation and feeding of complete feed blocks was adopted by only 5.6 per cent of the dairy farmers maintaining commercial dairy farms where as remaining 94.4 percent of the dairy farmers are unaware of this innovation.

Overall adoption of common dairy farming technologies: Majority of the dairy farmers were found belonging to medium level of adoption behaviour (51.46%) followed by 42 pe rcent with low and 6.54 per cent with high rate of adoption respectively.(Table 2)

Table 2: Distribution of dairy farmers based on their overall rate of adoption of suggested dairy innovations.

Sl.No.	Category	Frequency	Percentage
1.	Low rate of adoption	144	42
2.	Moderate rate of adoption	185	51.46
3.	High rate of adoption	31	6.54
	Total	**360**	**100**

Relational analysis of adoption of Dairy innovations and other independent variables:

Table 3 : Relationship between adoption of dairy innovations and profile characteristics of dairy farmers.

S.No.	Independent variables	Correlation coefficient r-value
1.	Age	-0.286**
2.	Gender	0.138^{NS}
3.	Education	0.215^{NS}
4.	Land holding	0.366*
5.	Experience	0.328**
6.	Herd size	0.265**
7.	Milk production	0.304**
8.	Income	0.480**
9.	Innovativeness	0.198^{NS}
10.	Decision making ability	0.389**
11.	Risk bearing ability	0.182^{NS}
12.	Economic orientation	0.333**
13.	Scientific orientation	0.178^{NS}
14.	Perception	0.325**
15.	Attitude	0.282^{NS}
16.	Information seeking behaviour	0.392**
17.	Communication channels	0.465**

* Correlation is significant at 0.05 level
**Correlation is significant at 0.01 level

The results of Table 3 revealed that the computed ‘r’ values between profile characteristics i.e., land holding, experience, herd size, milk production, income, decision making ability, economic orientation, perception, information seeking behavior and communication channels were positively and significantly related while age is negatively and significantly related at 0.01 percent probability with adoption level of dairy farmers. The variables gender, education, innovativeness, scientific orientation and communication channels correlated non-significantly with rate of adoption of dairy farmers.

Majority of the dairy farmers belonged to middle age group, willing to try new technologies and bear risk whereas old age group members were risk averse and rigid to try new technologies which might have lead to negative correlation. Dairying in our country is an age old practice where both male and female counter parts of the family share the work at different stages of dairy farming which might be the possible reason for its positive and non-significant relation. Majority of the respondents in the study area were illiterate and fell in early majority group of adopters which indicates that education had shown a positive impact on adoption of innovations.

Land holding exerted a positive and highly significant correlation with adoption of innovations. Farmers with sizeable land holdings had opportunity to maintain more number of animals, possessed sound knowledge on farming practices, had optimal risk bearing ability which facilitated them to adopt innovations at a faster pace. The farmers in the present study had an average experience of 15 years which increased their accessibility to various innovations in the dairy farming sector. Herd size is a critical factor in enhancing farming performance since outcome of new technology introduced is visible on a large scale which resulted in significant positive correlation. Gangasagar and Karanjkar (2009).

Majority of the farmers produced around 11 liters of milk /day on an average. Due to their regular contact with the milk societies the farmers became aware of the quality assurance of milk, clean and hygienic production of milk, importance of fat and SNF per cent etc., in milk which paved a way for highly significant co-relationship. Since most of the innovations suggested in the present study involved production and simple technology aspects, income had shown a positive and significant correlation.

Innovativeness showed a positive but non-significant effect on adoption of innovations. Dairy farmers advocated rationality in decision making and adopted useful technologies from moderate to high extent. Pooja Patel *et al.,* (2014) and Surkar S.H *et al.,* (2014). The respondents were not prepared to accept the element of risk to an optimal extent which resulted in non-significant co-relation.

Economic orientation is essential for any farmer to enhance profitability and sustainability of his enterprise which exerted a positive and significant relationship. The positive and non-significant relation with scientific orientation suggests that it is imperative to provide access to latest technologies through trainings, demonstrations, expert systems etc., which might push the farmers towards high scientific orientation. The adoption of new technologies is facilitated by how best the innovation is perceived by the farmer as profitable, compatible, simple in execution, trialable and practicable in his own situations. The innovations recommended in the study were perceived to meet the above attributes and hence a highly significant positive correlation. The farmers had a favourable attitude but only to a moderate extent towards recommended innovations.

Information seeking behaviour exerted a direct bearing on the adoption of innovations by the dairy farmers. Manisha C and Kansal S.K (2014) and Kassahun *et al.,* (2014).

Communication channels, like news papers, radio, T.V, ICT tools like expert systems, multi media modules, web-portals, what's app groups etc., have brought out revolution in communication by providing access to information within fraction of seconds. Majority of the farmers in the study area utilized these channels from moderate to high extent which resulted in positive and significant relationship.

Prediction of contribution of independent variables on rate of adoption of dairy farmers

Table 4 : Multiple linear regression analysis of independent variables with adoption of dairy farmers

S. No.	Variables	Regression coefficient (b)	SER	t value
1.	Age	-0.895	0.285	-2.438**
2.	Gender	0.058	0.160	0.175
3.	Education	0.005	0.137	0.072
4.	Land holding	0.935	0.236	1.813^{NS}
5.	Experience	3.916	0.893	2.787**
6.	Herd size	-0.131	0.046	-0.875
7.	Milk production	0.147	0.056	1.339^{NS}
8.	Income	0.550	0.186	3.777**
9.	Innovativeness	0.705	0.283	0.928
10.	Decision making ability	0.329	0.089	0.497**
11.	Risk bearing ability	0.690	0.287	2.407**
12.	Economic orientation	4.105	2.658	3.885**
13.	Scientific orientation	2.342	1.235	1.818
14.	Perception	0.887	0.234	0.361
15.	Attitude	0.229	0.013	1.446
16.	Information seeking behaviour	1.088	0.372	3.567**
17.	Communication channels	1.252	1.087	2.129

R^2 = 0.587,   F value = 12.22**

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

The R^2 value (0.587) indicated that all the independent variables put together explained variation in adoption of dairy farmers to an extent of 58.7 per cent. The computed F-value (12.22) was found to be highly significant.

Prediction of independent variables which contributed for maximum variation on adoption levels of dairy farmers

Table 5 : Step down multiple regression analysis for predicting the influence of selected profile characteristics with adoption of dairy farmers

S. No.	Variables	Regression coefficient (b)	t-value
1.	Age	-3.218	-4.208**
2.	Experience	0.049	3.870**
3.	Herd size	2.741	43.549**
4.	Milk production	1.673	2.172*
5.	Income	0.049	3.128**
6.	Risk bearing ability	0.0872	0.1825
7.	Economic orientation	1.312	3.374**
8.	Information seeking behaviour	0.594	3.184**

R^2 = 0.564, F value = 11.584**

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

The results of Table 5 confirmed that eight variables viz., age, experience, herd size, milk production, income, risk bearing ability, economic orientation and information seeking behaviour significantly contributed to 56.4 per cent variation in adoption of innovations by dairy farmers. The variance ratio (11.584) was found to be significant at 1% level of probability.

Conclusion

The results of the study indicate that livestock farmers in Andhra Pradesh have been exposed to dairy innovations/technology diffusion programmes. Majority of the dairy farmers adopted the innovations but the rate of adoption of these technologies is far from desired. Therefore, enhancing the dissemination of information and knowledge about dairy farming technologies, ensuring relationship between farmers, researchers and extension officers, distribution of input facilities among livestock owners is highly recommended. Rate of adoption and diffusion index need to be developed for other livestock species to focus on identified components for profit maximisation.

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"EMPOWERMENT OF RURAL WOMEN BY DESI BIRD REARING"

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ABSTRACT:

A study was carried out to ascertain the participation and empowerment of rural women in backyard poultry rearing, using structured interview schedule by personnel interview for the sample size of 60 rural women in Harpanhalli and Jagalur taluks of Davengere district of karnataka. The socio-economic profile revealed that majority of women were middle aged (70 per cent) and where illiterate (60 per cent) with nuclear type of family and were married (70 per cent). Majority of the respondents belonged to Scheduled caste category (50 percent). Most of the respondents were agriculture labourers (46.67 per cent) with low annual family income (76.67 per cent). Totally 16 operations of desi bird rearing were selected in consultation with experts and were categorized into seven category as general management, supplementary feeding, watering, brooding activities, hatching activities , health care and decision making activities. The study revealed that women participation was major in preservation of eggs and caring of hatching eggs (91.67 per cent) followed by brooding activities (90 per cent) and caring of newly hatched chicks. Women are also more involved in supplementary feeding (90 per cent) and watering (81.67 per cent). The farmwomen actively involved in cleaning of animal sheds (93.33 per cent), letting birds in and out of shed (75 per cent*).* The farm women participation was low in taking the birds for treatment (13.34 per cent) followed by purchase of medication (18.33 per cent), deworming and medication (13 per cent) and protecting the birds from predators (38.33 per cent) as these activities

need assistance of men. It was noticed from study that women are also more involved in decision making activities such as selling/purchase of eggs and birds 88.34 and 91.67 respectively, this increased income utilization pattern (85 per cent) of farm women. These findings indicate the rural women are empowered by backyard poultry farming. The interview with rural women indicated that involvement of women in desi birds rearing as enhanced their ability to contribute to their family income to some extent. Hence the study suggest that the government and non government agencies need to have an enabling environment to provide opportunities to make backyard poultry enterprise sustainable by facilitating easy access to support services such as marketing, vaccination, training etc for empowerment of rural women.

INTRODUCTION:

In India backyard poultry rearing is as old as its civilization. Poultry farming is possible in widely different agro-climatic environment as fowl possesses marked physiological adaptability (national commission on agriculture 1976). It is easy to manage and can be taken up under diversified agro-climatic conditions, its requirements of land, capital and other external inputs are low for small scale units, it can provide quick returns and continuous income throughout the year, as its enjoys good market demand and prices. BYP is the most efficient converter of household and farm waste into food of high value. BYP enhances women's social status and decision-making power in the household by increasing women's income and can be used as a tool to reduce poverty in rural areas. The rearing of poultry provides an excellent opportunity for gainful employment to idle or unemployed members of rural communities especially women. The backyard poultry rearing in karnataka are mainly in hands of women as they are smaller and easier to rear. The present study was designed to study the role and extent of involvement of rural women in backyard poultry rearing.

METHODOLOGY:

The present study was carried out to study the role and participation of rural women in backyard poultry rearing. Purposive sampling technique was used for selecting Harpanhalli and Jagalur Taluk of Davengere district. The study was conducted during January-march 2017. A structured interview schedule was used to collect the data by personal interview method. Ten women respondents were selected from each study village, thus making 60 rural women rearers for the final study. After the completion of the data collection, the collected data were coded, tabulated, classified and further categorized for systematic statistical analysis. The descriptive statistical tools like frequency, average and percentage were used for analysis of data and also Garrett ranking technique was used to study the purpose of rearing the backyard poultry birds. The results were interpreted following.

RESULT AND DISCUSSION:

Purpose of poultry rearing:

Table 1: Purpose of poultry rearing

Purpose	**Rank**
Source of income	**4**
Home consumption	**1**
Use on special occasion(religious ceremony)	**3**
Hobby	**5**
Guest visit	**2**

From the above table 1 majority of women ranked home consumption as first priority followed by guest visit , use during special occasion and source of income. Women also ranked poultry rearing as a hobby. These purposes of poultry rearing was tabulated and ranked using Garret ranking techniques. Garrett‘s ranking technique (Garrett, 1979) was used to rank the purpose of rearing the backyard poultry expressed by the respondents. According to this technique the respondents were asked to rank the listed 5 purposes. The order of merit thus given by the respondents was converted into ranks by using the following formula:

Per cent position = 100*(Rij – 0.5) / Ni

Where, Rij = Rank given for ith problem by jth individual

Ni = Number of constraints / problems ranked by jth individual.

Socio-economic profile of rural women backyard poultry rearers.

The study revealed that 70 per cent of rural women were middle aged followed by young (20 per cent) and old age (10 per cent) category. The probable reason for such distribution may be that, majority of middle aged women perceive it as profitable and they are biological fit to carry out physical activities. Similar finding are seen in the studies carried by Prakash Kumar et, al.2011. Education is one of the important factors which accelerate growth and development of any enterprise. The study revealed that 60 per cent of respondents were primary as schooling followed by high schooling; none of the respondents were above high schooling. Subrahmanyam and Murthy (2006) in their study reported that literacy has a positive impact on the productivity of birds. Regarding the type of family, majority of women lived in nuclear (61.67 per cent) while 38.33 per cent lived in joint family; the respondents belonged to nuclear type of family because of desire to lead an independent life with proper accommodation, basic amenities and to provide better future to their kids. This is in similar line with Manay and Farzana (2000). Majority of the women were married (70 per cent) .the married women are more responsible than that of unmarried women. The married women will be more bind to the husband family and will act as a helping hand in his activities whereas unmarried are free to make their own choice. The land holding capacity of respondents were agricultural labourer (46.67per cent) followed by small farmer and marginal farmer. The study also showed majority of respondents belonged to schedule caste (50 per cent) followed by schedule tribe (26.67per cent) and other backward caste (23.33 per cent). On an average the flock size of each respondents were around 6-10birds (43.33 per cent) followed by more than 10(30 per cent), some respondents also had a flock size which was less 5(26.67 per cent) these respondents mainly reared birds exclusively for home consumption and as their hobby. The information regarding the backyard poultry majority of the respondents revealed that they consult non-institutional (83.33 per cent) source for the information seeking. These non-institutional includes own family members, other backyard poultry farmers in the village and village key personnel. Less number of respondents seeks information from mass media (8.33 per cent) especially from television and least respondents responded that they seek help from institutional source.

The distribution of respondents according to their personal, social and economic traits included in the study is presented in Table 2.

Table 2: Socio-economic profile of rural poultry rearing women. N=60 (N is the number of respondents)

Sl no.	characters	No.	Percentage
1	**Age**		
	18-25 years(young)	12	20
	25-50 years(middle)	42	70
	>50 years(old)	06	10
2	**Education**		
	Illiterate	16	26.67
	Primary school	36	60
	High school	08	13.33
	Above high school	00	0

3	**Family type**		
	Nuclear family	37	61.67
	Joint family	23	38.33
4	**Category**		
	General	00	00.00
	OBC	14	23.33
	SC	30	50
	ST	16	26.67
5	**Marital status**		
	Married	42	70
	Unmarried	10	16.67
	Widow	6	13.33
6	**Land holding**		
	Labourer	28	46.67
	Small farmers(1-3acre)	22	36.67
	Marginal farmers(3-7acre)	10	16.67
	Large farmer(>7acre)	0	0
7	**Income of the family**		
	Low	46	76.67
	Medium	11	18.33
	High	03	5
8	**Income from backyard poultry rearing**		
	low (1000)	26	43.33
	medium (1000-3000)	30	50
	high (>3000)	4	6.67
9	**Flock size**		
	1-5 birds	16	26.67

	6-10 birds	26	43.33
	>10 birds	18	30
10	**Information sources about Backyard poultry rearing**		
	Institutional	2	3.33
	Non institutional	53	88.33
	Mass media	05	8.33

Role and participation of rural women in backyard poultry rearing:

The study focused on seven activities and findings of study is depicted in table 2.

General managemental activities: In the managemental activities women actively participated cleaning of shed and letting in and out of the shed. Similar finding is seen with Jain and Verma (1992). Less participation is seen in shed construction and protecting birds from predators as these activities need assistance from men.

Supplementary feeding: The study revealed that 90 per cent of women were involved in supplementary feeding followed by watering. These supplementary feeding includes locally available grain such as broken rice, maize, ragi along with the kitchen waste. Birds were fed according to the availability of feed ingredient. None of the respondents supplied birds with commercial feed preparations. This shows that the birds can be easily reared with minimal feed ingredient and can effectively utilize kitchen waste. The birds were given water daily in the wide open plastic containers.

Hatching activities: In case of hatching activities women more involved in preservation of eggs and care of hatching eggs. The majority of the women were collecting the eggs and storing them in a basket filled with wet sand before the brooding period of birds. After 6-7 days the birds sat on this basket for the incubation for the period of 21 days. These basket were kept above the ground level to prevent predator attach on hatching eggs.

Brooding: Majority of women respondents participated in preparation for the brooding activities which included cleaning, washing, arrangement of traditionally used earthen or plastic feeders and waterer. These finding are in similar line with B. O. Adisa and J.A. Akinkunmi 2012 which revealed that majority of the women were engaged in brooding activities like cleaning and disinfecting the brooding room, and also stated that this operation required thorough handling, skilful and careful planning. Therefore, most women preferred to handle this operation by themselves.

Health care activities: Majority of the women were involved in taking care of newly hatched chicks, care of sick chicks and traditional treatment for sick birds. Least participation was seen in deworming and vaccination process as they require calculation of drugs, skillful handing of tools and understanding of the disease symptoms which women lack. Less participation was seen in purchase of medicine and taking birds for treatment as these processes involve outdoor activities and most of this is looked after by men. As the study villages were not having the veterinary hospital in their area they were travelling to neighboring village for the treatment which was done by the men mainly.

Decision making activities: The women's participation in marketing of poultry products was very high. This is similar to the finding of Adeokun (2000) on the involvement of women in marketing of fish. Poultry is a source of self-reliance for women, since poultry and egg sales are decided by women both of which provide women with an immediate source of family income to meet household expenses this is in similar line with (Aklilu *et al*., 2007).

Table 3: Role and participation of rural women in BYP rearing. N=60

Activities	**No.**	**Percentage**
1: General managemental activities: 1. Protection from predator	23	38.33
2. Construction of shed	21	35
3. Letting birds in and out	45	75.00
4. Cleaning of shed	56	93.33
2: Supplementary feeding	54	90.00
3: Watering	49	81.667
4: Hatching activities: 1. Collection of eggs	48	80.00
2. Preservation of eggs and care of hatching eggs	55	91.67
3. Care of newly hatched birds	53	88.34
5: Brooding activities:	54	90.00

6: Health care activities: 1. Purchase of medicine	11	18.34
2. Deworming/ medication	13	21.67
3. Taking birds for treatment	8	13.34
4. Care of sick birds	48	80.00
5. Traditional method of treatment	43	71.67
7:Decision making activities: 1. Selling of eggs	53	88.34
2. Selling of chicken	55	91.67

CONCLUSION:

The study concluded that major activities in backyard poultry are carried out by the rural women. These findings indicate the rural women are empowered by backyard poultry farming. The interview with rural women indicated that involvement of women in desi birds rearing as enhanced their ability to contribute to their family income to some extent. Hence the study suggest that the government and non government agencies need to have an enabling environment to provide opportunities to make backyard poultry enterprise sustainable by facilitating easy access to support services such as marketing, vaccination, training etc for empowerment of rural women.

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Role of community approaches in drought mitigation for sustainable livelihood security

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Abstract: Drought may be defined as an extended period – a season, a year or more – of deficient rainfall relative to the statistical multi-year average for a region. Drought has a direct and indirect impact on the economic, social and environmental fabric of the country. Depending on its reach and scale it could bring about social unrest. Drought-prone villages and areas have to learn to adopt and sustain drought mitigation methodologies and harness traditional knowledge, using local resources. Rainwater harvesting measures in village can fortify food security and livelihood security. It can have deep implications on drinking water availability, eradication of poverty, rural unemployment and distress migration from rural to urban areas. Digging of farm pond, conservation techniques and methods of irrigation on community approaches leads to protection of crop during critical stages, protection of animals, protection of livelihood on sustainable basis for food and livelihood security.

Key words: Community approaches, Drought mitigation, rainwater harvesting.

Introduction:

Rain fed agro-ecosystem has a distinct place in Indian Agriculture, occupying 67% of the cultivated area, contributing 44% of the food grains and supporting 40% of the human and 65% of the livestock population (Venkareswarlu 2005). Karnataka ranks second, next only to Rajstahan in India, in terms of total geographical area prone to drought (Nagaraj *et al* 2004). Drought is a slow setting disaster that ravages some part of the country or the other almost every year following deficiencies in rainfall or its erratic temporal or spatial distribution. In recent past, the impact of drought causing to water and food shortages and destruction of ecological system had been widespread and became a national concern during 1987-88, 2002-03 and 2009-10. Although relief measures undertaken by Central and State Governments, NGOs, community organizations, etc. are well established, the lessons learnt are often quickly forgotten once the drought is over. Drought preparedness and mitigation through proactive actions for managing available resources optimally are yet to be evolved. Farmers and water managers require tools and resources to protect crops and water systems and reduce the impact of drought (Anonymous, 2011).

Drought should be assessed on parameters such as water, food, fodder and employment availability, because the effect of drought has an impact on all these factors of livelihood. Community education on natural resource management, conservation techniques, water management techniques, adoption of diversified cropping pattern, integrated farming system, whole farm approach on social ethics and IPR aspects contributes for society and individual for income generation on sustainable basis and also protect the ecosystem and environmental aspects for future generation.

Drought mitigation: Community approaches

As drought is a frequent phenomenon in the state society should evolve various strategies for coping before and after drought.

Rain water harvesting and water saving

Rainwater is collected, stored and utilized at a later point. It can be purified to make it into drinking water, used for daily applications and even utilized in large scale industries. Rainwater harvesting system provides certain advantages to the community. First of all, harvesting rainwater allows us to better utilize an energy resource. Rainwater is free from many chemicals found in ground water, making it suitable for irrigation and watering gardens. In fact, storing large reservoirs of harvested water is a great idea for areas where forest fires and bush fires are common during summer months.

Every village and settlement had traditional tanks, springs, ponds, lakes, wells and other community water sources; these shall be immediately rejuvenated so that any resident of the village can slake her thirst at any time. Village hand pumps should be included in this category. The responsibility for immediate maintenance lies with the administration. Conservation of water should be enforced in all the economic sectors of production – agriculture, industry, municipal and urban consumption etc. The value of water is a part of the right to life and livelihood and it is the responsibility of all sections of society to conserve water.

Community based natural resource management (CBNRM)

For centuries, communities have had a symbiotic relationship with their environment.The human society largely dependent on natural resources for their survival and livelihood. However, the increasing population and socio-economic changes that have occurred in last few decades have changed the relationship from mutual to exploitative one, resulting in degradation of forests, loss of pasture land, drying up of springs and a decrease in other resources. Through a combination of training, technical support and resource mobilization, our community needs encouragement for more sustainable management of community natural resources. Community Based NRM is an effort to incorporate local communities into guardianship of their immediate environment in an attempt to meet ecological and social security at both local and global scales (Agrawal & Gibson, 1999).It is an attempt to allow local people access to manage their surrounding natural resources, whether for direct subsistence or economic livelihood, and to preserve the species and ecological function that comprise native ecosystems. CBNRM can be implemented in the form of community wildlife management, community forest management, community watershed management, extractive reserves, integrated poverty alleviation and conservation initiatives, ecotourism.(Agrawal & Redford, 2006).

Integrated farming system: A whole farm approach

Integrated farming system is a whole farm management system and dynamic approach which aims to deliver more sustainable agriculture around the world. It involves attention to detail and continuous improvement in all areas of a farming business through informed management processes. Integrated Farming system combines the best of modern tools and technologies with traditional practices according to a given site and situation. In simple words, it means using many ways of cultivation in a small space or land. The key to successful farming in drought-prone areas is not ‘farming land’ rather it is ‘farming water’. Simple tools to calculate the farm or field water balance, and the on-farm level of efficiency of water or rainfall use in terms of crop yield- generated should be developed for use in action-learning processes with dry land and irrigation farmers.

Community based pasture management

Drought-tolerant breeds of livestock and varieties of crops must be explored to help build drought tolerance farming systems. Today, restoration of reserve pasturelands is one of the key drought mitigation measures being implemented by the community. Government should support communities to analyze their risks and then implement practical interventions to increase their livelihood security. This could include supporting the construction and maintenance of water harvesting facilities, reclaimation of community reserve pasture land, supporting community based animal health programmes or livestock marketing initiatives.(Ito Kasumi et.al,2001)

Conclusion and future strategies

There is ample scientific evidence to suggest that productivity of drought prone areas can be enhanced significantly on a sustainable basis, provided the two basic natural resources, soil and rainwater, are managed in a judicious manner. Over the last several decades, researchers have concentrated on methods of increasing crop production under dryland conditions in order to mitigate drought effects at farm level. Simple easily implementable practices were developed for increasing the yields even in dry years over farmers' practices. To meet the weather aberrations, focusing more on community based conservation of natural resources, alternate land use systems, community based livestock management and diversification of agriculture can easily suppress the societal vulnerability leading to sustainable livelihood. Drought-prone communities, villages and areas have to learn to adopt and sustain drought-proofing methodologies and harness traditional knowledge, using local resources to combat the adverse effect of drought on the community to have secured livelihood strategies. The next step that could be thought of is the identification and training of two members of every panchayat – one woman, one man – as Climate Risk Managers. It is best that they are identified by the Gram Sabha, it has been suggested by famous agricultural scientists M.S. Swaminathan of India. Above all, drought planning must be viewed as a dynamic process requiring continued attention.

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Role of periphyton in periphyton based pond poly culture using Indian carps.

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Introduction

The majority of fish producing country practice polyculture system in aquaculture, which is most widely practiced system practiced in India, China, Thailand, & Bangladesh. Fish polyculture can be defined as a management system in which two or more species with complementary breeding habits, staked together in the same pond in order to maximise available food so that fishes can use all food stuff different layers or zones. There are many fish species suitable for polyculture system, like *Catla*, *Labeo-rohita*, *Labeo-calbasu, Gonius, Mrigal, Common Carp, cyprinous Carpio, Milk fish, Barbs, & Prawns*, etc.

Alikhuni (1957) described polyculture of Indian Carps i.e. *Catla*(which is the surface plankton feeder), *Labeo -rohita* (which is column feeder and omnivore), and *cirrhinus mrigala* (a bottom feeding omnivore). Wang in 1998, Sharma, et al 1999 & Azim & Wahab 2003 also experimented with polyculture of Carps & observed good results. Considering their work & getting attracted to the recent periphyton based aquaculture technology developed for pond culture & efforts made by the World wide scientists, the present work has been

When we were doing the basic research work on periphyton based aquaculture (monoculture) suddenly got instinct the idea of pond polyculture system based on periphyton.

Periphyton is the nutritionally rich and naturally available food material & also has an important role in the ecosystem as interdependent aquatic bio-communities. If the Periphyton based aquaculture techniques are used then the total fish production will enhance, as Periphyton community is good source of natural and nutritional food, and provides primary productivity that supports a wide range of aquatic organism easily grazed upon by small invertebrates, fishes and shrimps, and hence contributes considerable to the productivity of aquatic ecosystem.. Periphyton is described as the entire complex of attached aquatic biota on submerges substrates including associated non-attached organism and detritus, comprising bacteria, fungi, algae, and zooplankton and invertebrate organisms.

Periphyton based aquaculture is a recent trend developed in Europe, Asia including India, Bangladesh, Malaysia, Thailand and Philippines and gaining importance in developing Countries. The substrate added based periphyton culture in which ponds are provided with artificial substrates can give an enhanced fish production, a resource to poor fishermen as it is a low cost technology. Studies on periphyton as a natural food source are of recent origin in India. Previously Shankar et.al 1998, Ramesh et.al. 1999 and Umesh et.al 1999 [evaluated biodegradable substrate viz, sugarcane bagasse, paddy straw and dried water hyacinth (*Eichornia Crassipes*) leaves in carp productions and observed good results]. The dried plant parts of marginal aquatic weed *Ipomoea Alba* was used as a substrate in Fish culture ponds to favour the growth of Periphyton. The substrates stimulates the growth of attached organisms that are easily harvested by fish. Hence according to Azim (2002) the biggest advantage gained from adding substrate is an increase in the energy and nutrient transfer efficiency of the system due to a shift from phytoplankton to Periphyton based production. By conducting such a different experiments improved rate of growth of fingerlings of Indian major carps and other cultureable fish species have been observed by many workers in the world. By considering the world wide work on substrate based aquaculture and get attracted to such innovative technology work, Dr.Asha Joshi also conducted periphyton based aquaculture by using different agricultural dried waste as cotton and Jawar and observed very good results .At the same time with reference to the efforts made to develop periphyton based pond polyculture by eminent scientists from Bangladesh and India ,the present work has been planned to observe the results ,by conducting the experiments on periphyton based pond polyculture. During the study the experiments conducted using three species of carps provided with natural agricultural substrate .and their production was compared with traditional polyculture system without substrate. The study has produced a useful data base for the improvement in the aquaculture practice.

Materials and Methods

The study was conducted at Maharashtra State Government fish seed Production Centre at Bhategaon (Circular Chinese Fish seed Hatchery Unit) Taluka Kalamnuri, District Hingoli,Maharashtra State with the permission from Assistant Fisheries Commissioner Parbhani District, Maharashtra, India. Two rearing ponds of size 15 x 10 x 1.5 m were selected for the experiment, Pond A was used as experimental pond and Pond B was used as control pond.

Ponds were dried, manured with cow dung manure @ 100 kg/ha. and lime treated and filled freshly with filtered water from Bhategaon Reservoir located nearby. Cotton and Jawar plant waste as the dried plant body of the Cotton and Jawar crop were selected to utilize as a substrate for the growth of Periphyton. The cotton and Jawar plant waste in dried form was cut in to pieces of size ½ m and tied in to bundles of total area of each bundle measures about ½ m2. placed in the experimental rearing pond A, with substrate density 3 x 2 m2 in the submerged state.

To determine the effects of Periphyton on Pond Poly culture species, First we have observed the growth, survival and production of Periphyton on single species of *Carps* as *Rohu*, *Catla,* &*Mrigal* were tested separately by using Cotton and Jawar as a substrate. After seeing trial experiment we have decided to use these three species for pond Polyculture. *Rohu, Catla, & Mrigal* fingerlings fingerlings of 12-14 cm standard length group of 25-30 gm were stocked at ratio of 50:30:20. The total density of 1000/Ha. The another pond without substrate served as a control pond. Difference in standard length of body of fingerlings of both the species from the control and experimental pond was examined as an indicator of growth.

Assessment of fish growth in the control and experimental Pond.

Method -Release and Capture method, wt. and length method.

Ponderal Index (K).

The morphometric measurements and length – weight relationship has been studied by many scientist. The application of length - weight relationship in fishery biology includes estimation of average weight of fish of given length group. (Beyer, 1987). Length – weight relationship has considerable importance in fishery research specially for the study of fish population dynamics and growth. (Mathur and Bhatra, 2007). Length – weight relationship and condition factors are extremely useful to for understanding the biological chages in fish stock. (Le Cren, 1951), Huxley (1924).

Total 100 fishes of both the sexes of both species were collected by netting and separated from using their morphological characters. Total length of fishes was majored with the vernier calliper (nearest 0.01 mm). A total length of individual fish was measured from a tip of snout to the tip of tail. After wiping off water, each fish was weighed on electronic balance. The average % growth difference is given in the tables.

The relationship between length and weight for individual fish were used to calculate Fulton's condition factor index. (CF, Ricker, 1958) which is estimated using a following equation.

$$CF = \left(\frac{W}{L^3}\right) X\ 100$$

where, L is length in cm. and W is weight in grams.

The percent growth difference was calculated by the formula

C = A – B

i.e. weight in difference = experimental weight (A) – control weight (B)

so percent growth in difference i.e.

$$x = \frac{weight\ in\ difference}{control\ weight}\ x\ 100$$

Table - Average % Growth of *Catla catla,* L*abeo rohita,& Mrigala* in control pond and Experimental pond

Length Group	% Growth of *Catla catla*	
	control pond	Experimental pond
10-11	32.13	35.45
11-12	33.25	35.20
12-13	36.25	44.25
13-14	38.46	52.56
14-15	40.32	55.28

% Growth of *Labeo rohita*	
control pond	Experimental pond
35.45	38.48
35.36	38.94
40.94	46.54
45.53	56.53
48.8	58.8

% Growth of *Mrigala*	
control pond	Experimental pond
30.13	33.45
31.25	34.20
35.25	43.25
37.46	51.56
39.32	54.28

Results and Discussion

The net production of experimental Pond where Jawar & Cotton used as substrate observed as increased compared to Control Pond without substrate. In experimental Pond the overall production was 18000 kg/Ha in 90 days culture period., & where as in Control pond was 13000 kg*/Ha*. The overall growth in Experimental Pond was observed as 60-80% as compared to the Control Pond Azim, et.al 2002 observed as 60-170% higher than average production.

For the increased production in experimental pond was obviously due to addition of substrate as Periphyton community served as additional natural nutritional food source, also the biggest benefit of this type of culture system is that it provides natural healthy food maintain the energy level & the another benefit is that the substrate which are used are of organic type no side effect and they are completely Bio degradable, so it couldn’t make any harm to the Pond sustainability. avoiding poaching.

Azim et. al. (2002) observed the growth of Periphyton on Bamboo substrate placed in the fish culture ponds, he observed the Nett production of fish in substrate and control as 570 kg/ha and 180 kg/ha respectively. Ramnath et. al. (2005) reported highest zooplankton density in the water tanks with sugarcane bagasse and paddy-straw for enhancing the growth of *Labeo fimbriatus*. Keshavnath et. al. (2001) observed the highest Periphyton growth on bamboo followed by growth on Poly Vinyl Chloride (PVC) waste pipes and sugarcane bagasse, they observed the highest Periphyton growth on bamboo followed by PVC pieces . Several experiments for the growth of Periphyton on artificial substrates have shown that, Periphyton can increase the production of fish compared with the fish culture systems without addition of substrates.

Conclusion

Economically most useful parts of agricultural crops like Cotton, Jawar, Banana, Sugarcane when harvested from these crops, then the remaining waste part of the plant is either used as fuel for cooking, in preparation of organic manure after the decomposition of these parts or fodder for the cattle and sometimes burned to clean up the farm for next crop. Apart from these tradition methods of using the agriculture waste of crop plants like Cotton and Jawar which are one of the important crops of this parts of India, these can be used as an effective

substrates for the growth of fish food in the form of ‘Periphyton’ which is a variety of congregated biological community in the form different species of algae, diatoms, microbenthos,meso-benthos and macro-benthos.

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STRATEGIES FOR DEVELOPING SKILLS AND AGRI-PRENEURSHIP FOR SUSTAINABLE LIVELIHOOD

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Introduction

The primary objective of developing counties is to achieve rapid, balanced and sustained rate of economic growth. In the Indian context, agriculture and allied sectors do play a major role in achievement of economic growth and socio-political objectives, being a predominantly agricultural country with nearly three-fourth of the Indian population residing in rural areas with agriculture as their main occupation.

Agriculture all over the world is going through a phase of transition. In this changing scenario, agriculture is taking new shape and expanding its scope beyond the limits of mere crop cultivation and animal husbandry for livelihood of rural population. Activities like diversification, value addition, precision farming, high-tech agriculture, agripreneurship, global marketing, organic farming etc. are gradually getting due attention of people involved on redefining agriculture.

Five-year plans undertaken by the government as well as the scientific break-through in the agricultural front have resulted in spectacular increase in agricultural production with a compound growth rate of 2.5 per cent annum over the last three decades. The food production in the country has been a great leap from 50 million tons in the fifties to 265 million tons in 2014-15. However, with this comfortable agricultural situation, agricultural growth in India is affected by seasonal rains which poses serious problems in increasing production and productivity, particularly during the years when monsoon fails creating drought conditions which damage the crops. Again there are sometimes untimely, unseasonal, or excessive rains which also damage the crops. It is rightly said that agriculture in India is a gamble for the farmers. To combat this situation, of course, there are already generated technologies, but remarkable growth in agriculture may be obtained if proper entrepreneurial skill and hard work are geared up appropriately.

Commercialization and modernization of economy gradually increased the proximity and affinity between agriculture and industries. Ricardo (1962) treated the industrial manufacturer and farmer synonymously as entrepreneurs. In his words, the farmer and the manufacturer can no more live without profit than the labour. Mahajan (1983) reported there is considerable complementarity between agriculture and industry and the growth of one is dependent upon the growth of the other. Hence, both are equally important for the economic development of the country.

All round development of agriculture is possible only with effective exploitation of entrepreneurial behavior skills as well as material resource. But India is scarce of material resources with abundant of human resources. Hence to identify can identify individuals who have the requisite entrepreneurial behavior skills is important. The entrepreneur is an economic man, who tries to maximize his profits by identification and adoption of INOVATIONS. However, the entrepreneurs are not simply innovators but they are persons with a will to act to assure risk and bring about a change through organization of human efforts. It plays a key role in economic development of the country.

Agripreneurship

Agripreneurship is an employment strategy that can lead to economic self-sufficiency of rural people. Agripreneurship development through training is a key element for the promotion of Micro, Small and Medium Enterprises (MSMEs), particularly, the first generation agripreneurs. These can result in improved performance of an individual which can contribute to employment generation, poverty reduction and Human Resource Development. To promote economic development in post-liberalization-reform India, central and state governments are pursuing growth and development policies that encourage entrepreneurship and self-employment (Ahluwalia 2002; Ahluwalia 2005).To improve the effectiveness of these policies, it is important to understand how regional factors influence on individual's decision to transition from employment to self-employment. Occupational transition from salaried employment to selfemployment is an important issue in developed economies (Evans and Leighton 1989. To make a real economic difference, however, a substantial number of individuals must make the transition from employment to selfemployment.

India is ninth in the Global Entrepreneurship Monitor (GEM) survey of entrepreneurial countries. It is highest among 28 countries in necessity based entrepreneurship, while 5th from the lowest in opportunity based entrepreneurship. The liberalization, which was started in 1991, and the Information Technology boom of the mid-late 90's, has been significant factors, leading to a wave of entrepreneurship sweeping through the country (www. International entrepreneurship.com/ asia _ entrepreneur/ India _ entrepreneur. asp). Government of India constituted a steering committee on agriculture and allied sectors under the chairmanship of Dr. M.S. Swaminathan. The committee, among others, suggested creation of Agriclinics and

Agribusiness Centers managed by Agricultural graduates so as to provide consultancy services to the farming community in rural areas. Subsequently, a scheme for setting up of Agriclinics and Agribusiness centers by agricultural graduates was announced by the then finance minister on February 28, 2001. NABARD has formulated a model scheme for financing Agriclinics and Agribusiness Centers. This scheme is being implemented jointly by NABARD, MANAGE since from 9th April, 2002.

Entrepreneurship Development in Agriculture

The concept of entrepreneurship emerged with the industrial revolution in India 1880s. But it could not be promoted much in many sectors, agriculture being one. Then came the agricultural colleges in 1900s followed by the ICAR Research Institutes and the State Agricultural Universities in 1960s. The emergence of agricultural technologies gave rise to opportunities through entrepreneurship training, for a varying periods, in food processing, horticultural products, post-harvest technologies, etc. The concept 'apprenticeship' also came to be promoted linking relatively the practical training of the industries with the theoretical knowledge, by and large, given by the training institutions. Food industries, chemical industries (fertilizers, plant protection equipment) and then came the Bio-fertilizers, the present efforts to promote organic farming.

According to Singh et al. (2012) the farmers have to become agripreneur where he identifies real business opportunities; draws holistic benefit from support system and build the global competitiveness of their produce. According the 'Global Employment Trends for Youth 2004' report of the International Labour Organization (ILO), Geneva, 42 million unemployed in India comprise the youth. Gone are the days when a higher secondary qualification of a graduate could fetch a job. To create and provide jobs to such large population will not be easy either for the government or the private sector. The need of the hour is to encourage job creators rather than job seekers through entrepreneurship. Inculcation of entrepreneurial spirit among youth can resolve this enormous problem. On the other side, entrepreneurship is a strategy, creating prospects through training, mentoring and providing other kinds of support system. Entrepreneurs are not born, but can be developed through appropriate education, skills development and guidance. Considering the serious need to create opportunities for the unemployed, entrepreneurship development needs to be taken up on a war footing. Awareness generation, entrepreneurial skills inculcation and survival mechanism to cope with ambiguous market fluctuations is the need of the hour for making any dent in the burgeoning problem of unemployment and rural farm distress situations.

A pioneering effort by premier agricultural research institute, IARI was initiated in 1995 establishing EDP unit with four scientists trained as national level accredited entrepreneurial trainers from National Institute of Entrepreneurship and Small Business Development. Simultaneously, a Post-graduate course on Entrepreneurship Development in Agriculture was designed and introduced as part of Ph.D. programme which was later on adopted all over the country by various state agricultural universities. Since then eight master trainer courses have been organized and the message of entrepreneurship spread nationwide. Besides training master trainers from SAUs, ICAR Institutes and KVKs, the Unit has trained many farm youth, farm women and farmers to become Agricultural entrepreneurs.

Strategies for skill and vocational enhancements in agriculture

In informal sector, 90% of workforce is unskilled/ inadequately skilled. Skilled workforce. In Developed countries- 60-90% of total workforce is skilled as against a dismal 5% in India. Women workforce can raise the agriculture output by 20-30 %. Among woman farmers, only 43% are skilled as against 30 % in India. It is clear that India faces a daunting task of skilling large labour force that is largely illiterate or below primary and unskilled. There is a target fixed for skilling 150 million by 2022 in fundamental and higher education sectors at an average of skilling 45000 per day.

Table: Proportion of Workforce (2011-12)

	Self Employed			**Regular salaried/ wage**	**Casual worker**	**Casual worker**
Sector	**Own Account worker**	**Employer**	**Unpaid helper**			**Total**
Agriculture	17.03	0.71	14.11	0.41	16.64	48.90
Manufacturing	4.36	0.19	1.64	4.33	2.09	12.60
Mining	0.02	0.00	0.01	0.20	0.31	0.54
Electricity & water supply	0.04	0.00	0.02	0.43	0.03	0.52
Construction	0.96	0.08	0.07	0.49	9.00	10.60
Trade	5.42	0.25	1.43	1.73	0.48	9.32
Hotel restaurant	0.64	0.07	0.27	0.48	0.18	1.64
Transportation, storage & communication	1.74	0.06	0.06	2.35	0.63	4.83
Banking & insurance	0.22	0.01	0.01	0.67	0.01	0.91

Real estate, renting & business related activities	0.50	0.04	0.06	0.72	0.09	1.41
Public administration & defence	-	-	-	1.66	0.01	1.67
Education	0.30	0.01	0.02	2.63	0.02	2.98
Health	0.23	0.01	0.01	0.64	0.02	0.92
Other services	1.34	0.02	0.28	1.13	0.41	3.17
Total	**32.79**	**1.45**	**17.99**	**17.85**	**29.92**	**100.00**

source: Extracted from NSSO unit level data

Unlike other sectors, agriculture has multiple disciplines having scope for small modules suitable for a variety of clientele – rural youth, farmers, startup entrepreneurs. These modules can generate employment, that are valuable resource material for practical guidance and that can be chosen as source of entrepreneurship.

However, the clientele for these courses pose a challenge that they are from illiterate/semi –literate background and they hail from remote and rural areas. Hence the content administration for transferring knowledge to these clientele has to be less of technical jargons, more crisp and preferably in the native language.

The efforts by KVKs and other state departments in organizing trainings to provide skill/ vocational knowledge involve logistics and can cater to small section of large group that has to be trained. Using digital means and communication networks is the only solution to solve these problems. Open and Distance Learning as a medium for promoting skill development programs has 20% growth rate in user base. Thus the digital technologies like MOOC and other online initiatives can be identified as the potential medium of delivery to reach wider audience.

Table: Vocational Training profile across sectors

Vocational Training	Agriculture	Manufacturing	Non-manufacturing	Services	Total
Receiving formal training	0.08	0.13	0.05	0.39	0.64
Receiving formal training	0.22	0.51	0.20	1.48	2.41
Non-formal hereditary	3.05	0.77	0.15	0.47	4.44
Non-formal self-learning	0.60	0.61	0.23	0.79	2.23
Non-formal learning on job	0.86	2.02	0.98	1.49	5.35
Non- formal others	0.07	0.15	0.04	0.18	0.44
Did not received	**38.22**	**7.56**	**9.45**	**20.56**	**75.80**

any training					
nr	5.81	0.85	0.55	1.48	8.69
Total	**48.90**	**12.60**	**11.65**	**26.84**	**100.00**

source: calculated from NSSO unit level data

Skill development: Way forward

Skill development and Entrepreneurship training are essential to address the challenges in agriculture similar to climate change, increasing cost of inputs, change in consumer preference, market linkage and effective resources utilization. Agricultural sector uses large number of technology for enhancing productivity in different commodities. There is notion that agriculture requires very limited or no skill and thus labour wages in the sector are low compare to other sector because of increased use of technologies and innovation in agriculture, increased productivity relies on improved skill in efficient usage of all resources. This highlights the need not only for skills development but also for more and better employment in the rural non-form economy.

Review of various reports indicated that skill development interventions in agriculture and allied sectors are seed production, providing para veterinary services, preparing and maintenance of farm equipment, retailing, providing crop advisory services by using information and communication technology etc. In view of advancement in e-courses, there is a strong need to convert every knowledge program into digital content mode to reach target groups in quick and efficient manner. It is also necessary to standardize the content development method/ protocols to quickly develop quality content

With the national level recognition of imparting skill to various sectors including agriculture, there is a need to prioritize the subdomains and areas having promise and demand to impart the new modules of knowledge to the needy clientele.

It is necessary to identify the content that has potential for

- ✓ developing skill of larger groups,
- ✓ providing entrepreneurial development programmes,
- ✓ vocational education programmes

To develop suitable action plans and policy interventions in skills and entrepreneurship in agriculture ICAR-NAARM organized two days workshop during March 2017 by inviting professionals from various strata like R&D, Line departments, Extension agencies, educational organizations and IT organizations. The outcome of the workshop indicated following potential areas in skill and entrepreneurship development in agriculture.

S.No	Major Area	Title of vocational education/ skill development module	Target group	Number of beneficiaries expected	Mode of digital content delivery	Duration of module
			HOME SCIENCE			
1.	Home Science	Natural dye production and application	Rural youth (women and men), Intermediate students	50,000	Videos in vernacular language	20 hrs
		Health Journalism	News reporters, ICDS Supervisors	1000	Video lessons Self-evaluation tests	10 hrs
		Web designing	Youth Polytechnic students	1000	Video lessons Self-evaluation tests	10 hrs
		Special Education	Intermediate passed youth	2000	Video lessons	32 hrs
		Pre-primary Teachers Training	Intermediate passed youth	1000	Self-evaluation tests	20 hrs
		Early child care service management	Intermediate passed youth	5000	Video lessons	20 hrs
			FISHERIES			
2.	Fisheries	Shrimp farming	Vocational higher secondary completed students Rural youth Unemployed persons	10,000 per year	Practical training, Videos, Self-evaluation tests, Presentations, vernacular support	5 hrs

		Ornamental fish breeding	Unexployed youth Women	10,000 per year	Practical training, Videos, Self-evaluation tests, Presentations, vernacular support	5 hrs
		Seaweed Farming	Fisher Men/ Women SHG	10,000/ year	Practical training, videos, Self Evaluation Tests, Vernacular support	5 hours
FARM MACHINERY						
	Agricultural Engg.	Tiller, winnower, threshers, harvester, decorticator, transplanters	Farmer Groups, Women Groups, Youth Groups	5 lacs	videos	1 hrs each for different produce /machines
		Paddy transplanter operation and maintenance	Rural youth, Women farmers, Diploma Agri Engineers, ITI candidates	10,000	PPT presentation of different models; Videos of paddy nursery raising , operation and maintenance and maintenance of paddy transplanter	1 hour
		Harvester/ combines of different crops - operation and maintenance	Rural youth, Women farmers, Diploma Agri Engineers, ITI candidates	10,000	PPT presentation of different models; Videos, operation and maintenance	1 hour
		Custom hiring centres	Rural youth, Women farmers, Diploma Agri Engineers, ITI candidates; Rural entrepreneurs; AgrilEngg Professionals	1,000	PPT presentation of different models; Videos of, operation and maintenance	1 hour
		Latest Agricultural Machinery	Rural youth, Women farmers, Diploma Agri	10,000	PPT presentation of different models;	1 hour

		Management	Engineers, ITI candidates; Rural entrepreneurs; AgrilEngg Professionals		Videos of operation and maintenance	
		Biogas Plants Operation and Maintenance	Rural youth, Women farmers, Diploma Agri Engineers, ITI candidates; Rural entrepreneurs; AgrilEngg Professionals	1,000	PPT presentation of different models; Videos of operation and maintenance	1 hour
SERICULTURE						
3.	**Sericulture**	(i) Mulberry Plantation (ii) Silkworm Crop Management, (iii) Seed Production Technology,	Persons engaged in sericultural institutions and support services, member of cooperatives and Farmers.	1000/year	Videos, Self-evaluation tests, Presentations, vernacular support	7 hours
HORTICULTURE						
4.	**Horticulture (Fruits, floriculture & Vegetables Including cash, plantation crops)**	Nursery Management and Plant Protection in Oil Palm	Rural Youth	100 per year	Presentations, vernacular support	1 Year
		Plant protection in Cocoa	Rural Youth*	100 persons	Presentations, vernacular support	10 days

		Captive cultivation of high value horticulture	Rural youth SHGs Dswakra group at certain	1000 per year	Video, vernacular support	60 mins Modules
		High density cultivation of guava and mango	Rural youth, entrepreneur	1000 per year	Video, vernacular support	60mins Modules
		Nursery management in fruit and plantation crop	Rural youth SHGs Dwakra group at certain	2000 per year	Video, vernacular support, e-manual	120 mins
ORGANIC FARMING						
5.	**Organic Farming**	1.Principles of organic farming 2.Certification and marketing 3.Organic input production	Rural youth,	10000	Videos	5hrs
FORESTRY AND NATURAL RESOURCES						
6.	**Forestry and Natural Resources**	Sustainable harvesting and processing of NTFPs	Tribal collectors , JFMC members and small traders	500 per year	Videos, Internet contents, Mobile-SMS, Mob apps, Community Radios	Two days of 5-6 hrs each
		Sustainable Forest Management &Forest Certification	Field staff of SFDs and JFMC members	250 per year	Videos, On line courses, Dedicated web portals	3-5 days training module; 2-3 months online certificate course
		Climate change-Mitigation & Adaptation strategies	Field staff of SFDs and JFMC members	250 per year	Videos, Internet contents, Short On-line course, Mobile-SMS, Mob apps,	3-5 days training module; 1 month online

					Community Radios	certificate course
		Marketing of NTFPs & other forest products	JFMC members, Foresters (Ex-officio JFMC Secreteies) and small /local traders	250 per year	Videos, Internet contents, Short On-line course, Mobile-SMS, Mob apps, Community Radios	3-5 days training module; 1 month online certificate course
		Nursery techniques – seedlings and clones	State Forest Department, Wood based industries, Private Nurseries	1000 per year	e-courses, Videos, Internet contents, presentations	3 hours
		Mini clonal technology	Forestry graduates, Centralized nurseries of wood based industries	1000 per year	Digital manuals, video presentations,	3 hours
		Plantation establishment – planting techniques (Timber, pulpwood, plywood, matchwood and NTFP species	Plantation Managers, forestry skilled laborers	2500 per year	Digital manuals, video presentations,	3 hrs
SEED PRODUCTION						
7.	**Seed Production, Hybrids**	Hybrid Seed Production in Oil Palm	Rural Unemployed Youth, Field Assistants *	10 per Year	Presentations, vernacular support	6 months
		Seed Production	Farmer Groups, Women Groups, Youth Groups	I lac	Videos with vernacular support	2hrs each for different crop groups
		Seed production	Rural youth, Agri,	5000	Videos, Self-	15

		and quality control	diploma holders, B.Sc.(Agri.) holders, seed producing company field personnel, seed industry personnel	per year	evaluation tests, Presentations, vernacular support	hours
		ANIMAL HUSBANDRY				
8.	**Animal Husbandry**	Commercial Dairy Farming	Rural youth, and women	15000 per year	Video	one hours
		Quality Meat Production	Rural youth, and women	25000 per year	Video	One hour
		Quality feed and fodder for livestock	Rural youth, and women	50,000 Per years	Video	One hour
		Management of major ailments of livestock	Rural youth, and women	50,000 Per year	Video	One hour
		Value addition of milk and milk products	Rural youth, and women	20,000 per year	Video	One hour
		Commercial pig farming	Rural youth, and women	50,000 per year	Video	One hour
		POULTRY				
10.	**Poultry**	Maintenance of Backyard Poultry Mother Units	Rural Youth WSHGs	30 per District (Approx 20,000)	SLM in Local Language Video Lectures	5 Videos of 20 Min each
		Broiler Farming	Rural Youth WSHGs	100 per District (Approx	SLM in Local Language Video Lectures	10 Videos of 20 Min each

				60,000)		
		Layer Farming	Rural Youth WSHGs	100 per District (Approx 60,000)	SLM in Local Language Video Lectures	10 Videos of 20 Min each
			POST HARVEST TECHNOLOGY			
9.	**Food processing, Value addition & Harvest Technology, Storage**	Oil Palm Bunch analysis	Rural Youth*, Field Officers /Assistants	10 per Year	Presentations, vernacular support	10 days
		Cocoa Processing and Value addition	Unemployed Youth*	100 Persons	Presentations, vernacular support	15 days
		Cleaning, Grading and Storing of Produce	Farmer Groups, Women Groups, Youth Groups	2 lac	Videos , Ppt with vernacular support	1 hrs each for different crop groups
		Grain Processing w.r.t Rice milling, Parboiling, Products from Rice and other Grains in RTC and RTE forms.	Rural as well as Urban Youth, all educated and skilled workers	As many as applicable for grain processing in and around villages and Urban places	Holding workshops about processing of Rice, Pulses. Presentations, Demonstrations, lectures in local languages	2 to 4h
		Processing of soft grains a) Brown rice stabilization and usage b) Rice By-products utilization	Rural youths, SHG, NGO, Entrepreneurs	1000 in each sector	Lecture, power point, photographs, animations and videos	2 hours each

		c) Rice Products preparation (Flaked , popped, expanded rice)				
		Processing of coarse grains (Major millets/ Minor millets)	Rural youths, SHG, NGO, Entrepreneurs	1000 in each sector	Lecture, power point, photographs, animations and videos	2 hours each
		Processing of legumes and spices	Rural youths, SHG, NGO, Entrepreneurs	1000 in each sector	Lecture, power point, photographs, animations and videos	2 hours each
		Processing of Fruits, Vegetables and Plantation crops	Rural youths, SHG, NGO, Entrepreneurs	2000 in each sector	Lecture, power point, photographs, animations and videos	2 hours each
		Processing of Medicinal and Aromatic crops	Rural youths, SHG, NGO, Entrepreneurs	2000 in each sector	Lecture, power point, photographs, animations and videos	2 hours each
IRRIGATION MANAGEMENT						
12.	**Micro Irrigation, Water conservation**	Micro-Irrigation Technician	Rural Unemployed Youth	10 Per year	Presentations, vernacular support	15 days
		Drip Irrigation - Understanding drip design layout and installation	Rural youth; company technicians, diploma students and farmers	10,000 to 12,000 per annum	Vernacular language - power point, animations, videos	45 min
		Drip Irrigation - Execution and commissioning - Quality of work - Reducing the head losses to bare minimum	Rural youth; company technicians, diploma students and farmers	10,000 to 12,000 per annum	Vernacular language- power point, animation, videos	45 min

DAIRY TECHNOLOGY						
13.	**Dairy Technology**	Machine Milking of Dairy Animals	Women, Rural youth, SHGs	20 per batch 20000 per year	Videos, Presentations, Demonstrations (Hands-on training)	One month
		Feed formulation for dairy animals	Women, Rural youth, SHGs, Company technicians	20 per batch 50000 per year	Videos, Presentations, Demonstrations	1 month
		Heat detection and artificial insemination in dairy animals	Women, Rural youth, SHGs, Company technicians	20 per batch 50000 per year	Videos, Presentations, Demonstrations	1 week
		Fodder Conservation	Women, Rural youth, SHGs, Company technicians	20 per batch 50000 per year	Videos, Presentations, Demonstrations	1 week
		Preparation of value added milk products	Women, Rural youth, SHGs/CIGs, farmer clubs	20 per batch 50000 per year	Videos, Presentations, Demonstrations	1 week
PLANT HEALTH MANAGEMENT						
14.	**Plant management & Crop production**	Manure and Bio control Agent Production	Women Groups, Rural Youth,	50,000	Videos with vernacular support	2hrs each for different inputs
		Organic Waste management and manure production	Women farmer Groups, Youth	50,000	Videos with vernacular support	2hrs each for different models of waste management

Conclusion

Skill development and agripreneurship promotes rural youth, farmers, farm women and agricultural labourers to take up small enterprises in agriculture which in turn reduces migration and enhances work force in agriculture. Therefore, the extension programme/schemes should enhance knowledge and skills of farmers and other stake holders to enhance their income and employment. The Government schemes to entrepreneurs and various concessions and incentives should be part of extension services. Networks of entrepreneurs may be established to share their experiences.

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Gender Equality and Empowerment with relevant case studies

Women's Role in the Growth of Sericulture Sector in Andhra Pradesh and Telangana states

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Abstract

Empowerment to Women comes along with contributing their share to the family's resources and also getting their right in decision making. Sericulture activities right from the Plantation to fabric making largely taken up by the Women folk help them not only in employing them in leisure time for meaningful, productive and monetary gains but also support their family and improve their Socio-Economic status. Many women sericulturists with enterprising aptitude have achieved success and become role models in their family and society. A study conducted to assess the socio-economic impact of Sericulture on the Rural households in the different geographic regions in Andhra Pradesh and Telangana states revealed that women's participation is crucial for quality Bivoltine production and increased work participation of women is noticed as the men in farming families attend to many other works other than farming besides migrating to urban areas in search of employment and higher incomes.

Keywords

Sericulture, Silkworm, Mulberry, Catalytic Development Programme (CDP), Chawkie, Dairy.

Introduction

Sericulture is the science of producing Silk by cultivating food plants, Silkworm Rearing, Reeling cocoons, Silk Twisting and Weaving fabrics. Sericulture industry can be seen as an effective socio-economic tool for creation of gainful Employment especially for the women in the rural areas. Sericulture is ecological sustainable and commercial Viable socio-economic activity requiring proper support and caring hands aimed with creation of an environment conducive to its healthy development.

India is the second biggest producer of Silk and highest consumer of Silk and Silk garments in the world. Size of Indian population, Silk wearing habit of working women in the country creates a very high domestic demand for silk production and consumption. Increasing production cost, inefficient reeling machinery poses constraints for Indian farmers and entrepreneurs to compete with China Silk in the Global and Domestic markets. However, working women in the farmers, reelers and weavers families play a major role in Silk production and provide caring hands in crafting the wonder fabric. Besides producing Silk Indian women constitute the largest Silk consumers in the world. Various schemes designed by the Ministry of Textiles / Central Silk Board / State Governments appreciated the contributions of Women to Silk sector and provided subsidies / incentives under various programmes.

53% women's work participation and 57% of gross value of silk flows to Silk producers in the rural and semi urban areas is a proof that Sericulture provides secured livelihoods and sustainable incomes to women in the families. In the era of increasing labour shortages in the agriculture sector, farming families not having women workers may not be suitable for Mulberry cultivation and Silkworm rearing. However, patriarchal society, property rights and entitlements, institutional credit, market access, dual roles restrict the women only in the production areas in the value chain. Access to markets and control over incomes in favour of women can bring positive changes in the family incomes besides empowering women in decision making.

In 1980's and 1990's Andhra Pradesh State was dependent on Karnataka for sale and processing of cocoons. Non-farm activity (Reeling, Twisting and Dyeing) in the private sector triggered the growth of Sericulture in X and XI plan (2002-12) period. There are 3510 motorised Charkas (Basins), 183 improved cottage basins and 506 Multi End Reeling (Basins) units established to meet the domestic requirement of Silk yarn for handlooms. Annual production of Silk is 500 MTs on the domestic infrastructure created. Majority of Improved Cross Breeds (ICB) Cocoons are sold in the Markets in Karnataka. Proddutur (in Kadapa District) Silk Exchange for Dupion Silk, Dharmavaram and Hindupur for filature silk are major markets

The State has a strong traditional handloom silk weaver's population in 1.0 lakh families. Silk sarees produced in Pochampally, Dharmavaram are popular in export markets. Since the weaving clusters in Andhra Pradesh are predominately handloom based, there is a demand for filature for warp and charka for weft. Wet processing technology is unique to the type of weaving in the State. All the Weavers clusters in the State require uniform dyeing except Pochampally which requires tie and dye technology. Wet processing is carried out in-house or in centralised dyeing units. In the Dharmavaram and Narayanpet belts, there are dyeing units which operate on a job work basis. In Pochampally, weavers dye their own yarn because of the tie and dye technology adopted. The ikat or tie and dye pattern requires that weavers print the design on the yarn, and tie and dye those portions where a specific colour is required, based on design requirements.

Women's Role in Sericulture Development:

Andhra Pradesh State Government has been implementing 33.3% reservation for women in appointments since 28.05.1996 vide GO Ms. No: 237, General Administration (SER-D) Dept, only **10.39% women** employees are working in the Department. This is due to lack of recruitment after the issue of the above Government Order except filling the backlog vacancies.

Number of women staff in various cadres as on 01.09.2013 is as follows:

Sl No.	DESIGNAME	Men	Women	Total	% of Women
1.	Deputy Director	3	1	4	25
2.	Assistant Director (Sericulture)	19	2	21	9.52
3.	Sericulture Officer	127	11	138	7.97
4.	Assistant Sericulture Officer	152	12	164	7.32
5.	Technical Officer	340	26	366	7.10

6.	Technical Assistant	294	41	335	12.24
		935	93	1028	11.05
7.	Superintendent	10	3	13	23.08
8.	Senior Assistant	29	17	46	36.96
		39	20	59	33.89
		974	**113**	**1087**	**10.39**

Number of Women farmers in 11 Clusters covered under CPP (CDP-XI Plan) and State projects is as follows

	CPP Name	Men	Women	Total	% of Women
State Clusters	Srikakulam	105	15	120	12.5
	Rayachoti	206	49	255	19.22
	Atmakur	173	49	222	22.07
	Sangareddy	121	38	159	23.90
	Chandur	264	75	339	22.12
CDP Clusters	Bhimadole	159	29	188	15.43
	Kuppam	265	12	277	4.33
	Palamaner	255	9	264	3.41
	Hindupur	314	28	342	8.19
	Madakasira	311	8	319	2.51
	Kalyandurg	276	39	315	12.38
	TOTAL	**2449**	**351**	**2800**	**12.54**

Objectives of the Study:

- To assess the impact of CDP / CPP Schemes on the Socio-economic development of Women farmers in the Mulberry sector covered under XI Plan.
- To know the technology adoption level by the women farmers.
- To know the scope for further development.
  - The study was conducted in 2011-12 by covering 23 women farmers were selected from all 3 regions in the State i.e., Coastal, Rayalaseema

and Telangana. Care was taken to see that the district has a minimum of

1,000 Sericulture farmers.

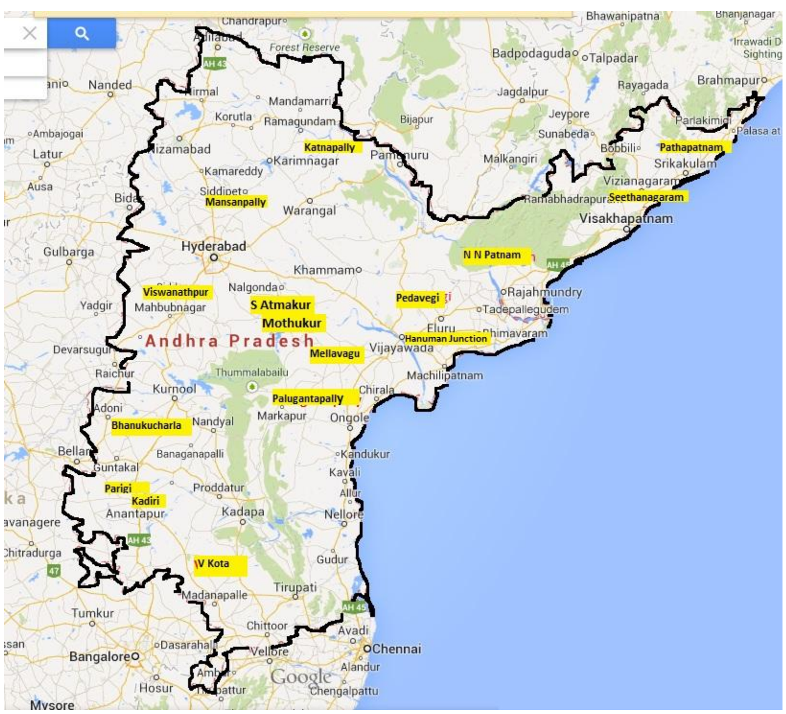
Access to Technology and Skills in Silk Reeling – We are workers and managers – S Reshma Begum.

The list of women farmers selected for the study are as follows:

Name of the Farmer	Husband Name	Village	Mandal	District
Smt. Manubolu Venkataratnam	M. Venkateshwar Rao	Vegivada	Pedavegi	West Godavari
Smt Kumari	Sri Surya Prakash	K Kannapuram	Pedavegi	West Godavari
Smt. Satyavathi	Widow	K Kannapuram	Pedavegi	West Godavari
Smt Aruna Kumari	Widow	Telaprolu		Krishna
Smt Panchada Gayatri,	Ganeshwar Rao,	N N Patnam	Rowtalapudi	East Godavari
Smt. K. Shakunthalamma	K Chandrappa	Thimmapuram	Guntakal	Anantapur
Smt Nagaratnamma	P.G Chandrappa	G V Palem	Madakasira	Anantapur
Smt K Sandhya Rani	Nandagopal Reddy	Gadamnagepaly	Somandevpally	Anantapur
Smt. M. Swarna Latha	M Chandra Reddy	Atmakur (S)	Atmakur (S)	Nalgonda
Smt. R. Rajini	Sanjeeva Reddy	Patimatla	Mothkur	Nalgonda
Smt B Rama	Sri Vijay Reddy	Patimatla	Mothkur	Nalgonda
Smt.M.Kasamma	Late.Galireddy	Palugantapalli	Racharla	Prakasam
Smt. Akiveeti Jyohti	Balasubrahmanyam	Cumbum	Giddalur	Prakasam
Smt. K. Chandrakala	Chandrasekhar			Chittoor.
Smt K. Sudharani	K. Somappa	Mittoor	V.Kota	Chittoor.
Smt G Nagaveni	Sri Gurumurthy	Eduru	Gangavaram	Chittoor.
Smt Para Koteswaramma	Venkateshwarlu	Mellavagu	Bollapalli	Guntur
Smt C Swarupa Rani	Sri C. Krishna Reddy	Kotta Bhanukacherla	Pamulapadu, Atmakur	Kurnool
Smt D. Vijaya Bharathi	Ravindrababu	Seethanagaram	Seethanagaram	Vizianagaram
Smt. Ganapathi. Vijaya Lakshmi	G. Papi Naidu	Korasavada	Pathapatnam	Srikakulam
Smt. Pichakuntla Satyamma	Sri. Anjaiah	Mansanpalli	Kondapur	Medak
Smt.G.Saraswathi	Raja Narasimha Reddy	Viswanathapur	Kondurg	Mahabubnagar
Smt. Oruganti Aruna	Damodara Reddy	Katna Palli	Choppadandi	Karimnagar

Materials and Methods:

- A detailed questionnaire was prepared to collect primary details like Extent of Mulberry gardens, Rearing facilities, details of subsidies availed under CDP / CPP Schemes, adoption levels of technologies, yield and income details, and assets purchased with the income from Sericulture.
- An interaction was made with the farmers to know their views on the schemes, suggestions for further development, development of facilities / requirement of further assistance for consolidation.
- The survey was conducted from June - November 2011 by conducting extensive and intensive field visits.
- Mapping of the areas is furnished below:



Land holding	No. of Farmers
1.5 - 2 acre	13
2 - 4 acres	09
Category	
OC	13
OBC	08
SC / ST	01
No. of Rearing Shed	
1	20
2	02
No. of crops in a year	
< 5	01
5-6	06
7-10	08
> 10	07
Average yield	
50-55	03
60-65	06
70-75	13
Annual Income (in Rs. lakhs)	
1-2	09
2-3	08
3-4	06

No. of Women farmers	Experience in Sericulture since
01	1984-85
03	1988-89
02	2003-04
04	2004-05
01	2006-07
02	2007-08
06	2008-09
03	2009-10

<table>
<tr>
<td>
"The more you give, the more you get"
Smt. Savitramma.</td>
<td>
"Feeding the worms is like feeding Children and i feel their hunger" – Smt Swarna Latha.</td>
</tr>
<tr>
<td>
Preparing harvest to the Market – Smt K Sudha Rani.</td>
<td>
One for all and All for one – Women workers in the neighborhood is very essential at the time of Harvest.</td>
</tr>
</table>

 *Caring hands for Small worms – Smt Kumari*	 *I can do it! And I'm the Winner – Smt. Akiveeti Jyothi.*

Results and discussions:

- Supply of Quality Chawkie worms and quality linked pricing system for cocoons will boost Bivoltine production.
- Farm Mechanization schemes are useful for reducing labor costs
- MG-NREGS works create scarcity of labour for leaf and cocoon harvest.
- Crop diversion from irrigated crops to Mulberry is noticed in almost all the respondent's families. Mulberry replaced Sugarcane and paddy in many families.

Most of the respondent's expressed that Electricity tariff to Rearing sheds should be as per Domestic rates but the farmers are charged Industrial rates – Solar lighting and heating facilities will reduce the electricity bills.

- Adolescent girls in the families acquiring skills in silkworm rearing take up sericulture after marriage in their husband's place besides motivating farmers in the neighborhood to take up Moriculture.
- Increased subsidy to the rearing shed will enable many Small and Marginal farmers to take up Mulberry cultivation.
- Training in Mulberry cultivation and silkworm rearing in the village in the progressive farmer's fields.
- Establishment of Seri Poly Clinics in the nearest vicinity for accessing inputs.
- Location of markets in distant places in Non-traditional areas posts problems for women to sell the produce.
- Lack of infrastructure facilities like Accommodation and toilets in the markets restrict women's participation.
- Health insurance services – implementation of scheme is not satisfactory.
- Institutional credit for Rearing sheds will enable many farmers to take up Mulberry cultivation.

Socio-Economic Impact of Sericulture on the Family:

- All the respondents expressed that Monthly incomes in Sericulture is advantages over other crops.
- All the respondents took up dairy as a subsidiary activity and found that Farmyard manure for Mulberry cultivation has an added advantage in improving the quality leaf and left over mulberry leaf are fed to cows. **Silk and Milk** is a preferred enterprise for women headed households.
- Creation of immovable assets like Dwelling houses, investing in permanent rearing sheds, procurement of household items like Motor bikes, Refrigerator, Color TV, Cell Phones, Jewelry, Bank deposits, life and asset insurance are noticed from surplus income.

- Investing in Children's education especially girl child has a positive impact on the family profile.
- Purchasing Agriculture land, farm implements like Tractor and tillers, farm ponds, Bore wells, drip irrigation systems helped women farmers to consolidate their gains in Sericulture
- Smt. Para Koteswaramma, W/o Sri P Venkateswarlu, Retired Teacher, Mellavagu Village, Gollapally Mandal in Guntur District motivated her husband to invest retirement benefits in Sericulture. She feels that *Moriculture is a good option for retired employees to have an opportunity to live in Green and Serene Surroundings for good health besides getting monthly incomes.*
- Smt. Savitramma, W/o Sri Prabhudeva, Technical Assistant working in the Department took up Moriculture and also engaged her son Mr. Suresh Babu and daughter in Silkworm rearing and marketing activities. She feels that though her husband is an employee in the Department, rarely interferes in her work. *She a workaholic and enjoy her work with the living creatures and feels proved that she is earning on par with her husband.*
- Most of the women farmers felt that due to the persuasion of Departmental staff, they took up Sericulture.
- Exposure visits to CSR&TI, Mysore and Best farmers within and outside the State were very useful.
- Mrs. G. Nagaveni, W/o Sri Guru Murthy, Eduru Village, Gangavaram Mandal in chittoor District draws a balance sheet for each crop. *She stated that surplus income from Sericulture was utilized for building a residential house, mini chawkie centre, rearing shed, mini mounting hall and tractor and purchased 2 acres of land.*
- Smt. Jyothi, W/o Sri Balasubrahmanyam, Cumbum Village in Prakasam District helped her husband while working a Government farm in Kurnool District, learnt the technical aspects of silkworm rearing. She

established a Chawkie Rearing Centre in Cumbum and supply good quality chawkie worms to more than 200 farmers. She renders technical advice and provides handholding support to all her clients besides personally supervising the crops. She assures 70-75 Kgs Bivoltine yields for 100 DFLs. *She supplies artificial diet for the young age silkworms and stated that like farex for the babies, artificial diet for chawkie worms make them grow healthy.*

- Mrs. K. Sandhya Rani, Gaddam nagepally Village in Somandevpally Mandal is practicing Sericulture since 1988. Though the size of the Mulberry garden is decreased from 3 acres to 1.5 acres due to depleted ground water and failed bore wells, Cocoon yields have been doubled (40 kgs to 75 kgs / 100 DFLs) due to adoption of JICA technologies. *She states that her family ekes livelihood only from Sericulture.*
- Smt. Kumari, K Kannapuram Village in Pedavegi Mandal of West Godavari District established Durga Manohar Chawkie Centre earning a net profit of Rs.30, 000/- per month. Through her Seri Poly Clinic, she provides extension services to farmers besides supplying inputs. *Efforts of private chawkie entrepreneurs in West Godavari District made the district 100% saturation in supply of chawkie worms within 3 years of initiating sericulture industry.*
- Smt satyavathi, K. Kannapuram (V), Pedaveghi (M), West Godavari District gave up tailoring job and entered into Moriculture in 4 acres of leased land. She has also established a Chawkie Rearing Centre and *helps other women getting good prices in the market by educating them on the importance of quality cocoon production for fetching higher incomes.*
- Smt. B. Rama, W/o Vijay Reddy, Patiimatla, Nalgonda District acquired natural leadership styles due to her involvement in a Self Help Group. Smt Rama produces 8-9 Bivoltine crops right from the beginning and feels confident of growing Bivoltine in non-traditional Nalgonda District. *She feels that never to lose grip on Sericulture and caring hands are most*

essential for quality cocoon production besides quality leaf and chawkie worms.

- Smt Aruna Kumari, Reeler, Telaprolu in Krishna District made a modest beginning with an initial investment of Rs.5,000/-, loan borrowed from Self Help Group in which she is a member. Being a widow, she did not lose her confidence and competes with male bidders in Hanuman Junction cocoon market, Krishna district and offers best price to farmers. Over 6 years, her monthly turnover is Rs.1.0 lakh and earns a minimum monthly profit of Rs.15,000 to 20,000/- through sale of dupion silk in Prodduttor Market in Kadapa District. She states that *"I experience success and failures but I will move on"*.

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Key elements of failure of the enterprises operated by the women entrepreneurs

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ABSTRACT

Women's entrepreneurship is both about women's position in society and about the role of entrepreneurship in the same society. Women entrepreneurs faced many obstacles specifically in marketing their products (including family responsibilities) that have to be overcome in order to give them access to the same opportunities as men. Empowerment among women makes them to join in the mainstream of development. Hence the present paper focused on analyzing the Key elements of failure of the enterprises operated by the women entrepreneurs. The failure elements are- heavy competition, lack of advertisement for the product, Lack of remunerative price for the product in the market, Insufficient working capital and Seasonal demand for the product in various enterprises.

Key words: Women entrepreneurs, failure elements.

INTRODUCTION

Entrepreneurship itself has been recently recognized as full-fledged profession and women entrepreneurship is an even newer phenomenon. The assertion and analysis of the concept of women entrepreneurship is essential to understand how they can be empowered much to take up entrepreneurial activities more on scientific manner. Many dimensions shall contribute for the empowerment of women entrepreneurs in general whereas the Critical consciousness and Resource mobilisation would influence significantly in empowering the women to take up entrepreneurial activities. A few research studies focused their attention to understand the role and influence of these factors on empowering the women entrepreneurs. Keeping this in view the present paper focused on analyzing the key elements of failure of enterprises.

Material and Methods

Ex- post facto research design was followed for carrying out the study. The State of Andhra Pradesh and telangana region were selected purposively for the study as the investigator hails from the state. Out of 10 districts of the region, Medak district was selected purposively for the study. Out of 46 mandals of the district, five mandals were selected randomly. The selected mandals were Siddipet, Thoguta, Chinnakodur, Nanganoor, Dubbak, Sangareddy. From each mandal two villages were selected at randomly.

1. Ph.D scholar
2. Professor
3. Professor

The selected villages were- Hensanpally and Bandarupally from Siddipet mandal; Thukkapur and Ghanpur from Thoguta; Ramancha and Lingareddypally from Chnnakodur; Nanganoor, and Akkannapally from Nanganoor; Dubbak and Cheekode from Dubbak, where as Pothireddy pally and Malkapur from Sangreddy mandal. Ten respondents were selected randomly from each village thus making a total of 120 respondents. Key elements of success of an enterprise is selected. An interview schedule was developed to collect the data from the respondents.

Results and Discussion

Key elements of failure

It was found from the Table 1. that in case of vegetable marketing enterprise, the failure elements are- heavy competition (55%) followed by overburden (50%), Lack of remunerative price for the product in the market (45%), Poor quality of product (40%), Lack of skilled labour (35%), Lack of peer group encouragement and Seasonal availability of inputs (30%), Lack of advertisement (25%), Insufficient working capital and Seasonal demand for the product (20%).

In case of NPM inputs sale enterprise, the failure elements are- lack of advertisement for the product (75.00%) followed by lack of skilled labour (60.00%), over burden, seasonal demand for the product and seasonal availability of inputs (50%), less remunerative price for the product (40.00%), lack of peer group encouragement (35.00%), insufficient working capital (25.00%), poor quality of product (15.00%) and heavy competition (10.00%).

In case of Vermi compost enterprise, the failure elements are-Lack of remunerative price for the product in the market (60.00%) followed by Lack of advertisement for the product and overburden (55.00%), Insufficient working capital (50.00%), Poor quality of product, lack of skilled labour and lack of peer group encouragement and seasonal demand for the product (40.00%), seasonal availability of inputs (30.00%) and heavy competition (10.00%).

In case of Flour mill enterprise, the failure elements are- Insufficient working capital (60.00%) followed by Over burden (55.00%), heavy competition (40.00%), Lack of advertisement for the product and Lack of peer group encouragement (30.00%), Lack of remunerative price for the product in the market and Seasonal availability of inputs (20.00%), Seasonal demand for the product (15.00%), Lack of skilled labour and poor quality of product (10.00%).

In case of Nursery raising enterprise, the failure elements are- Seasonal demand for the product (65.00%) followed by Lack of skilled labour (60%), Over burden (55%), Lack of advertisement for the product and Insufficient working capital (50%), Heavy competition and Lack of remunerative price for the product in the market (45.00%) Poor quality of product (40%), Lack of peer group encouragement and Seasonal availability of inputs (30%).

In case of pickle selling enterprise, the failure elements are- Heavy competition (70%) followed by Lack of advertisement for the product (65%), Lack of remunerative price for the product in the market and Seasonal availability of inputs (60%), Poor quality of product and Over burden (45%), Lack of skilled labour (40%), Insufficient working capital (35.00%), Lack of peer group encouragement and Seasonal demand for the product (20%).

It could inferred from the Table 1. that heavy competition and overburden are the key elements of failure in vegetable marketing, normally if more the players more will be the competition, now a days the vegetable marketing enterprises in various scales are coming into the market in this way this has led to more competition. The overburden could be due to attending various production practices and marketing arrangements, shortage of labour and enhanced wages. The failure of NPM input sale could be attribute to lack of advertisements for the product and lack of skilled labour, the products of NPM are not percolated much down to the gross root level farmers, may be due to poor publicity this has not taken place and preparation of NPM inputs require enough capacities which are lacking among most of the entrepreneurs operating this enterprise; The failure elements of vermicompost are lack of remunerative price, lack of advertisements for the product and over burden, preparation of vermicompost is involved reasonable expenditure on various inputs, labour and maintenance, the absence of remunerative price for the product definitely puts the enterprise under loss, the preparation of vermicompost is a lengthy procedure carried out in a phased and systematic manner, hence the entrepreneur feel overburdened and the advertisement for the product definitely boosts the marketing. The failure of enterprise flour mill could be attributed to the elements like insufficient working capital and over burden, due to lack of enough working capital the entrepreneurs of flour mill could not able to attend the recurring problems encountered and because of continuous presence and operation of the machine and timely completion of the product might have contributed to over burden. The elements like seasonal demand for the product and lack of skilled labour were contributed for the failure of enterprise of nursery raising. In nursery, plants will be purchased and planted by the customers during commencement of the season enmasse. During rest of the year they could not able to get the income, in nursery raising a few operations may be carried out exclusively by the experienced and skilled labour, this is most often lacking in nursery enterprise; Heavy competition and lack of advertisement for the product are the reasons for the failure of enterprise of pickle selling. Now a days pickle marketing has been taken up extensively in various forms by the corporate companies. The small women entrepreneurs could not able to withstand with this stiff competition, lack of publicity about the pickle products prepared by the women entrepreneurs could not able to boost the sales.

Conclusion

In case of vegetable marketing enterprise, the failure elements are- heavy competition, In case of NPM inputs sale enterprise, - lack of advertisement for the product, In case of Vermi compost enterprise, Lack of remunerative price for the product in the market, In case of Flour mill enterprise Insufficient working capital, In case of Nursery raising enterprise Seasonal demand for the product and In case of pickle selling enterprise, the failure elements are- Heavy competition.

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Sustainable Rural Livelihoods

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Promotion and sustenance of Rural Livelihoods is a big challenge for all stake holders - primary stakeholders, Government organisations, Non Government Organisations and others. The rural poor are unable to cope with the changing micro and macro economics and as a result they are either migrating to urban areas and live in subhuman environment. Or they fall into permanent indebtedness.

The Government both at state and centre have been implementing any number of schemes with subsidy attached and capacity building programs. But after nearly 70 years of independence the rural scenario is becoming worse with continuous irregular monsoons and dubious lure of urban livelihoods. The reasons for this situation are: untimely or mistimed delivery of services from Government, exclusion of the poor in planning and implementation, inadequate financial services, inadequate or lack of professional approach etc.

Considering all these experiences, we took a slightly different approach when we were associated with SERP(society for Elimination of Rural Poverty Government of Telangana/AP). While believing in the inherent capacity of the poor in promotion of livelihoods, we adopted the strategy of 1)mobilising the poor, 2)building their capacity and 3)establishing linkages for financial services and letting the poor to do whatever they know and start with whatever they have and wherever they are. The poor were involved in choosing a livelihood and in the planning and implementation. . This clicked for a long time though no subsidy was attached to the initiatives of SERP. For example the involvement of women SHGs in paddy marketing which is running very successfully even now. It benefitted the farmers, the organisations of the poor alike. The loan recovery rate is more than 95% all through these years is an ample proof of the capacity of the poor in promoting their livelihoods and enhancing their incomes.

A few attempts were made to do some innovative livelihoods but it did not sustain in the absence of continuous support systems and inadequate backward and forward linkages. It is a lesson for all policy makers that livelihood initiatives should be based on local knowledge, local experiences and professional support systems. After few years we noticed that the pace of economic development is not on par with their peers in urban areas. Then a question arose in the minds of all stakeholders - what impact is made after 15 years of social mobilisation, capacity building and continuous flow of financial services.

In order to address this situation the Government of Telangana and AP are now focussing on promoting livelihoods by organising Producers Groups/organisations in a big way. Efforts are on now to promote farmers organisations, goat/sheep rearers organisation and all such organisations for every type of livelihoods/produce. These producers organisations will plan their livelihoods after weighing all options, collective procurement of raw material or inputs, collective maintenance and collective marketing of their produce. The professional services will be provided by SERP at the call of these organisations.

A case study: Goat/sheep rearers organisations in Petralchenu and kommanapenta both remote chenchu hamlets in Amrabad mandal on Srisaialm road. The writer of this paper visited Kommanapenta chenchu hamlet of 23 families with no electricity and no motorable road and spent a night on 3 November 2016 in this habitation . Income of these families is mainly from forest produce gathered and sold to Girijan Corporation and from works under MGNREGS. There is no scope for agriculture and their is no scope for taking up other livelihoods due to marketing problems. They have to walk 5 to 20 km for marketing. Marketing of goat/sheep is also a problem because of distance from centres of market. On the other hand with depleting forest produce on account of failed monsoons their incomes have come down drastically. In this situation SERP took the initiative of forming these goat/sheep rearers organisation. For this we adopted the same strategy - mobilise, educate/build capacity and establish linkages for financial and other technical services and backed up by continuous support systems.

In these habitations a preliminary meeting with all SHG members was held to elicit their views and to know their preparedness in taking up this collective livelihood activity. Once they are ready even to make their initial contribution orientation meeting was held and planning and implementation strategy was finalised with their full participation and involvement. After this meeting and orientation they made their initial contribution and approached SERP for financial assistance. They formed a producer organisation, purchased goats/sheep, constructed common sheds for night shelter for goat/sheep(Photo attached) with MGNREGS funds, appointed a " pasha Vaidya karyakartha" to take medical care of the goat/sheep(who was trained by

Government Veterinary Department Officers) and insured all the animals. All these activities were carried out by the committees appointed by the Women SHGs. Based on the earlier experiences when they were selling the animals to middelmen at very lesser rate when animals are at tender age, they constituted committees to counsel the owners against this practice and monitor the maintenance of the animals.

The staff of SERP are on constant vigil to ensure that these animals are sold at market price in the presence of the Producer organisation members. As a result of these continuous support and monitor systems put in place, the average income for each family has risen from Rs. 40000/- when they sold their entire stock including the mother goats/sheepto 60000/- while the mother goats/sheep are still retained with them. In effect their average income has doubled in a year. Now the tribal families are confident that they will have continuous income for several years to come.

Theme IV Adaptation and Resilience to Climate change

Community Participation to mitigate Climate Change through Forest Management Practices

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Abstract:

Community Forest Management is a widespread conservation approach in the tropics. It is promoted as a means by which payment for ecosystem service schemes can be implemented. Community based adaption to climate change focuses on empowering communities to use their own knowledge and decision-making processes pay notable rewards to people. However, community participation and community based management are important themes in current policy and discussion revolving around decision making process especially those dealing with natural resource management. There have been enormous changes in the forest management scenario of the country over the last few decades. Several states are currently experiencing the debate for organizational changes on forest department to increase the effectiveness in a completely changed scenario of forest management. This includes both structural and attitudinal (approach) suitability. The important steps in these attempts are the Van Panchayats are enduring Village Forest Committees, recognised under a specific State Act. These play major role in take up afforestation activity in village area, planting activities in community land and forest settlements carried out regularly. Community participation is still a very new practice among community members and it therefore requires a lot of nurturing. There is need to empower community members through training thus giving them the guidelines in forest conservation and financial management as well which seems to be a major challenge in most village forest committees. Through this the couumnity people aware and make responsible towards management of forests for minimise global worming which directly responsible for climate change.

Key words: Community, sustainable development, Participation.

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Introduction

Climate change is increasing at an alarming stage, there may be many causes for this but it is believed that the major cause for this is anthropogenic green house gas (GHG) emission. Out of all green house gasses the most important is carbon-di-oxide. Human induced activities which are mainly responsible for increased concentration of carbon-di-oxide is first, the burning of fossil fuels and the next is deforestation or conversion of forest lands due to migration and other reasons. Even though if these two things were stopped, earth's temperature remain to be increased till another 50 years due to time lag between emission and earth's response. The relationship between development and environment is indirectly proportional, for developmental activities natural resources are being depleted and the impact of this on human community is very wide. Instead of conducting several international meets from Kyoto to Copenhagen for sustaining the need of the present generation and also to sustain the future generation, it is better option to involve local community people in protecting and improving the natural resource like forest and biodiversity through community forest management. Through this we can make the community people aware of and to minimize this uncontrolled problems is our responsibility towards environment protection thereby better management can be seen.

Role of Forest and Agroforestry in Carbon Sequestration

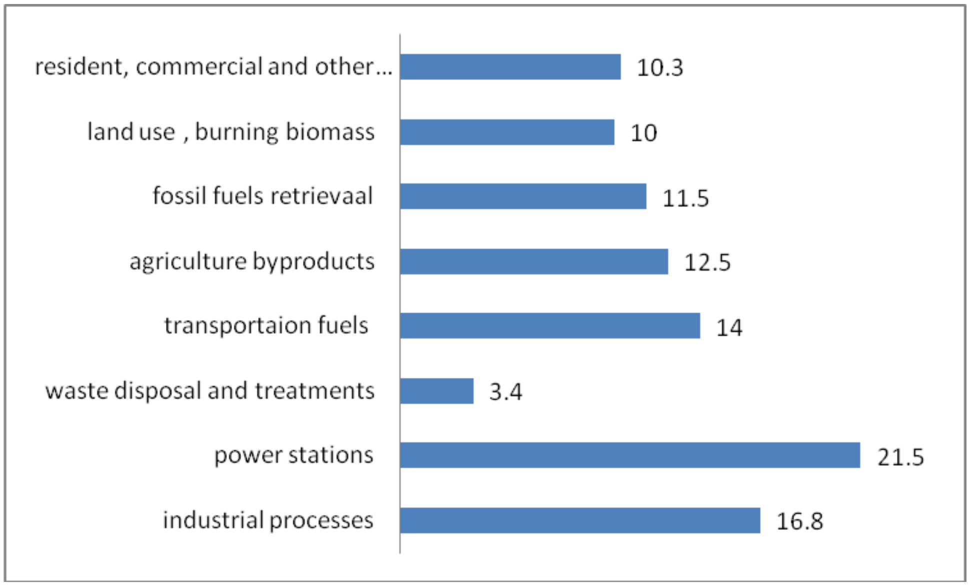
Forest balances carbon cycle because it acts as both sink and source of carbon. Where there is high density of forest they sequester carbon from the atmosphere and stores the carbon above and below ground level which indirectly increases soil organic carbon content and acts as a sink. In another side the best option for mitigating climate change according to Kyoto Protocol on climate change is afforestation and reforestation which are nothing but increasing biomass and agroforestry systems. Crops along with tree species in the agricultural land increases soil fertility, checks erosion of soil, reduce water logging and develop coping mechanism for adverse climate change impacts. Agroforestry system have potential to sequester over 70 Mg/ha in the top 20 cm of the soil, and it depends on geography, species and different components in the agroforestry system which is put into practice. Further Agroforestry system can reduce CO_2 emission by conserving soil and avoiding burning of forest based fossil fuels.

Estimates of Future Levels of CO_2

years	**CO_2 (Ppm)**
2000	369
2010-2015	388-398
2050/2060	463-623
2100	478-1099

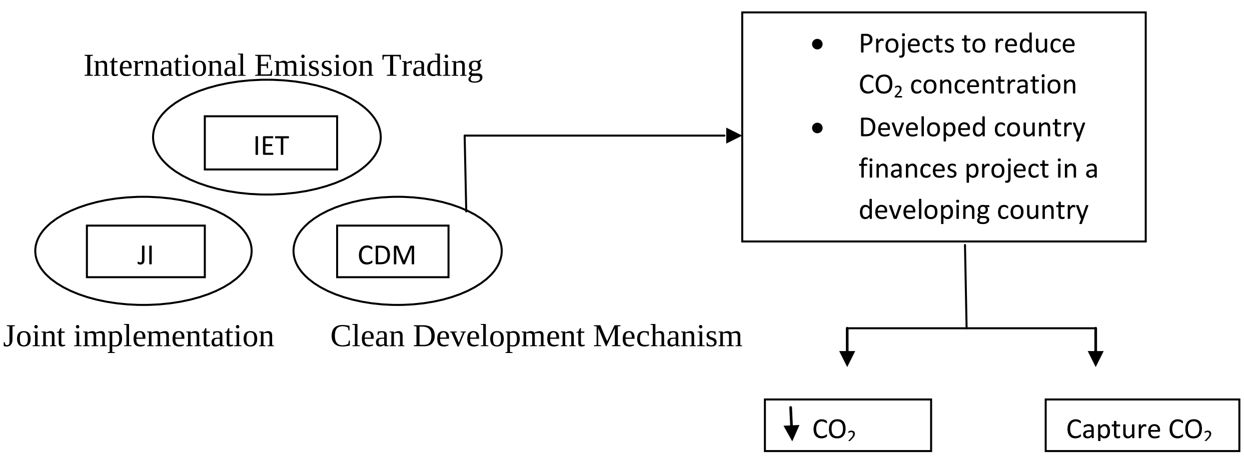
(source: P K Agarwal, 2007)

Annual Green House Gas Emission by Different Sectors



(souce: Climate change and its impact on food security, Rajegowda 2009)

Kyoto Protocol: A Flexible Mechanism



Clean Development Mechanism

CDM which was one of the market mechanisms of Kyoto Protocol to reduce carbon emission is very much cost effective and it allows industrialized countries to reduce emission and increase storage of carbon very cheaply in abroad than at home. It paved a way for them to offset their small portion of carbon emission by undertaking forestry projects and the eligible options for this are only through afforestation and reforestation. Under this market mechanism the countries which are industrialized can involve in these carbon sequestering projects in developing countries to meet their emission reduction targets specified by Kyoto Protocol (UNEP, 2002). This initiative increases the economic inflow to developing countries and thereby reduce poverty and increases livelihood of rural people if it is done by including small holders.

Concept of Participation

Participation is the only mean through which people can influence their decisions and opinions and they can know it will be listened because the people who faces difficulties or problems are the best persons who can understand it and find solutions for it and the changes which is felt by collective decisions has to be borne by them only in terms of its sustainability, management and its growth. Participation helps in identifying the people and respects them which is one of the desire of people to be respected in the society. If human resource should be developed and empowered then it cannot be done without people's participation.

Self Initiated Forest Protection Groups

These are the groups of local people which come forward voluntarily to take active participation in the forest protection activities without support of any departments and the government. There are many such groups in various parts of India which are working for reducing pollution and for sustainable development. These groups were also called as Van Panchayats in the hilly regions like Uttarakhand, Himachal Pradesh etc.,

Beginning of Van Panchayats

It occurred in British colonial period, the local people resented when restrictions was imposed by British on customary rights of people in the beginning of 19^{th} century. The local people burnt down the forest which lead to the destroy of vast areas of forest land and to resolve this the British government appointed a committee known as Kumaon forest grievance committee to enquire the people rights over forest resources. The recommendations of this committee led to the beginning of Van Panchayats which is also called as Forest council/committee.

In this VPs, even though the land is owned by stated forest department , people considers it as their own and joint property, works for it and they were made responsible for managing, maintaining, conserving and harvesting the forest resource. (Daniel Murdiyarso and Margaret Skutsch, 2006)

Community Forest Management

Even though the government has taken many projects and initiatives to protect, maintain, manage forest and to reduce carbon emission for sustainable development the results were not up to the level because without the involvement and cooperation of local people there will be no success. So the government decided to encourage the community people who takes initiative and voluntarily comes forward by making groups and registering their groups under Japan funded project called JFPM by forming various types of committees namely Forest Protection

Committees, Village Forest Committees and Eco Development Committees for protection of well developed resourceful forest, for improvising the degraded forest and to look after in and around protected areas respectively. These groups were made within the 5km radius from the forest area. In return the group members get rights to use some of the forest products without its degradation and revenue from the non timber products. Though the returns are less in monetary terms but it is more in real and intangible means. It also helps and support to growth and development of community infrastructure. Training and other capacity building programmes will be conducted for group members regarding managing and measurement of biomass. Frequent monitoring and evaluation will be done to check the proper utilization of the funds and regular conducting of meeting. The chairman who signed for MOU is responsible for allotting works and its effective execution and management.

Community forestry also have its own impact on local people. It gives awareness to rural youths and others about natural resource and its impacts on human community. It helps in income generating activities and thereby increases the standard of living of rural people. Through collective management both human and social capital can be increased and it also improves community infrastructure and other development activities needed for the community.

Composition, Formation, Management and duties of Village Forest Committees

To become a member of VFC he/she should be an adult who have self interest in management of forest and its protection and lives within the jurisdiction of VFC. They can enroll their names with member secretary of VFC by paying Rs.2/-. For formation and registration of VFC the villagers along with the list of interested villagers should approach the Range Forest Officer along with the appointed promoters to express their willingness in participating in JFMP programme. Later RFO will submit the proposal of the villagers in front of Deputy Conservator of Forests who is in charge to that specific area for registration as associations under Forest Act.

Managing committee consists of members to whom the villagers trust and have faith on them and in their working. It is also based on the person's willingness in spending time for carrying out the activities for a period of 5years. VFC's role is to carry out activities according to MOU, it should actively take part in preparing management plan for selected sites and help the forest department by providing ideas regarding maintaining, managing and protecting the waste lands which are included in the management plan. For implementing the management plan VFC should access funds through various departments of government and development agencies. For afforestation and reforestation activities VFC should guide the department members about types of species to be planted, site selection, way of protection by cooperating with department officials, later VFC will become the sole responsible in those afforested area for its protection and management. The overall responsibility of VFC is to conserve forest , avoid deforestation, forest fires and illegal smuggling. They should inform the forest department about the persons responsible for illegal transportation, smuggling and also about wild animals hunting.

Case studies:

Case 1: Dhaili village, Uttaranchal, India

Uttaranchal is a state which is in Central Himalayas of India considered to be a hilly region. On an average 68-70% of the state is covered with forest land and the remaining 30% is meant for agriculture. To protect, maintain and manage these forest for about 12,000 Van Panchayats are working. From these VPs nearly 0.5Mha forest land is protected.

The people expressed that after formation of these VPs the forest lands were improved and there has been decrease in forest degradation and from past 10years no forest fire has occurred. More than this from these VP forests the members of VPs are collecting fuel - wood and fodder for their livelihood purposes along with non timber products rarely. They have kept forest guards by paying them from the income which is generated from the forest. VPs' also carrying out plantations of some special trees like Bamboo, Bhimal etc., with the help of villagers. Selected members of VPs were also given training in measurement and mapping of the forest. In this way this community forestry in Uttaranchal serves as an example for sustainable development and contributing rural livelihood.

Case 2: Carbon Mitigation Potential through Community Forestry in Betalghat Watershed

Betalghat watershed is an area in Naintal district where river kosi flows. Even in this water shed area community people are taking part in managing forest which was under the revenue department earlier.

After the formation of Van Panchayats where local people are protecting forest and maintaining it the total soil carbon has increased when compared to the forest lands maintaining by revenue department.

Carbon storage in various land use category

Carbon (t ha-1)		
Land use category	Revenue department	Van Panchayats
Soil carbon	36.5	56.3
Above ground carbon	0.9	5.1
Below ground carbon	0.2	1.3
Woody litter	0.1	0.1
Total carbon	37.7	62.8

(source: Hooda N *et.al*.)

Indian Agroforestry and its Impacts on Rural livelihood

India being one of the richest country in its natural resources comprising of various agro forestry systems which includes community forests, ethno forests, scattered forests in local areas and has traditionally followed practice of planting forest species along with agricultural crops which are grown for shade, fuelwood, medicinal, fodder and other purpose. Besides these, the practice of shifting cultivation by tribes and nomads are the best illustrations of traditional agroforestry.

Along with diversity and density of biomass creation it also has its own role on livelihood of rural populace. It acts as a fertilizer by enhancing soil fertility greater than crop rotation practices, because as the leaf litter falls down from trees it decompose and converts to become humus. It checks runoff, water logging, soil acidification, salinization and helps in developing coping mechanism for adverse impacts of climate. Tree species stores carbon by capturing it from the atmosphere and thereby increase the soil organic carbon and act as a effective carbon sink thereby it increases productivity when tree species are intercropped with food crops. Practicing agroforestry reduces disease and pest attack to main crops, holds moisture content and helps in nitrogen fixation. An Agroforestry system creates landscapes of various types and adds aesthetic value. It also provides feed and fodder for livestock and from this additional cost needed for animal husbandry and allied activities can be minimized. They generate income to rural populace and make them self employed.

Conclusion:

World is facing so many problems due to drastic climate change, irregular rainfall and adverse impacts on populace. For all these problems the most reliable reason is green house gas emission. Reducing this GHG emission is not so easy at a stretch because some of the necessary industry goods production, very high standard of living of urban people and migration of rural people to urban areas etc., cannot be controlled in a short span of time. Even though if we reduce doing all these things which causes GHG emission the climate and its impacts cannot be bring in control because human already disturbed earth and its components to such an extent that still they should realize its impact for some more years. Even though human beings cannot change the entire scenario but have realized the importance of biodiversity, natural resource etc., and considered that protection of forest is an alternative and viable option for them so they are moving forward voluntarily for maintaining and protecting forest and its resource, community forest management and taking advantage from those forests quantitatively and qualitatively. From this type of management by involving local people for some extent they are making possible to reduce carbon emission and forest degradation compared to other projects of the government without any participation of local people. The concerned department should intervene and still there is a need to encourage rural people and educate them regarding forest and its importance and process of managing and maintaining forest for sustainable development.

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Climate Smart Extension for Food Security and Development Goals

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Abstract

Climate smart agriculture is a way to achieve short term and long term agriculture development goals. Climate change is the major concern and its impact is visible on eco systems, water, land, agriculture, forestry etc as a result the agriculture and allied activities are directly and indirectly affected. Extension system can play key role for mitigation of the climate change effects by providing value added information at the right time and place among the farming communities. Using wide range of information communication tools such as mobile based integrated Advisory services with green phone technologies and knowledge delivery pathways in combination with traditional media has given good results in rural areas. Agricultural extension personnel are the main stake holders to communicate with the farmers on how to cope with climate change through education, awareness raising and adaption strategies. Therefore, there is a need to develop appropriate training modules on the Science of climate change including adaptation & mitigation strategies for extension staff and lead farmer. There are different methods, approaches and models that are used by the public and private extension providers, the knowledge and application can help to redress the effects of climate change and contribute towards achieving the major developmental goals including food security and improved nutrition. Several cases on climate smart extension will be illustrated during the conference.

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Climate Smart Extension for Food Security and Development Goals

One of the sustainable development goals that are targeted to be achieved by 2030, set by United Nations (Goal 13) is to take urgent action to Combat Climate Change and its impacts. As highlighted by COB 21, deliberations in Paris, Agricultural Extension has an enormous role to play in both mitigation and adaptation of climate change and its impacts through improving education, awareness rising, human & institutional capacity of farmers on climate change mitigation, adaption impact reductions and early warning. Besides this, extension also have to play an important role to promote mechanisms for raising capacity for effective climate change related planning and management in least developed countries and small island developing states focusing on human, youth and local and marginalized communities. In addition extension along with research can also play a major role in strengthening resilience and adaptive capacity of especially small scale farmers about the climate related hazards and natural disasters in all countries.

Agricultural Extension :

Is an applied science designed to bring desirable technology changes by generation, transpiration and application of knowledge and skill in order to improve the enterprises, vocations, living standards and livelihoods of rural people engaged in agriculture.

The extension role is not only handing over the technology but also empowering them to accept the technology and adopting.

Climate Smart Extension (CSE) can be operationally defined as the process which includes practical, technological methods and methodologies that can be used for sustainable increase in productivity support famer’s adaptation to climate change and reduce levels of green house gasses. It primarily focus on the ability of the farmers and the ways to adjust to moderate potential damage and cope up with consequences. This is being done through different climate smart approaches, methods and methodologies.

Need for capacity building of extension workers

As described in the pervious paras, to deliver climate smart extension methods and to motivate farmers towards adaptations and adoption of practices related to climate change, a new extension worker is needed, who is not only equipped with advisories on climate variabilities, extremes and mitigation measures which can be carried through new extension methods and methodologies. Therefore, there is an urgent need for capacity building of all the extension service providers as a crash programme on the climate smart agriculture and other aspects of climate change. This also needs development of communication for training and action research programme. Research and extension scientists and other stakeholders should come together in developing suitable training modules, methods and methodology. At present there is no adequate research base in extension to cope up with this change.

Capacity building and information dissemination to farmers :

There are several approaches and methods to address the capacity building and information dissemination of Climate Smart Agriculture (CSA) to the farmers.

Climate content

ICT tools	Function	Content	Delivery format
TV/Radio/Print media	✓ Information dissemination ✓ Distance learning	○ Information on climate ○ Critical farming practices ○ Schemes of government/ ads/ commodity prices /market and weather	→ News awareness → Question & answers → Talk by experts → Demonstrations → Success stories
Internet enabled computer	✓ Dissemination of information	○ Wide variation on content depending	

centres, information kiosks, knowledge centres, counseling centre, village knowledge centre, e-choupal	✓ Forum for interactive learning ✓ Management by NGOs/CBS ✓ Distance learning	on objectives ○ Availability of inputs	
Portals, climate smart agricultural portals	✓ Information dissemination ✓ E-commerce	○ Climate management ○ Crop production ○ Linking producers to traders/consumers ○ Q&A forums	→ Visuals → Generic information → Current price → Weather updates
Kissan Call Centre	✓ Specific quires answered	○ Sources of information	→ Answers of expenditure

		technology	
Mobile phones	✓ Information mostly on weather ✓ Prices of commodity ✓ Climate mitigation news ✓ Advisory services	○ Text and voice messages	→
Community radio	✓ Awareness advisory	○ Broad casted through local dilates	→
Video	✓ Advocacy ✓ Training and capacity building	○ Promotion of good technology / good practices ○ Awareness on climate issue ○ Training tool ○ Cases / Success stories	→ Screening videos

Interactive CD ROM, touch screen technology, kiosks	✓ Information dissemination	○ Crops	→
Digital photography, e-seva, green phone technology	✓ Plant management	○	→
Traditional media kula jathra	✓ Information dissemination ✓ Public awareness	○ Attitudinal charges	→
Social media	✓ Open line of communication	○ Problem solving strategies ○ Gathering public opinion on special topics	→
Methods of	✓ Participatory	○ Community	→

IFS / FLS / FLDs / adoptive trails	methods	mobilization ○ Information dissemination ○ Skills / knowledge	

Case I : Better Cotton Initiative

Case II : Sustainable spice initiatives

Effect of Climate Change On Livestock and its Amelioration

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Climate change has become an important issue for India to ensure food and nutritional security for growing human population. The impact of climate change is global , but countries like India are vulnerable as majority of its population depends on agriculture. India having the largest livestock population (512.05 million), but the livestock production system is also sensitive to climate change. In India , significant negative impacts have been noticed during last decade like reduction in crop yields and animal's productive performance. The Government of India has launched a major project entitled National Initiative on Climate Resilient Agriculture (NICRA) for research and development to cope with climate change in agriculture and allied sector. The mandate of this project is to enhance the resilience Indian agriculture covering crops, livestocks and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.

Climate change is expected to increase temperature, precipitation, atmospheric Green House Gases (carbon dioxide, methane and nitrous oxide) levels and water availability in ways that will affect the productivity of crops and livestocks (Hatfield et al., 2008). For, livestocks system, climate change could increase thermal stress and results reduction in animal production and profitability by lowering feed efficiency , milk yield and reproductive performance (St-Pierre et al., 2003). The recent studies on impact of climate change on Indian livestocks indicate that livestocks performance is greatly affected by temperature variations. A small change in Temperature Humidity Index (THI) as result of rise in temperature due to climate change is not likely to cause much effect on physiological functions of animals, as animals have enough capacity to adapt. But both milk production and reproductive functions of livestocks will be adversely affected. Both increase in temperature (more than 4^0C above normal) during summer and decrease (more than 3^0C than normal) during winter season negatively affects the milk production of cattle and buffaloes. The direct effect of climate change on livestocks is heat stress while the indirect effect being the low feed availability and water scarcity and increase incidence of pest and diseases. Increased environmental temperature leads to heat stress and decreased rainfall have detrimental effect on reproductive performance of cattle and buffaloes. The most visible effect of climate change on livestock production system are non availability of feed resources and grazing land.

In the present changing climate situation, the high temperature exposure is of major concern for livestocks especially in hot region of India resulting in poor performance, immune-suppression, and occurrence of more diseases and mortality of animals.

Impact of heat stress in cattle and buffaloes

Heat stress is one of the major stressors in animal production and produces a wide range of physiological changes. The nature and magnitude of these changes depend upon the degree of heat stress imposed. From an environmental perspective, heat stress is a combination of temperature, relative humidity, and wind speed. However, animal factors, such as age, hair coat length, hair coat colour, degree of adaptation, and nutrition status, interact with these environmental factors to determine the severity of heat stress. The ideal ambient temperature for a dairy cow is between 5 and 25°C. Above 25^0C, cattle release heat by sweating, panting, and increasing blood flow to skin surfaces. Since cattle sweat at only 10% of the human rate, they rely more on panting for dissipating heat. Panting usually begins once rectal temperatures reach 40°C or higher, and may be accompanied by drooling. Humidity also affects heat stress significantly. At low humidity (20%), the temperature must reach 27°C before an animal is under stress, but when humidity approaches 10%m mild stress occurs at even 22°C and severe stress occurs at 37°C. High producing cows are most sensitive to heat stress because of their high feed intake, nutritional level and body heat load. The respiratory rate increases from panting to open-mouth breathing with the rise in ambient temperature resulting in respiratory alkalosis due to rapid loss of carbon dioxide. The cow compensates by increasing urinary output of bicarbonate, and rumen buffering is affected by decreased salivary bicarbonate pool. Heat stress affects growth rate, milk production, fertility and immuno-competence and nutrient conversion efficiency. In addition to reduced milk yield (51 to 40%), milk fat content is decreased, reproductive performance (anestrous, silent heat, poor conception rate, poor semen quality, etc.) is affected, and animals become greater susceptible to health problems during hot weather. Dry matter intake starts to drop (8-12%) and milk production losses of 20-30% when temperatures exceed 32.2°C (Jones and Stallings, 1999). Heat stress can also contribute to lameness perhaps due to acidosis or increase output of bicarbonate (Jones and Stallings, 1999). Heat stressed animals eat less frequently and feed during cooler times of a day, but they eat more at each feeding (Shearer, 1999). Reduced feed intake, followed by slug feeding when the temperature cools down can cause acidosis, which is considered a major cause of laminitis (Jones and Stallings, 1999). Heat stressed cows seek out shade, which they often will not leave to drink or eat; consumer more water and less feed; stand rather than lie down; respire more, and show increased body temperature and saliva production (Combs,1966). In severe heat stress, the ability of animal to digest feed is depressed (Bhattacharya and Hussain, 1974). Feed digestibility is affected by ambient temperature due to altered volume of the gastrointestinal tract and rate of passage of digesta. However, during heat exposure rumen motility of cattle decreases and there is a concomitant increase in the retention time of digesta that may increase the digestibility of feed. Virtually opposite responses are reported for cold-exposed sheep and cattle. There is increase in reticulo-rumen motility, rumination, and rate of passage of digesta resulting in decreased retention time and apparent digestibility of feeds during cold exposure. Voluntary intake in cattle is influenced by temperature greater than 25°C and less than 15°C. In temperate cattle breeds, once the environmental temperature goes above 25-27°C feed intake is reduced which has a negative impact on production. At 32°C or above, a dramatic decrease in milk production ranging from 3% to 20% is noticed. Studies with temperate breeds indicated tat dry matter intake (DMI) of dairy cows may be depressed about 3.3% for every ^{O}C above 25^OC and at temperatures above 35°C full animals may experience 10-35% depression in DMI and animals near maintenance will have 5-20% depression in DMI (Fox and Black,1984). Heat stress depresses feed intake when high temperature humidity index (THI) exceeds 72 (Holter et al., 1996). This reduction in feed intake reduces volatile fatty acid production in rumen resulting in decreased production. Effect of heat stress is exaggerated if there is no night cooling.

Feeding strategies to ameliorate thermal stress

Provision of *ad libitum* drinking water:

Increased water consumption is major response to thermal stress. Total heat load in cattle is a combination of environmental heat, metabolic heat (heat produced by the animal's body processes), and fermentation heat(heat produced in the rumen as part of digestion). Unlimited supply of fresh, cool water(12-18°C) for drinking is required during times of heat stress to dissipate heat through the lungs (respiration) and by sweating. If cows are not consuming all the cool water they can, then dry matter intake will not be maximized. Water consumption will increase by as much as 50% during heat stress. If water supplies are not adequate or heat stress becomes severe, cows divert water normally used in milk synthesis to the metabolic processes of heat dissipation. Access to water is provided right after milking as large intakes of water shortly before milking may elevate freezing point of milk. Waterers and water tanks should be kept clean and those should be washed with brushes daily and with a chlorine solution to disinfect surfaces and cut down on algae growth once in a week. The water temperature should be monitored as the temperature of water in waterer is also increased in summer. The water is stagnant in pipe and tank and the temperature increases much beyond room temperature. This is especially true for closed pipe and tank system. It is important to supply cool water during warmer climate and water temperature should preferably be below 25°C .

Feeding management:

Feeding of animals should be done during cooler times of the day. Switching from a morning to afternoon feeding has also been shown to provide benefits and feed bunks have been empty for several hours. According to Jones and stallings (1999), some good points on feeding management of lactating dairy cattle during hot weather are feeding frequency (an extra feeding or two), time of feeding (cooler time of day), adequate feed bunk space (all cows can eat together without crowding), plenty of cool water, and adequate air flow. Keeping cows comfortable is the key to keeping cows comfortable is the key to keeping them eating which is critical in keeping them productive. Frequent feeding provides fresh feed, stimulates the cow's curiosity and encourages more frequent eating, all desirable during hot weather. The heat associated with digestion of feed peaks about 3 to 4 hours after feeding. By feeding cows in early morning (5 to 6 a.m.), the heat of digestion peaks at 8 to 9 a.m., and allows the cow to dissipate some of that heat before the day gets hot. A cow fed at 8:00 a.m. will have her peak of heat production at 11:00 a.m. to noon when the day is hotter, which is undesirable. Similarly, cows fed during the evening will be more comfortable and likely to consume feed and their peak of heat production will occur during the night, when environmental temperatures are lower. In addition, frequent small meals result in less heat generated than fewer, but larger, meals. Addition of water to dry diets during mixing is required to improve intake and reduce sorting. Sudden ration changes needs to be avoided that force cows off-feed.

Provision of optimum roughage to concentrate ratio and dietary fibre:

Diet of heat stressed animals should be formulated to minimize heat increment. Low quality forages with more fibre produce more heat than less fibrous forages during fermentation. High forage diet leads to higher concentration of acetate in rumen, which leads to higher heat increament. Further , forages require more chewing which also increase energy expenditure and heat production in the process of digestion. Decreasing forage to concentrate ratio causes rations more digestible, and consumed in greater amounts. Thus high concentrate diet is preferred over high forage diet during heat stress. Increasing energy density will help in compensating the decreases in feed intake due to heat stress. However increasing concentrates to greater than 55 to 60% of the diet dry matter is risky and can result in depressed milk fat content, acidosis, cows going off feed, laminitis, and reduced efficiency of nutrient use. Fibre levels (Acid Detergent Fibre –ABF and Neutral Detergent Fibre –NDF) should be kept at National Research Council minimum levels. High quality forages are to be fed hut ADF level should not be below 18 – 19% of diet. The optimum ADF level should be 19 -21% and for NDF 25 – 28% of diet dry matter. The minimum quantity of fibre (at least 21% ADF in ration) in form of succulent forage of high digestibility is recommended during heat stress to sustain good rumen function and avoid milk fat depression. " Effective fibre " in form of succulent forage or good quality hay is necessary to stimulate cud chewing and maintain the rumen fibre mat. This could mean that 1 to 1.5kg of long hay per day are necessary in the diet.

Inclusion of dietary fat in ration :

Whole oilseeds (full fat soybeans, cottonseeds or sunflower seeds) and added fat or oil can reduce heal increment and increase the performance of heat stressed animals. Added dietary fat often boosts milk fat test a point or two. However, fat level should not exceed 6-7% of ration DM in ruminants. Feeding of protected fat can be beneficial for high yielding ruminants. One-third of the fat should come from sources already in the diet (such as found in corn, feed grains, cakes, bran, etc.), 1/3 can come from sources such as oilseeds and 1/3 can come from rumen inert or protected fats.

Inclusion of dietary protein in ration :

To compensate for the drop in feed intake, increasing protein in the diet may be helpful. Avoid overfeeding either rumen-soluble or degradable protein. However, rations high in protein may result in excessive rumen ammonia levels that require extra energy to metabolize and excrete the ammonia in the form of urea as waste. Metabolizable energy intake was decreased by 12 kcal per gram of digested nitrogen consumed above requirement in one study. In addition, diets high in rumen degradable protein have been implicated in infertility problems in dairy herds. Rumen escape or "bypass" protein is usually beneficial for high lactating (more than 25-30 lit/day) cows. Feeding bypass protein to stressed cattle resulted in increased performance. The diets should not contain an excess of 17% crude protein with greater than 62% degradable intake protein during hot weather. Rumen un-degradable protein may be increased as high as 38-40% of crude protein. Stressed calves have lower tolerance to NPN (urea) than non-stressed calves. High protein diets (19% of CP) of high rumen degradability (60% degradability) reduced milk yield significantly as compared to cows fed low protein (16% CP) of high (59%) or high protein (21% CP) of low degradability (41% degradability).

Supplementation of minerals and vitamins:

Heat stressed animals have higher requirement of sodium and potassium because of increased excretion through sweat during hot and humid weather. Considerable quantity of Na and K may lost via secretion of milk and sweating, respectively. Raising dielary sodium from 0.18 to 0.55% and potassium from 0.87 to1.5% increases milk yield significantly (5-10% increase). Magnesium level also should be increased from 0.2 to 0.3% during heat stress. Complete minerals designed to contain the higher levels of potassium and sodium should be fed only to lactating cows since udder edema is more prevalent in dry cows receiving extra salt or potassium. Mineral content of the ration should be boosted before the onset of hot weather so that the cow is prepared and a sharp drop in production can be avoided. Supplementation of some trace minerals viz. chromium in its organic form i.e chromium yeast (Guo and Liu, 1997) has to play a significant role in reliving the detrimental effect of heat stress and improve the productive performance of the animals. Some studies indicated that cows fed fungal products resulted in lower rectal temperatures and respiration rates than control animals. While the authors have been unable to define the mechanism responsible for the decreased body temperature, a possible influence on the body temperature control center was suggested. If sufficient quantity of green fodder is provided, the requirements for vitamin A and E are met. The animals exposed to sunlight can synthesize vitamin D. Addition of niacin, however, helps in improving performance during stress by improving energy utilization. Niacin can prevent ketosis and is involved with lipid metabolism. It is speculated that niacin improved milk yield by affecting lipid and energy metabolism by stimulating protein synthesis by ruminal microorganism or causing other effects on ruminal microorganism (Muller et al., 1986) .

Supplementation of feed additives:

Additional supplements of feed additives are also some times beneficial during the heat stress. Certain buffers, such as sodium bicarbonate, potassium bicarbonate or sodium sesquioxide or sesquicarbonate, when added @ 0.75-1% in ration (100 to 200g/d/animal) helps in preventing rumen acidosis and milk fat depression during heat stress when forage consumption is less than 1% of body weight. Magnesium oxide at 0.35-0.4% of diet dry matter also helps to maintain milk fat test. Other feed additives yeast (improved fibre digestion) and fungal such as Aspergillus oryzoe have been somewhat successful in hot weather. However, these additives should not usually be used together.

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INDIGENOUS TECHNICAL KNOWLEDGE (ITKs) IN CLIMATE SMART AGRICULTURE

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Introduction:

The concept of sustainable agriculture in late eighties in Indian agricultural scenario has evoked interest on indigenous technical knowledge (ITK) that has the element of use of natural products to solve the problems pertaining to agriculture and allied activities. The farmers of India have learnt to grow food and to survive in difficult environments, where the rich tradition of ITK has been woven together with the agricultural practices followed by them (Prakash and Roy, 2010)

Phonological knowledge held in the indigenous communities has a high value. Many traditional societies have built up knowledge over long periods about environmental change and have developed elaborate strategies to recognize and cope with these changes. Worldwide, however, applications of traditional knowledge systems in mitigation and adaptation to climate change have long been neglected in developing and implementing climate change policy and have only recently become part of the climate change discourse (Egeru, 2011).

The paper by Lefale (2009) examines the local phonological observations of Samoans—as documented in their local seasonal calendar. Key indicators highlighted in this calendar include changes in behaviour of animals and plants which are still used as indicators for cultural and subsistence activities. Indigenous knowledge is currently drawn on for weather forecasts, and it is this knowledge which the author suggests is crucial to document for developing regional climate adaptation strategies.

Though climate change equally affect all the people but indigenous people are going to be more vulnerable as compare to other section of the community. This is due to the fact that indigenous people live more close to the natural environment and they are the first one to experience, identify and adapt to any climate related change. However, indigenous people make the use of their own wisdom and accumulated knowledge from their predecessor over time to adapt to any change in climate. They can perceive the change by disappearance of certain animal and plant species, change in direction of wind, mating behaviour of animal and so on. These all criteria they established to identify climate change not just based on any assumption or perception o f individual.

Indigenous people (the term broadly encompassing local and traditional cultures) as primary actors in terms of global climate change monitoring, adaptation, and mitigation in order to provide innovative perspectives that could contribute to global change efforts. Indigenous and other local peoples are vital and active parts of many ecosystems and may

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help to enhance the resilience of these ecosystems. In addition, they interpret and react to climate change impacts in creative ways, drawing on traditional knowledge as well as new technologies to find solutions, which may help society at large to cope with the impending changes (Global Environmental Change, 2009)

Current research on vulnerability to climate change suggests that indigenous communities are among those who suffer the most from the economic, social and environmental stresses triggered by a changing climate, in part due to small population sizes, isolation, and the absence of recognized rights over their territories and resources (Ribot *et al.*, 1996; Adger and Kelly, 2001; Adger *et al.,* 2004). In addition, they rely on biological, ecological, cultural and social assets (including traditional and indigenous knowledge) for their livelihoods, which furthermore depend on the balancing of societal, natural and spiritual realms (Kronik and Verner, 2010a).

In a recent statement, World Bank Group President Robert Zoellick acknowledged that Indigenous people carry a 'disproportionate share of the burden of climate change effects' and must be included in international climate change discussions. Translating this largely theoretical recognition into practice remains a major challenge, in large part because of the perceived inferiority of local Indigenous knowledge compared to the conventional western scientific mode of inquiry. While this perception dominates public and policy discourse, the acknowledgement of the value of Indigenous peoples' observations of environmental, particularly weather and climate-related changes, is gradually increasing in the western scientific peer reviewed literature (Green and Raygorodetsky, 2010)

The final paper by Green *et al.* (2010) draws together seasonal weather calendars for northern Australia, noting that for many Aboriginal communities this knowledge is beginning to be documented both in local languages and translated into English. The paper discusses how cultural activities on the mainland have adapted to past climate changes, and how Indigenous knowledge held in these communities today is still highly valued. The paper then discusses research carried out in the Torres Strait to document seasonal weather observations and environmental indicators that are still in use. The paper concludes with the recommendation to develop a comprehensive programme to record this knowledge before it is lost. They suggest that such a programme would be of immeasurable value to the communities themselves to allow the intergenerational transfer of knowledge, and also potentially to contribute to a greater understanding of regional climate change for regions of Australia without long historic climate data observations.

'Eskimo is a scientist' the polar sea ice environment figures prominently in global climate change debates. More than four decades ago, Richard Nelson (1969) documented indigenous knowledge of this critical milieu in great detail. Extending well beyond an investigation of survival techniques for a harsh environment, Nelson describes the sophistication and meticulous detail of Inuit hunter knowledge of snow and ice regimes. This trail-blazing research laid the foundations for recent investigations of climate change impacts on snow-ice environments.

Indigenous Knowledge as a Foundation for Decision-Making across the circumpolar North within the framework of the International Polar Year (Krupnik *et al.*, 2010). Nelson provides a revealing account of one hunting experience. Following a young Inuk to the sea ice edge in early winter, he witnessed how an experienced hunter combines an intimate knowledge of seal behaviour, with traditional and modern technology and techniques, to produce a successful hunting outcome. His young companion summed it up by declaring: 'You see, Eskimo is a scientist'. After several years of research, Nelson concluded: 'Indeed, the Eskimo is a scientist, one whose major concern is discovering the secrets of the environment and of the animals that live in it. … What may seem unfathomable to us at first is often so only because we lack knowledge and understanding' (Nelson, 1969: xxii–xxiii).

Traditional knowledge is also a vital component of indigenous peoples' ability to respond to and manage environmental change (Berkes, Colding and Folke, 2000). In Columbia, for example, the shamans of the Tukano people rely upon their traditional knowledge of local biodiversity and climate to schedule hunting expeditions during periods of species abundance, and to limit them during droughts and other unexpected environmental changes (Berkes, Colding and Folke, 2000). In the Puno region of Peru, indigenous peoples use traditional knowledge about the environment and about wildlife (i.e. frequency of rains, flowering of certain plants, appearance of certain animals, mating of animals, incidence of pest infestations, etc.) to determine when to plant and when to harvest (Claverias, 2000).

Sherpa tribe of Nepal is well know about Himalayan climate. Sherpas are highly regarded as elite mountaineers and experts in their local area. They were immeasurably valuable to early explorers of the Himalayan region, serving as guides at the extreme altitudes of the peaks and passes in the region, particularly for expeditions to climb Mount Everest. Sherpas are renowned in the international climbing and mountaineering community for their hardiness, expertise, and experience at very high altitudes. It has been speculated that a part of the Sherpas' climbing ability is the result of a genetic adaptation to living in high altitudes. Some of these adaptations include unique haemoglobin-binding capacity and doubled nitric oxide production.

Definitions of ITK or Traditional Knowledge:

Indigenous Technical Knowledge (ITK) also referred to as local or traditional knowledge is the cumulative body of knowledge generated and evolved over a long period of time and generations of experience (Grenier, 1998). It includes the skills, beliefs, norms, practices and behaviour patterns handed down from one generation to the next (Matowanyika *et al*., 1994)

Indigenous Knowledge refers to the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. Indigenous knowledge is the local knowledge - knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision in agriculture, health care, food preparation, education, natural resource management, and a host of their activities in rural communities (Warren, 1991).

Understanding of the local environment, known as traditional knowledge (TK), can provide expert information for the study of climate change effects on agriculture and other species (Riedlinger and Berkes, 2001; Furgal *et al*., 2006; Laidler, 2006) and is being increasingly recognized by the scientific community as a valuable way to understand our environment (Huntington *et al.*, 2004).

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Defines indigenous and local knowledge as "the multi-faceted arrays of knowledge, know how, practices and representations that guide societies in their innumerable interactions with their natural surroundings. this interplay between people and place has given rise to a diversity of knowledge systems that are at once empirical and symbolic, pragmatic and intellectual, and traditional and adaptive" (Berkes, 2012). This study is also based on an understanding of ILKP evolving over time, "acquired through accumulation of years of experiences of local people and passed on from generation to generation"(Mukhopadhyay, 2010).

Traditional knowledge is still under-used by science, although it is of great value and can contribute significantly to the development of humankind" - Vyacheslav Shadrin.

Indigenous Knowledge (IK): is the participants' knowledge of their temporal and social space. Indigenous knowledge as such refers not only to knowledge of indigenous peoples, but to that of any other defined community.

Indigenous knowledge system (IKS): delineates a cognitive structure in which theories and perceptions of nature and culture are conceptualized. Thus it includes definitions, classifications and concepts of the physical, natural, social, economic and ideational environments. The dynamics of IKS takes place on two different levels, the cognitive and the empirical. On the empirical level, IKS are visible in institutions, artifacts and technologies.

Indigenous Technical Knowledge (ITK): is specifically concerned with actual application of the thinking of the local people in various operations of agriculture and allied areas.

Diversity of Indigenous Knowledge systems are:

- Adaptive skills of local people usually derived from many years of experience that have often been communicated through oral traditions and learned through family members over generations. Time-tested agricultural and natural resource management practices, which pave the way for sustainable agriculture.
- Strategies and techniques developed by local people to cope with the changes in the socio-cultural and environmental conditions.
- Practices that are accumulated by farmers due to constant experimentation and innovation.
- Trial-and-error problem-solving approaches by groups of people with an objective to meet the challenges they face in their local environments.
- Decision-making skills of local people that draw upon the resources they have at hand.

Characteristics of ITK:

- ITK is not static but dynamic, exogenous knowledge and endogenous creativity brings change to ITK.
- ITK is intuitive in its mode of thinking; ITK is mainly qualitative in nature.
- ITK study needs a holistic approach, ITK, if properly tapped can provide valuable insights into resources, processes, possibilities and problems in particular area.
- ITK is recorded and transferred through oral tradition.
- ITK is learned through observation and hands-on experience ITK forms an information base for variety.
- ITK reflects local tradition

Classes of ITK in Agriculture:

- Climatology
- Local soil and taxonomy
- Soil fertility
- Primitive cultivar
- Inter cropping
- Agronomic practices
- Irrigation and water management
- Plant protection
- Post harvest technology and methods.

Roles of ITK:

- ITK can aid development efforts
- ITK can facilitate local people's participation
- ITK is a valuable source of developing appropriate technologies

Scope of ITK analysis

- New biological and ecological analysis
- insight Resource management
- Protected areas and conservation education
- Development planning
- Environment assessment

Small population size, isolation, and the absence of recognized rights over their territories and resources may also contribute to their vulnerability to economic, social and environmental impacts brought about by a changing climate.

Despite their high exposure-sensitivity, indigenous peoples and local communities are actively responding to changing climatic conditions and have demonstrated their resourcefulness and resilience in the face of climate change.

Indigenous knowledge and knowledge-based practice are the foundations of indigenous resilience. Strategies such as maintaining genetic and species diversity in fields and herds provide a low-risk buffer in uncertain weather environments.

Diversified use of the landscape, mobility and access to multiple resources increase the capacity to respond to environmental variability and change, including climate change. Traditional systems of governance and social networks contribute to the ability to collectively respond to environmental change and thus heighten resilience.

Climate change, however, is only one of many drivers of change. Its effects cannot be isolated from the multiple social, political, economic and environmental changes confronting present-day indigenous and marginalized communities. These impacts interact together and induce exacerbating and cascading effects.

In summary, rather than describing indigenous men and women as vulnerable to climate change, it would be more accurate to emphasize their high degree of exposure-sensitivity, while drawing attention to their considerable adaptive capacity. Adaptive capacity contributes to resilience in that it relates to people's ability to modify their behaviour and environment to manage and take advantage of changing climatic conditions (Ford et al., 2006).

Indigenous observations of changing weather and climate Adaptation to climate change has lately emerged as a priority for the global community (Parry *et al*., 2009). If policies and actions in support of adaptation are to be effective, however, they must be attuned to the on-the-ground

Realities of communities, as well as their priorities and aspirations (Anchorage Declaration, 2009; Reid et al., 2009). This presupposes a solid engagement with local community members, who are uniquely placed to share their traditional knowledge on the nature of climate change affects, specific vulnerabilities and opportunities for adaptation (Krupnik and Ray, 2007). Recognition of the need for direct community involvement is all the more important in the Arctic due to the unique livelihoods and cultures of the indigenous peoples (Huntington, 2009; Pearce *et al*., 2009).

Importance of ITKs:

Agricultural traditional knowledge has also proven to be an invaluable adaptation tool for indigenous peoples in agriculture. In coping with excessive or low rainfall, drought and other environmental changes, indigenous peoples rely on a diversity of crops, varieties and planting locations. This serves as a safety measure to ensure that, in the face of severe environmental change, some crops will survive. The Chipaya people of Bolivia monitor the wind, snow, clouds and stars to determine what species to plant and when and where to plant them (Llosa Larrabure, Pajares Garay and Toro Quinto, 2009). In Chile, the Mapuche have a complex traditional seed bank for conserving genetic variability within species (Chehuaicura, Thomet and Perez, 2010). Such diversity provides security for the Mapuche against environmental change and other stresses.

Traditional knowledge about ocean and marine life is also important for adapting indigenous livelihoods to climate change. This indigenous knowledge is used to direct fishing so as to increase catches and target specific species at particular times during periods of environmental stress (Riedlinger and Berkes, 2001; Moore and Huntington, 2008). Traditional institutions also contribute to a community's adaptive capacity and resilience (Robards and Alessa, 2003; Ford, Smit and Wandel, 2006). In the Americas, indigenous peoples rely on traditional modes of social organization and coordination to achieve shared goals. Successful adaptation relies on the ability to produce and exchange resources, especially during times of environmental stress (i.e. hurricanes, floods, disasters, etc.). The Weensuk Cree in Canada note that while they have successfully adapted to change in the past, the rapidity and pervasiveness of social and environmental change is presenting a significant challenge to their well-being and to the sustainability of their livelihoods (Lemelin et al., 2010). A similar pattern is also observed with the Wemindji Cree on the eastern side of James Bay (Peloquin and Berkes, 2009).

Traditional local communities have continued to rely heavily on their own indigenous knowledge systems in observing the environment and dealing with natural disasters. These communities, particularly those in hazard prone areas, have collectively generated a vast body of knowledge on disaster prevention and mitigation, early warning, preparedness and response and post disaster recovery. This knowledge is acquired through observation and study, and is often based on cumulative experience handed down from generation to generation. Such traditional environmental knowledge systems are important tools today in environmental conservation and natural disaster management.

Indigenous knowledge systems have enabled the various communities in the area to live in harmony with their environments for generations, and that their traditional knowledge systems are important tools in environmental conservation and natural disaster management. Based on this traditional knowledge and peoples long- standing experiences concerning cloud formation, lightning wind direction, occurrence of rains in a particular period of the lunar calendar, the Indigenous rain forecasters predict the reasonably exact nature of rainfall for the entire season, including good and undesired effects (e.g., flooding, droughts). There are well known Sutras given in the ancient books to predict the monsoon and inform people about prospects of agriculture in a given year. Even in villages it is very common for farmers to consult Brahmans about the monsoon in a year.

Monsoon predictions are also made according to the nature, colour, and direction of flow of clouds and lightning in the clouds. In the prediction that a particular year is likely to be a drought year, the nature of clouds is described as follows: "There would neither be prosperity nor rain in the land should the clouds be rough and small, tossed about by the wind have the shape of camels, corms, dead bodies, monkeys or other inauspicious creatures, and be silent" The tribal peoples of Rajasthan face many natural hazards, but the major ones are drought and floods; these invariably cause famine, food insecurity and poverty. However, the people have developed a variety of measures to contend with these situations, such as growing drought-resistant and early-maturing indigenous crop varieties, gathering a diversity of wild fruits and vegetables, wetlands cultivation, livestock diversifying and splitting, that have enabled them to survive climatic hazards independently, with little or no support from the outside world. The people are well aware of the disasters they face and in most cases had the knowledge and administrative structures, or social institutions to cope with them.

The past studies have reported the existence of indigenous knowledge on fish habitats, migratory patterns, proper timing of fishing, fish resource management (Berkes, 1993), traditional fishing methods (Dutta and Bhattacharjya, 2009), fish behaviour and harvesting (Tuara, 1995). This knowledge is very essential to them since their livelihood directly depends on availability of fish resources which could be applied for predication of fish abundance.

Fishing communities have often developed adaptation and coping strategies to deal with fluctuating environmental conditions. Greater understanding of how communities cope with and adapt to fisheries with extreme natural variations would assist in developing adaptation strategies for climate change (Vivekanandan, 2011). Fishermen are generally able to track seasonal and spatial variations in fish stock availability and relate it to climatic variability. The available

Indigenous knowledge can be effectively used for understanding climate change related to fisheries issues (Salick and Ross 2009).

The main knowledge-holders of the site-specific holistic knowledge about various aspects of this diversity, Indigenous peoples, play a significant role in maintaining locally resilient social–ecological systems. Despite the recent adoption of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007, Indigenous people continue to be denied their rights and are subjected to climate injustice, remaining largely excluded from the official UN climate negotiations.

In Africa, many communities have used IK as a critical knowledge base and survival tool for adapting to extreme climate events and other natural hazards. They have developed techniques and strategies for forecasting, and managing climate variability including coping mechanisms to respond to both normal and harsh conditions of their local environments.

Initiatives in protecting ITKs:

Poorly designed and implemented climate change adaptation programmes, for example, Reducing Emissions form Deforestation and Degradation (REDD/REDD+) initiatives, often weaken the customary rights of indigenous peoples to their lands and natural resources, impairing their resilience. Indigenous peoples are facing these escalating pressures at a time when their cultures and livelihoods are already exposed to the significant stress of accelerated natural resource development in their traditional territories, due to trade liberalization and globalization.

In India, Indigenous Technical Knowledge Resource Centres (ITKRC) Establishing a National Indigenous Technical Knowledge Resource Centre forms the starting point for the entire framework of incorporating indigenous knowledge systems into agricultural research and extension. The resource persons in the national indigenous knowledge systems resource centre will provide training on the methodologies for recording indigenous knowledge systems.

The functions of this centre are:

1. Provide a national data management function where published and unpublished information on indigenous knowledge are systematically documented for use by development practitioners.
2. Design training materials on the methodologies for recording indigenous knowledge systems for use in national training institutes and universities;
3. 3. Establish a link between the rural people of a country who are the originators of indigenous knowledge and the development community;
4. 4. Facilitate the active participation of rural people in the conservation, utilization, and dissemination of their specialized knowledge through in sit knowledge banks, involvement in research and development activities, farmer-to-farmer training, and farmer consultancies.

5. Act as a two-way conduit between the indigenous knowledge-based informal research and development systems and formal research.

Training on ITK

Training programmes on indigenous knowledge systems are inevitable for bringing a desirable change in the attitudes of researchers and extension workers. The need for conducting training programs for extension workers on the role of indigenous knowledge in agricultural developments.

1. If the extension personnel including village extension workers and agricultural extension officers are provided training on scientific technological innovations, but have not learned to regard farmers as their colleagues, their potential to support farmers' local research efforts will be comparatively lower
2. 2. Training programmes on the role of ITKs in agricultural development help to remove the impression among the extension workers that research scientists are the only generators of technological innovations and their (extension workers) job is to merely transmit those innovations
3. Information provided in these training programmes regarding local farmer organizations and their functions can stimulate ideas among extension workers for a number of viable action-programs.

Strategies

Keeping these potential constraints in conventional transfer of technology, a conceptual framework for incorporating indigenous knowledge systems into agricultural research and extension has been developed with the following salient features:

1. Strengthening the capacities of regional research and extension organizations
2. Building upon local people's knowledge that are acquired through various processes such as farmer-to-farmer communication, and farmer experimentation
3. Identifying the need for extension scientist/ social scientist in an interdisciplinary regional research team
4. Formation of a sustainable technology development consortium to bring farmers, researchers, NGOs, and extension workers together well ahead of the process of technology development
5. Generating technological options rather than fixed technical packages

6. Working with the existing organization and management of research and public sector extension
7. Outlining areas that research and extension organizations need to concentrate on during the process of working with farmers.
8. Understanding that it is impractical to depend entirely on research stations for innovations considering the inadequate human resource capacity of the regional research system.

Developing extension programmes to validate farmer experiments Farmers are not passive consumers, but active problem solvers who develop for themselves most of the technology they use. For many hundreds of years before today's national agricultural research systems were set up, farmers did their own research. And, by integrating technology from different sources and continuing to adapt it on their farms, they still do so today. Indigenous knowledge systems form the basis for informal experimentation of farmers. The factors which influence farmer experimentation are:

Ecological: innovations that result due to interaction among crops, soil, and climate.

Historical: a major happening such as crop failure or year of glut or scarcity Serendipity: a practice discovered by farmers accidentally.

Economical: Farmers innovate new practices taking advantage of government subsidies for flood and drought relief activities.

Validating farmer experiments is an extension process in which SMSs encourage farmers to replicate their own experiments in their own environment in order to:

- Understand experiments in the socio-cultural and agro-ecological environments.
- Determine the impact of the experiments on productivity, profitability, and sustainability of the agricultural system.

Indegenous knowledge of the Tribal farmers forecasting climate

Ficus species : Flowering and generation of new leaves indicates near rainfall onset.

Butterfly : Appearance of many butterflies indicate early rainfall onset and also gives a prospect of good season.

Ants **:** Appearance of ants indicate imminent rainfall onset and signifies a prospect for good season Termites : Appearance of many termites indicates near rainfall onset.

Frogs : When frogs start to make a lot noise, it indicates near rainfall onset.

The tribals of Rajasthan also have faith in the sayings of elders about the prediction of weather, for E.g: "*Sukarvar ri badri,rahi shanichar jaye,barsa bina na jaya*". It means that if clouds form on Friday and remain till Saturday then they will not go without rain, such indications predict rains. In another saying "*Nada tankan,balad bikavan.mat baje tu,adhe saawan*". It means that in mid monsoon if South east wind blow then farmer of marwar region cries because it indicates famine in the particular region. Similarly "*Pawan baje Suryo,to hali halav kim puryo*" means that if winds flow in the North –west direction then farmer should not plough his field because it indicates heavy rains. Indicators such as the position of the sun or the cry of a specific bird on trees near rivers help people to predict the onset of the rainy season.

Farmers of Himachal Pradesh developed several layers of plain land by cutting the slope of hill. Popularly it is known as terrace cultivation. Such land is formed into multiple terraces, giving a stepped appearance. It conserves the soil as it slows rapid surface run-off which would erode the soil as it wipes off the top layer depositing it further down the hill. The terrace or mind cultivation was gaining high importance under changing climatic scenario due to its potential to conserve soil and water. Moreover, farmers also experienced heavy rainfall within few days which increase the potentiality of soil erosion and frequent landslide in sloppy hill.

The farmers of Kenya, Uganda and Tanzania already adapted to climate change led soil erosion in the form of heavy snowfall, landslide and rainfall through *"Fanya Zuu Terraces* (terrace cultivation)" in more scientific way (40-50 cm high terraces and 10-20 m apart with suitable agro-forestry practices). Therefore, this century old traditional practices need to be relooked in context of climate change in more scientific and participatory way for better adaptation to climate change led soil erosion.

Successful Examples of Climate change:

Athrva Veda discusses drought mitigation strategies and *Arthashastra* (4th Century BC) has a section on famine relief and mitigation measures. These became part of folklore and form basis of coping mechanisms extant at community level today.

Researchers have documented a number of indigenous building practices that have prevented collapse of structures in seismic zones, for example *Koti Banal* architecture of Uttarakhand, *Dhaji Diwari* of Kashmir, *Bhongas* of Kutch, brick-nogged wood frame constructions in Himachal Pradesh and bamboo based *Ekra* constructions in Assam, India (Indegenous knowledge for Disaster Risk Reduction in South Asia).

Changes in the climate of Rajasthan have exceeded the expected natural climate variability prevailing in this area. Studies have shown that Rajasthan falls within the areas of greatest climate sensitivity, maximum vulnerability and lowest adaptive capacity known from different parts of the globe. Rajasthan also has the maximum probability of occurrence of drought of anywhere in India.

Krupnik and Jolly (2002) provide a collection of early works on indigenous observations of change, including climate change, with revealing titles such as 'We can't predict the weather like we used to' (Jolly *et al.,* 2002). The compendium includes detailed documentation of indigenous knowledge of Climate change effects from across the North American Arctic and Subarctic: Yupik from the Bering Sea coast of Alaska (Krupnik, 2002); Gwitchin and

Inupiat/Inuvialuit from the Alaska-Canada borderlands (Kofinas, 2002); and Inuit from the western, central and high Arctic, Nunavut, Canada (Jolly *et al*., 2002; Fox, 2002).

Recent work on indigenous knowledge and climate change observation has been completed within the framework of the International Polar Year (IPY) (Hovelstrud, Krupnik and White, 2011). One such project, Sea Ice Knowledge and Use: Assessing Arctic Environmental and Social Change (SIKU), involved the establishment of daily ice and weather observations by indigenous monitors in 10 communities in Alaska, Canada and Russian Chukotka, between 2006 and 2009 (Krupnik *et al.,* 2010). This community-based monitoring was continued for a fourth year in three Alaskan villages, thus providing an uninterrupted record of indigenous observations covering four consecutive ice seasons. Overall, the SIKU project produced several hundred pages of local indigenous observations, organized in more than 150 monthly logs (Hovelstrud, Krupnik and White, 2011).

The Example of the application of traditional calendars is the use of lunar observations in the organization of local artisanal fisheries practices and weather forecasting in Cape Verde in the Eastern Atlantic. Knowledge of the lunar cycle is incorporated into a 'mental map of every fisherman, including the coordinates of each [fishing] ground based on landmarks'. Due to its influence on sea tides, fishers regard the moon as a compass. Ilic further notes how the lunar observations play a role in traditional weather forecasting: 'If there is a green circle around moon, weather will be fresh and rainy; if it is white one, it will be windy'. Traditional lunar-based calendars are also important in the structuring of traditional agricultural practices. In Tuvalu, traditional seasonal calendars have been used as the basis for interpreting weather, including extreme weather events (Resture, see IPMPCC, 2011).

Many small island environments are prone to rapid and severe changes in environmental conditions due to drought, hurricanes/cyclones, earthquakes and tsunamis. In response, small island societies have developed highly complex systems to enhance resilience in the face of such rapid and significant changes. In Tonga (Faka'osi, see IPMPCC, 2011) and Tuvalu (Resture, see IPMPCC, 2011), these include a wide range of traditional forecasting techniques relating to anticipating extreme weather events. Such techniques rely upon observations of the sea and lagoon (e.g. the sizes, strengths and sounds of waves, the colour and smell of the water, and the amount of seaweed deposited on the beach); the sky (e.g. type and colour of clouds, the appearance of the moon in a particular way); and the winds (e.g. primarily direction and speed). Other key indicators are phenology (e.g. the abundance of particular fruit like mangoes and breadfruit is a sign of strong wind or heavy rain, and a rise in the groundwater table of taro gardens is an indicator of rising seas); bird and animal behaviour (e.g. low-flying albatross is a sign of poor weather, and animals seeking higher ground is a warning sign of approaching tsunami); and insects and arachnids (e.g. their appearance indicates the approach of unfavourable weather).

Having suffered the occurrence of two powerful earthquakes, which drastically altered the coastal morphology of Linua Island in 1997 and 2008, the example of Torres Islands illustrates how a small island culture inhabiting a seismically very active area has developed a high degree of resilience to even sudden and violent shifts in coastal morphology and hydrodynamics.

The aspects of traditional food production systems that enhance local capacity to address consequences of climate change are traditional preparation and storage of emergency foods (Bourke and Harwood, 2009). In the islands of Tuvalu in the South Pacific, these foods are employed to enhance resilience by stocking each family's food storage (kaufata) with enough preserved foods to last them through a cyclone or drought event (Resture, see IPMPCC, 2011). In low-lying atolls of the Marshall Islands in the central Pacific 'traditional knowledge about food storage and fermentation of local root crops not only provide food security in times of scarcity, but also serve[s] to replenish the nutrient deficient soils for further agriculture' (Butler and Coughlan, 2011).

Movement of animals and insect

Farmers in Himachal Pradesh believed that if honeybee fly toward northern hill then there will be no rainfall and good rainfall is expected if it moves towards southern hill. Some section of the community believed that good rainfall occurred when winged termite emerged from the ground. Another section of community believed that when glow worms flew upwards, it indicated the onset of south west monsoon. The farmers of Himachal Pradesh reported increased temperature, change in rainfall and snowfall pattern under changing climatic conditions. They can take the necessary action for field preparation and procuring inputs based on aforesaid traditional forecasting methods to adapt to changing climatic pattern.

Famine

Plants are used as emergency food by the people of the Rajasthan desert during periods of famine. The utilization of little known foods in times of acute crisis is recognized as a form of resilience. Several indigenous crop species are described which could be grown and utilized to prevent a great deal of suffering. The information could be an indicator of the extent to which a region may be suffering silent famine. This natural phenomenon may be related to wind direction, cloud pattern, position of planets, behavior of animals, birds and changes in plants, etc.

This case study focuses on traditional adaptation practices used by vulnerable communities in the drought-prone areas of district, Rajasthan. Communities here already bear the brunt of drought and have learnt to cope. Successive droughts over wider geographic areas, combined with other stresses, now threaten to overwhelm coping capacity in ways that might become the norm with climate change. New adaptation strategies have been introduced in the district by local non-governmental organizations that build on existing knowledge and expertise about water, agriculture and livestock management. These include: growing new crops such as vegetables, fodder and higher value medicinal crops for commercial sale; use of environmentally sound fertilizers (vermin culture); improved storage for fodder and food grains; and improved water conservation and harvesting techniques through construction of *anicuts* and digging and deepening ponds and wells.

Bharara and Seeland (1994) identified traditional social indicators of drought prediction in arid region of Rajasthan and compared their accuracy with that of rainfall data as a contribution to the discussion of the relevance of indigenous knowledge to the development process in rural society. Though Thar, the desert ecosystem is unique, with harsh climatic and terrain conditions coupled with an amazing grace that life and practices speak of that conserves natural resources. The heat generated in the atmosphere actually helps to draw the monsoon into the region. Although there is a water shortage, traditional water management has kept the desert relatively moist. The UNDP supported water conservation project in the arid Marwar region of Rajasthan has shown that traditional knowledge and community involvement goes on long way in saving every precious drop of water.

In the event of a drought, a *diviner* would be anointed by calling of the ancestors; he/she would be the one to mobilize the people of a particular village to organize a rain-making ceremony (*elelekeja*). The diviner would advise on the food items to be cooked according to the revelations she/he has obtained from the ancestors. These items usually included: cucumber fruit (*akobokobo*), cowpeas (*imare*) and intestines (*offals - these would first be read/interpreted by the diviner before they would be cooked*) of goats, sheep and cows. The rain-making ceremony included construction of an entrance near a big tree closer to the wetlands. Food and local brew (*ajon*) would be served, dancing and singing and mud smearing would be performed on the locals. During dancing and singing, participants would chant “Rain! rain! rain! (*Akiru! akiru!)*. This was an act of invoking the ancestors to grant them rain. A child with a particular hand orientation (left or right), male or female, a twin or not, would be selected by a diviner to serve food during the rain-making ceremony. This was believed to bring good luck because it was obedience to the dictates of the ancestors. After the ceremony only men were allowed back to the ceremonial grounds until rain fell.

Policy implications:

1. Land tenure policies impacting on traditional forest management

Community-based forest management strategies in these communities involve the setting aside of conservation, woodcutting and watershed management zones, which have an important role to play in reversing the process of deforestation, thereby sequestering carbon and promoting rural development. A common problem in each of these communities is lack of political control over their land and forests. For the Loita Maasai of Kenya, forest resources are held in trust by the Marok County Council on behalf of the government; for the Miskitu of Nicaragua, use, control and access of natural resources is impacted by government norms and regulations, and external settlers are causing deforestation; and the Dayak Jalai of Indonesia are faced with government-promoted expansion of palm plantations and the continued operations of mining companies.

Mobility and the option to access resources across an extensive area are, for both hunting and pastoral peoples, essential to the maintenance of their cultures and livelihoods (Ayantunde *et al.,* 2011). They constitute a key component of community resilience. Mobility provides a mechanism for managing areas with low fertility and sparse vegetation.

2. Indigenous adaptation measures

The examination of changes in a variety of traditional practices has identified adaptability measures in the communities of the autonomous regions, These include: delimitation and ownership of territories (such as forming and strengthening the structures of territorial governments, and the creation of alliances); improvement of social control mechanisms and environmental resources; and cultural revitalization (i.e. implementation of measures to strengthen identity, culture and values, such as reinforcement of the role of elders, recovery of traditional foods, and strengthening of traditional medicine).

3. Scouting, Documentation ,Validation and Upscaling of ITKs

Indian Council of Agricultural Research launched a nationwide Mission Mode project on collection, documentation and validation of indigenous technical knowledge under National Agricultural Technology Project (NATP) during 2003-04. Information on ITK was collected from the primary sources through the voluntary disclosure. Simultaneously, an effort was also made to collect and compile the practices on ITK from the available literature, books, journals, theses etc. and published into following seven documents:

All ITK documents have been classified under different subject matter areas viz. rain water management, soil and water erosion, tillage and intercultural management, crops and cropping systems, pest and disease management, soil fertility management, farm implements, post-harvest technology, Grain/seed storage, horticultural crops, veterinary science and animal husbandry, fisheries, ethno-botany and agro-biodiversity, weather forecasting, food product development, agro-animal based yarns/natural dyes, and low cost housing materials. There was validation of few ITKs and some found superior, efficient and economical. But extrapolation in identical areas and upscaling of them is still in infant stages. There should be a policy and guidelines for effective blending of ITKs with modern technologies or upscaling and *insitu* adoption of them in agriculture and allied sectors.

Conclusion:

Indigenous peoples and rural communities are vulnerable to the impacts of global climate change, not only because they depend on resources and the environment for their living, but also because they are often marginalized from decision making processes and places of power. This said, they are neither passive nor without ways and means. They engage actively with their natural environment in their day-to-day lives, are experienced and attentive observers, and have accumulated sizable and sophisticated bodies of knowledge and practices about their environment, its variability and transformation. This knowledge and knowhow provides the basis for people’s livelihoods, which are in turn at the centre of societal efforts to adapt to variability and change.

Indigenous knowledge can therefore provide important insights into processes of adaptation. The significance of indigenous knowledge becomes all the more evident once it is acknowledged that indigenous peoples and local communities have been confronted with environmental variability and unpredictability for centuries. They have developed a wide variety of technical, social and economic responses that constitute the basis for their resilience in the face of change. Even though the transformations brought about by global climate change will undoubtedly surpass the lived experience of everyone, including indigenous peoples, a strong case can nonetheless be made for recognising indigenous resilience as the basis for indigenous adaptation, and for fostering their fullest expression.

Government policy and action should preserve and boost indigenous resilience. This may include policies to preserve strategic choices and fallback options by supporting the continuation of nomadic or semi-nomadic lifestyles, securing access and ownership over traditional territories, removing unnecessary restrictions on resources, and fostering diversity of domestic crops and animals, among other things. Such policies will need to be formulated on the basis of further interdisciplinary action research that brings together indigenous knowledge holders and scientists, both natural and social, to build mutual understanding and reinforce dialogue. It is essential that indigenous peoples – who are active resource users and bearers of traditional knowledge – play a central role in this process. Recent partnerships between indigenous peoples and scientists are producing new knowledge in response to the emerging challenges of climate change. This co-produced knowledge that derives from synergies between both systems of knowledge may point the way forward to promising and productive ways to address the complexities of climate change adaptation.

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STRATEGIES FOR PROMOTION OF ADAPTATION INTERVENTIONS FOR CLIMATE RESILIENT AGRICULTURE

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India is blessed with excellent natural resources like soil, water and climatic conditions. Farmers have benefited from latest innovations from agriculture which has transformed them from traditional agriculture to scientific agriculture. Due to ignorance many a times is observed that, farmers are indiscriminately adopting technologies not suited to their farming situations thereby causing irreparable losses. The farmer's first response to pest resurgence is to spray more. The effect of prolonged and over usage of chemicals in crops production has resulted in human health hazards and pollution of environment and ground water. The food we eat is now the greatest single threat to our health. Laboratory findings indicate that the environment is highly polluted as there are many toxic metals and residues found in the soil, water, humans, animal and plants. Possible alternative could be application of non-toxic environment friendly formulations and solutions to combat pest for maintaining environment security and creating a healthy society for attaining overall development and well being. In fact there is a paradigm shift in agriculture towards low external input sustainable farming and subsequently (ecological)

farming with local available resources. Good agricultural practices and technologies already provided proven benefits to farmers' food security, resilience and productivity. Ecological or organic farming is considered as environmentally sustainable, economically viable and socially adaptable.

Adaptation interventions for climate resilient agriculture requires interdisciplinary, multifunctional approach. Strong mechanisms for finance, capacity enhancement and technology transfer are prerequisites for success. To meet these challenges, the extension system should be geared up to advise and transfer relevant technologies to the farmers through: On-farm research and On-farm extension on comparative and competitive advantages, micro-farming situation based extension, multi-disciplinary approach, Training to upgrade skills and knowledge at various levels, Use of distance mode of education for masses (Electronic & Print media), leveraging ICTs, Public-private partnership extension etc. The detailed literature on pesticides & fertilizers impact on environment, constraints in adoption of pro-environment package including IPM, Organic farming, resource conservation practices, adjusting the crop sowing dates, in-situ moisture conservation with sub soiling, Direct Sown Rice, System of Rice Intensification, Zero Budget Natural Farming, Site-specific nutrient management, Farm ponds, Rain guns, rational indigenous technical knowledge with few case studies, along with suggested extension strategies to promote such eco-friendly practices are discussed in the review paper.

Key words: Adaptation interventions, Climate Resilient agriculture

Background

Agriculture is the backbone of Indian economy. In India around 70% of the population earns its livelihood from agriculture. It still provides livelihood to the people in our country. It fulfills the basic need of human beings and animals. It is an important source of raw material for many agro based industries. India's geographical condition is unique for agriculture because it provides many favourable conditions. There are plain areas, fertile soil, long growing season and wide variation in climatic condition etc. Apart from unique geographical conditions, India has been consistently making innovative efforts by using science and technology to increase production.

Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. India has made immense progress towards food security. Indian population has tripled, and food-grain production more than quadrupled. There has been a substantial increase in available food-grain per capita. Environment and natural resources preservation is vital to the economic growth of any country or a region in many ways but also susceptible to the extent that their utilization, management and sustainability can be affected by performance and deeds of various actions within the society. Natural resources and environmental issues matters and apprehensions are cross-sectorial but also render input in every sector in terms of reducing poverty and destitute conditions of people.

Enhancing agricultural productivity is critical for ensuring food and nutritional security for all, particularly the resource poor small and marginal farmers who would be affected most. In the absence of planned adaptation, the consequences of long term climate change could be severe on the livelihood security of the poor. Maintaining food production for the growing population requires using new technology and intensifying production and management to grow more food on current cropland. Fertilizers and pesticides are essential for accomplishing this. Farmers have benefited from latest innovations from agriculture which has transformed them from traditional agriculture to scientific agriculture. Due to ignorance many a times is observed that, farmers are indiscriminately adopting technologies not suited to their farming situations thereby causing irreparable losses. The farmer's first response to pest resurgence is to spray more. The effect of prolonged and over usage of chemicals in crops production has resulted in human health hazards and pollution of environment and ground water. The food we eat is now the greatest single threat to our health. Laboratory findings indicate that the environment is highly polluted as there are many toxic metals and residues found in the soil, water, humans, animal and plants.

If the credits of pesticides include enhanced economic potential in terms of increased production of food and fibre and amelioration of vector-borne diseases, then their debits have resulted in serious health implications to man and his environment. There is now overwhelming evidence that some of these chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment (Forget, 1993; Igbedioh, 1991; Jeyaratnam, 1981). No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects, though a disproportionate burden, is shouldered by the people of developing countries and by high risk groups in each country (WHO, 1990). The world-wide deaths and chronic diseases due to pesticide poisoning number about 1 million per year (Environews Forum, 1999).The high risk groups exposed to pesticides include production workers, formulators, sprayers, mixers, loaders and agricultural farm workers. During manufacture and formulation, the possibility of hazards may be higher because the processes involved are not risk free. In industrial settings, workers are at increased risk since they handle various toxic chemicals including pesticides, raw materials, toxic solvents and inert carriers.

Pesticides contaminate soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects and non-target plants. Insecticides are generally the most acutely toxic class of pesticides, but herbicides can also pose risks to non-target organisms (Wasim *et al* (2009**).**

Chaturvedi (2013) reported that Pesticides can be absorbed through the skin swallowed or inhaled (most toxic). During application pesticides drift and settled on ponds laundry, toys, pools and furniture. People and pets track pesticides residue into the house. Only 5% of pesticides reach target weeds. The rest runs off into water or dissipates in the air. Drift from landscaping ranges from 12 feet to 14.5 miles. More serious effect appears to be produced by direct inhalation of pesticide sprays than by absorption or in gestation of toxics. Pesticides are applied in many forms via various delivery methods to forests, rangeland aquatic habitats, farmland, rights-of-way, urban turf and gardens. Their widespread use makes contact with pesticide residues inevitable for some wildlife. Pesticide poisonings to wildlife may result from acute or chronic exposure. Additionally, pesticides may impact wildlife via secondary exposure or through indirect effects to the animal or its habitat.

For decades people have believed that harmful chemical pesticides were the only true way to rid gardens and crop fields from pests. Soil pollution, Air pollution has occurred from the use of pesticides and it takes years and sometimes decades for some of these chemicals to break down. These pesticides are also harmful to animal plants as well as human health. Luckily there are many organic chemicals that are just as effective. The effects of pesticides on soil micro-organisms are less invasive when organic pesticides are used. People need to break the habit of using harmful pesticides and switch to rising organic ones that break down quickly in the sunlight and in the soil. The faster a chemical breaks down, the sooner the soil can return to a healthy state. Most organic pesticides are also safe to use around people and pets. They can easily be washed from fruits and vegetables making them healthier for us and our family to eat.

A study was carried out in the three districts of Barak valley (Cachar, Karimganj and Hailakandi) Assam, India to ascertain the variety of pesticides that are used in the agriculture sector and their probable impact on the health of farmers. The study revealed that the farmers often use pesticides ranging from high to extremely hazardous categories like Organochlorides, Organophosphates and Carbamates. Various signs and symptoms of diseases/ physiological disorders were observed; and the relative risk (RR) was also observed to be high. Lack of adoption of adequate protective measures were noticed to have increased the declining state of the health of farmers in the region. (Dey *et al*., 2013)

In modern agriculture, pesticides are inevitable inputs in agro-ecosystems in spite of the variety of problems associated with them.In India there is a trade-off between agricultural production and increasing soil, air and water pollution and associated health hazards (Gupta, 2004; Agoramoorthy, 2008; Abhilash and Singh, 2009). Currently, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides. Although the average consumption of pesticides is far lower than many other countries, the problem of pesticide pollution is serious in India. Unfortunately, India is one of the few remaining countries still producing and using some of the chlorinated pesticides such as DDT and lindane (Abhilash and Singh, 2009; Vijgen *et al*., 2011).

Most of the farmers mix two or more pesticides and spray them in the field. This is a very harmful practice both for the farmer and the environment. Generally the farmers do not enter a field for at least three days after spraying insecticides, but during peak harvest period, they harvest brinjal, tomato, and other vegetables immediately after spraying (i.e. the next day). It has also been noticed that most of the family members of the farmers suffer from general ill health and chronic diseases. These can be due to the side effects caused by the handling of these harmful chemicals. As majority of the farmers are illiterate and unknowingly use their house for storing the pesticides. Moreover they hardly follow any precautions before and after spraying the chemicals in the field.

Standing Committee on Agriculture (2015-2016) reported that declining soil fertility is often cited as one of the reasons for stagnating or declining yields. The inadequate and imbalanced nutrient use coupled with neglect of organic manures has caused multi-nutrient deficiencies in many areas with time. The imbalanced fertilizer use in terms of NPK is evidenced by their wider consumption ratios of 31.4:8.0:1 and 27.7:6.1:1 against a desirable one of 4:2:1 in agriculturally important states of Punjab and Haryana, respectively, during 2014-15. Further, out of total 525 districts in the country, about 292 districts account for 85 % of the total fertilizer consumption. Today, the nutrient deficiencies at the country level are of the order of 89, 80, 50, 41, 49, 33, 13, 12, 5 and 3 % for nitrogen, phosphorus, potassium, sulphur, zinc, boron, molybdenum, iron, manganese and copper, respectively. The continuous use of high analysis chemical fertilizers (devoid of sulphur impurities) has made sulphur a limiting nutrient in many soils of the country. The deficiencies are becoming more critical for sulphur, zinc and boron. The limiting nutrients do not allow the full expression of other nutrients, thereby, lowering the fertilizer responses and crop productivity. The Indian agriculture, presently, is operating with a negative balance of plant nutrients in the soils.

A concern is being voiced, of late, regarding pollution of groundwater with nitrates due to more use of nitrogenous fertilizers. The problem is thought to be more in areas having light textured soils consuming higher doses of N followed by heavy irrigations. There are reports of nitrate pollution of ground water above the permissible levels (10 mg NO3-N/L of water as safe limit in drinking waters) in agriculturally intensive areas of Punjab, Haryana, Gujarat, Maharashtra and Andhra Pradesh. The Committee are of the view that there is need to examine pros and cons of strategy of use of chemical fertilizers and pesticides to enhance food production in order to incorporate suitable changes to conserve our natural resources and minimize adverse effects on agriculture & allied sectors without jeopardizing agricultural growth. The Committee notes that the country will require enhancing the food grains production to the level of 300 mt by 2025 to feed its teeming millions.

Need for looking at Climate Resilience

Agriculture plays an important role in the social and economic life of people in India, and will continue to do so in the foreseeable future. Today agriculture accounts for about 14 percent of the Gross Domestic Product (GDP) and 11 per cent of exports (Sharma, 2007; Ministry of Agriculture, 2013). It faces many challenges. Some of the sectoral challenges since the last decade or so are: a slowdown in growth, increased exposure to world commodity price volatility, degradation of the natural resource base, rapid and widespread decline in the groundwater table, land fragmentation, lack of extension services, and the indebtedness of farmers. Further, non-sectoral *challenges* that are stressors for agriculture are: population growth, expanding urbanization, demographic transition (larger sections of society becoming affluent) with increasing incomes, improving life styles and changes in food habits, globalization, and the demand for bio-fuels. Added to the latter is the increasing absorption of agricultural land into Special Economic Zones and townships, large industrial and irrigation-cum power projects and mining.

.More than 80 percent of the farmers are smallholder producers with very poor capacity and resources to deal with the vagaries of weather and changes in climate. For the farmer, climate is the seasonal temperature and rainfall pattern expected in their area, based on experience over decades. Weather, on the other hand, is the actual temperature, rainfall, and other climatic conditions experienced from day to day, for which they need adaptation or coping strategies to deal with these variations. With approximately 60 percent of Indian agriculture being rain fed and dependent on the vagaries of the monsoons, the climate will be a major determinant of agricultural production. Temperature, rainfall, and seasonal weather variations will thus aggravate the existing agricultural challenges.

Natural Resources Management

Soil, water and vegetation are three basic natural resources. The survival of creation depends upon them and nature has provided them as assets to human beings. In a wider view, land, water, biodiversity and genetic resources, biomass resources, forests, livestock, fisheries, wild flora and fauna are considered as natural resources. Now the question is are we aware of these resources? Or the question may be reframed as do we regard those as resources? If we really regard those as our resources then we have to think about managing those efficiently.

Concern for natural resources management

Over-exploitation of natural resources by growing population resulted in various severe problems. Destruction of vegetation has resulted in land degradation, denudation, soil erosion, landslides, floods, drought and unbalanced ecosystems. A balanced ecosystem is an urgent need. Natural resources (land, water, biodiversity and genetic resources, biomass resources, forests, livestock and fisheries) – the very foundation of human survival, progress and prosperity, have been degrading fast, and the unprecedented pace of their erosion is one of the root causes of the agrarian crisis that the country is facing. The demographic and socio-economic pressures notwithstanding, the unmindful agricultural intensification, over use of marginal lands, imbalanced use of fertilizers, organic matter depletion and deteriorating soil health, extensive diversion of prime agricultural lands to non-agricultural uses, misuse and inefficient use of irrigation water, depleting aquifers, salination of fertile lands and water logging, deforestation, biodiversity loss and genetic erosion, and climate change are the main underlying causes.

Adaptation Measures

Anitha Kumari *et al* (2014) suggested the following remedial measures for Eco-friendly approaches for farming system:

A. Organic farming: Organic farming is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming system rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests..

B. Biological farming: Biological farming allows the use of selected chemical fertilizers (avoiding disruptive materials such as anhydrous ammonia and potassium choloride) and adopts low-inputs approaches to use of herbicides and insecticides. (Diagnostic instruments to monitor plant and soil conditions are frequently used in biological farming. These include refract meters to monitor sugar content (Brix) in plant tissue sap; electrical conductivity meters to monitor ERGS (or energy releasedper gram of soil); ORPS meters (or oxygen reduction potential of soil); and radionics.**)**

C. Regenerative Agriculture: In regenerative agriculture bunds on nature's own inherent capacity to cope with pests, enhance soil fertility, and increase productivity. It implies a continuing ability to recreate the resources that the system requires. In practice, regenerative agriculture uses low-input and organic farming systems as a frame work to achieve these goals.

D. Permaculture: Permaculture is the harmonious integration of landscape and people providing their food, energy, shelter and other material and non- material nedds in a sustainable way. Permaculture is concerned with designing ecological human habitats and food production systems, and follows specific guidelines and principles in the design of these systems. To the extent that permaculture is not a production system, per se, but rather a land use planning philosophy, it is not limited to a specific method of production. Thus, practically any site-specific ecological farming system is amenable to permaculture.

Integrated Pest Management

Integrated Pest Management has been the policy of the Government to stimulate judicious and need-based use of chemical pesticides as well as those of biological origin such as botanical pesticides (neem-based and plant origin pesticide formulations, microbial preparations such as those from antagonistic fungi – *Trichoderma* spp., bacterial formulations such as that of *Bacillus thuringiensis* (Bt.).

The tool box of IPM lays emphasis on pest management through a combination of agronomic, chemical and biological methods. Timely sowing, use of tolerant and resistant plant varieties, transgenic pest resistant crop, bio control agents, and need-based application of chemical pesticides are the basic tools of IPM tool box. A number of novel pesticide chemistries that have low impact to agro-ecologies and natural habitats and also requiring small dosage per unit farm land have revolutionized the pesticide application in crops in a large measure. The general trend in the reduction of pesticide use is due to low dosage pesticide chemistries, particularly in the class of herbicides and insecticides that have been now registered for manufacture and use in the country

Success Stories of adaptation measures

Case-1: Direct Seeded Rice

Visualizing the present scenario of changing climate, sky rocketing food prices and energy crisis, major emphasis is being given on conservation agriculture in improving efficiency, equity and environment that can be realized with application of resource conservation technologies such as utilization of on-farm resources, zero-till, laser leveling, raised bed techniques, direct seeding of rice, managing crop residues, etc. Among Resource Conservation Technologies (RCTs) direct seeding of rice, is gaining momentum particularly in Indo-Gangetic Plains (IGP) where rice-wheat is a predominant cropping system. Generally manual transplanting of Rice after 2–3 paddling operations with 21 – 35 days old rice seedling is common in the District. This age-old method of planting is used to reduce water percolation and also help in weed control. However, this system is labor intensive, requires huge tractor usage which often delays transplanting of paddy up to second week of August, it ultimately lead is poor tillering, poor grain formation and low yields of rice. Delayed harvesting of rice also delays sowing of wheat that ultimately reduce wheat grain yield. On the negative side, puddling degrades the soil physical properties resulting into poor soil physical conditions for establishment of the next upland crop such as wheat. There has been a lot of research in the region to look at the possibility of establishing rice without puddling. The major hurdle has been paucity of knowledge in the area of good weed management. A total of 1382 mm to 1838 mm water is required for the RW system at different locations in the IGP, accounting to more than 80% for the rice growing season. Thus to save on water, saving must be effected during the rice growing season, the major water user in the RW system. The key issue is if higher system productivity is desired, the rice crop must be planted early with the onset of monsoons by raising rice nurseries with ground water and vacating the main fields early in the season for the succeeding wheat or other crop.

To overcome these problems in rice-wheat cropping system, direct seeded rice (DSR) was demonstrated at farmers' fields of Kushinagar of U.P along with KVK Farm, Sargatia (Kushinagar) for adoption and promotion of this technology among the farmers. Apart from this technology, improved varieties coupled with integrated plant nutrient management and integrated pest management technologies were also included under Resource Conservation Technology.

Farmer's Feedback

- Direct seeded rice (DSR) save the time, labour, critical inputs and conserve the natural resources like, soil, water etc.
- DSR also save 30-40 per cent water due to un-paddled field and not raising nursery in advance.
- Farmers showed a great response in adopting the techniques of DSR as well as short duration high yielding varieties of paddy along with other recommended technologies of balance use of fertilizers, use of herbicides and less irrigation in paddy field.

Environmental Benefits

- Improving water use efficiency and conservation (important as water becomes scarcer).
- Helping to control erosion.
- Reducing the amount of N that "leaks" into the environment.
- Providing environmentally friendly options for managing crop residues.
- Reducing soil compaction; and bettering soil physical structure

Case-2: Organic Cotton

Budlapur, a small village of Ranga Reddy district of Telangana, is known for its cotton production. Cotton is one of the main crops in *kharif* season in the area. Cotton, a highly sensitive crop, is prone to insects and pests. The farmers of the villages relied on chemical pesticides and insecticides to save their crop. But with improved resilience of the pests and insects to these chemicals, farmers were forced to spray higher doses more frequently each year. This was leading to steep increase in cost of cultivation. On the other hand indiscriminate use of chemical inputs was reducing the soil fertility leading to a drop in the yields. The farmers were very depressed with the decreasing yields and increasing costs. But they struggled to find a solution of the problem.

An opportunity arrived in the village in the form of the watershed project under 'Hariyali' guidelines of Government of India (GoI). Realizing the problem of the cotton farmers as an acute one, the Project decided to tackle it head on. It introduced the farmers to the concepts and practices of integrated pest management practices and organic fertilizers. Farmers were also encouraged to take up trap crops which control pests and insects in natural manner. These practices were less costly and were not harmful for soil. The farmers were thus able to reduce the cost of cultivation for cotton and the crop started giving higher yields.

However, convincing the farmers to give up long years of established practice and replace it with an unknown practice was not easy. The farmers by this time were very wary of taking any risk. But the Project gradually convinced the farmers who were members of user groups and Village Organization (VO) to at least attend the training programmes on Integrated Pest Management (IPM). They were taken to places where IPM measures were on demonstration. Seeing the practice in action convinced the farmers who returned to their village and tried out the natural methods of pest control in their fields. The Project established convergence with local agriculture department to help the farmers get subsidy for IPM and organic farming practices.

These interventions under productivity enhancement component of watershed programme brought the desired results. Farmers stopped using chemical fertilizers like DAP and pesticides. They started the practice of deep ploughing for better soil and pest management. Due to the intervention, the cost of cultivation was reduced by 50 per cent and the yields increased to 5 to 6 quintals from 3 to 4 quintals per acre. The farmers were able to manage pests and insects in an effective manner. Now K. Shankriya who grows cotton in two acres of land spends only Rs. 500/ annually instead of Rs. 6000/ which he used to spend earlier, mostly on chemicals. He adopted natural pesticides like neem kernel spray, cow dung and cow urine, and chilli-garlic pastes to control pests. He also adopted trap crops like marigold to attract and trap the pests.

V. Namya who owns four acres and grows cotton used to get profit of Rs. 3000 to Rs. 4000 per acre. But by using IPM practices, he now earns a profit of Rs.7000 per acre. Pochamma who owns two acres of land and grows cotton, earlier used to get a yield of only three quintals per acre. After using neem and cow dung based natural pesticides, deep ploughing and using castor as a trap crop, her cost of cultivation is reduced by 50 per cent and the yields have increased to 5 - 6 quintals per acre. On the whole, the experience in the Project suggest that use of organic fertilizers and methods like IPM increased the yield of cotton by 50 per cent and reduced the cost of cultivation to around Rs 2000/ per acre from Rs.6000/ per acre. In terms of quality, the colour and filling of the cotton ball improved fetching the farmers a better price for the same yield. Now the farmers from Bramanpally and other nearby villages come to see and learn the practices adopted by Budlapur farmers. Raju, a technical officer for Budlapur watershed project says, “You see, in life, lots of people know what to do, but few people actually do what they know.

Case-3: Farm Ponds save village from Drought

Vikram Patel, a 71-year-old farmer in Chidavad village of Dewas district in Madhya Pradesh is one of the first farmers to have embraced the idea of farm ponds to increase the groundwater level in his farm.“For the last two decades, the Chidavad village in the Tonk Khurd block, was one among the parched villages in the Malwa region. The women of the village walked more than 3-5km just to bring drinking water home. The traditional water-harvesting practices had almost vanished from this region. The villagers had started migrating to other places in search of livelihood and the farmers were getting caught in debt traps,” says Patel. In 1984, when Patel took the initiative to build his first farm pond, nobody believed that it would reap benefits for him. But it did. The idea, however, found no takers until Raghunath Singh Tomar--another farmer from Tonk Khurd block--dug a farm pond in Harnavda during the acute water crisis in 2005. That year, he earned double the amount he spent on the farm pond. Since then, many farmers have taken the initiative to build farm ponds to improve the groundwater situation. There are more than 5000 farm ponds in the Tonk Khurd block now which have substantially improved the groundwater table in the area.

During the water crisis in the recent past, the farmers of Chidavad dug more than 1000 tube wells in their 250 acres of farmland in search of ground water, out of which, only 50 per cent was found to have the capacity to yield water. The farmers then decided to construct farm ponds around those tube wells that had water. “When we built farm ponds near the tube wells, we found the groundwater table to improve considerably,” says Baoji Daya, a farmer in his mid-40s. Chidavad village now has 200 farm ponds. These incidents prompted the Dewas district administration to encourage the farmers to build farm ponds as a solution to the water crisis in the area. As a result, the farmers constructed more than 10,000 farm ponds since 2006, but it is only in the Tonk Khurd block that the groundwater recharge has been a major success.

The success of the improvement of groundwater table in Tonk Khurd cannot be entirely dedicated to the farm ponds. In addition to the ponds, the farmers have adopted ways of recharging groundwater like drainage channels around the farm ponds and aquifers, soak pits around tube wells, rooftop harvesting, and more. The Dewas district is a good example of the fact that when it comes to solving water crisis, one size does not fit all. The groundwater recharge depends on the geomorphology of an area. Every village should develop its own groundwater recharge security plan.

To manage groundwater, a two-fold approach is required:

•Large scale community participation

•Better groundwater governance by implementing smart regulations and legislations

STRATEGIES FOR PROMOTION OF ADAPTATION MEASURES

There are several ways that extension systems can help farmers deal with climate change. These include adaptation and contingency measures for what cannot be prevented. Extension can help farmers prepare for greater climate variability and uncertainty, create contingency measures to deal with exponentially increasing risk and alleviate the consequences of climate change by providing advice on how to deal with droughts, floods and so forth. Extension can also help with mitigation of climate change. This assistance may include providing links to new markets (especially carbon), information about new regulatory structures and new government priorities and policies.

Discussed below are different ways in which extension can help with adaptation and mitigation related to climate change **(**Iqbal singh and Jagdish Grover, 2013).

(i) Technologies and management information

Extension traditionally has played a role in providing information and promoting new technologies or new ways of managing crops and farms. Extension also links farmers to researchers and other actors in the innovation system. Farmers, extension agents and researchers must work together on farmers’ fields to prioritize, test and promote new crop varieties and management techniques. While extension must now go beyond such methods there is still a need for simple technology transfer in order to increase resilience to climate change and mitigate GHG emissions. Today’s farmers will need to be able to quickly respond to climate change and adeptly manage risk. This will be especially challenging for extension in terms of knowledge and information systems. Farmers need to have access to this kind of information be it climatic information, forecasts, adaptive technology innovations or markets through extension and information systems. Extension agents can introduce locally appropriate technologies and management techniques that enable farmers to adapt to climate change for example developing and disseminating local cultivars of drought resistant crop varieties with information about the crops’ advantages and disadvantages. Additionally extension staff can share with farmers their knowledge of cropping and management systems that are resilient to changing climate conditions such as agroforestry, intercropping, sequential cropping and no-till agriculture. Some of these practices have the added advantage of improved natural resource management. Tree planting can also help to improve soil, prevent soil erosion and increase biodiversity. It is important to provide farmers with information about how the various options will potentially increase income and yields, protect household food security, improve soils, enhance sustainability and generally help to alleviate the effects of climate change. At the same time extension staff can play an important role in transferring indigenous technical knowledge to help farmers worldwide. A core challenge for extension in the future is to shift from providing 'packages' of technological and management advice to instead supporting farmers with the skills they need to choose the best option to deal with the climate uncertainty and variability and to make informed decisions about if and how to engage in new markets for carbon emissions. Some farmers will also need access to new technologies and management options in those areas where climate change renders their current farming systems in viable.

(ii) Capacity development

One of extension's major activities over time has been adult and non-formal education. This role continues today and is even more important in light of climate change. In addition extension is also responsible for providing information using techniques ranging from flyers and radio messages to field demonstrations. Recent innovative extension activities include the adult education and experiential learning approaches utilized in farmer field schools an extension and education approach already working with farmers on issues of climate change. Climate Field Schools (CFSs) have been established in West Java, Indonesia to deal with climate change in agriculture. Another example is a multimedia campaign planned by True Nature Kenya and the World Agroforestry Centre that will show films and offer educational follow-up by extension agents to publicize grassroots solutions to the problems of climate change. Climate change will initiate extreme events like sudden onset disasters and new vectors of human and livestock diseases. Evidence is emerging that the biggest impacts will be in the form of small droughts, floods and other events that cause severe hardship but do not attract the attention of the international community. The capacity of farmers to cope with such different forms of risk will become ever more crucial and extension efforts must pay special attention to educating farmers about their options to enhance resilience and response capacity.Education must thus move beyond technical training to enhance farmers' abilities for planning, problem solving, critical thinking, prioritizing, negotiating, building consensus and leadership skills, working with multiple stakeholders and finally being proactive. Capacity development is important within extension as well. There are many different ways to inform and educate farmers about adaptation options. Climate change adaptation funding should focus on extension systems and programs that incorporate a good understanding of what practices and skills are needed to best promote activities that help in the climate change effort and on increasing the capacity of extension agents and farmers where needed.

(iii) Co-ordination

Agriculture development system presents a complex coordination phenomenon inter-institutional and interdisciplinary. Coordination is required within the disciplines/specializations, between institutions and departments and in functional areas like research, extension and training. The old concept of people's participation and new thrust on participatory research and development bring farmers also in the framework of interactions at all levels. More allied agencies have to be brought together to serve the farmers on the line of farming systems approach.

(iv) Infrastructures/institutions

Keeping in view the local conditions the village extension workers and farmers ratio to be reduced for covering larger areas and scattered population as also for more personalized approach. Rural institutions especially village cooperatives must function to meet the local needs of inputs-small and marginal farmers cannot afford to spend a lot of time in searching for the inputs.

(v) Materials

Mobility is the first requirement for the extension work in different areas. To economize on travels motor-cycles may be used instead of jeeps, station wagons etc. low cost indigenous audio-visual aids may be preferred over expensive communication gadgets. Village library may be promoted where extension publications in local language could be available for at least those who can read and write; the latter can function as extension agents for others. The concept of mini-farmers fair in villages can be promoted. Mobile exhibition van and soil testing kits can prove useful and effective for promoting different agriculture systems approach. Extension personnel should not suffer for want of simple common requirements like papers, pencils, pens, typing facility and other stationeries for effective bottom-up communication and reporting.

(vi) Training

Poor resource farmers have to be trained more for they are less enlightened mostly illiterate and neglected from the mainstream of development. Because of their background trainings have to be based on the principles of ‘training by doing’ and ‘learning by doing’ like being followed by the Krishi Vigyan Kendras. Most of the trainings have to be in situ, off-campus/ village based for such farmers cannot afford to come for residential courses; they have to be one or two day courses. The training strategy should be to reach farmers, farm women and young farmers including boys and girls with special priority to school dropouts. We must build training infrastructures/institutions nearer to the farming situations as best as possible. KVKs being promoted in India for each district are a good example in this respect.

(vii) Use of technology demonstrations

Extension agents can use various extension teaching approaches including method demonstration, result demonstration, print media (for example, posters, leaflets etc) and computer/ telecommunication media (for example internet, television, cinema, radio, computer, etc) to further inform and educate farmers on various issues of climate change. Farmers learn by doing and practices learnt during a demonstration session could lead to adoption of the technology. Farmers perceive the use of demonstration methods as a significant role of extension in disseminating the coping and adaptive measures that could reduce climate change risks among vulnerable communities.

(Viii) Climate change and conservation agriculture

Use of resource conservation technologies such as zero tillage maize, direct seeded rice (DSR), soil conservation measures, zero budget natural farming etc can help in improving the soil structure along with carbon sequestration as well as saving of groundwater resources. While intensive soil tillage reduces soil organic matter through aerobic mineralization, low tillage and the maintenance of a permanent soil cover (through crops, crop residues or cover crops and the introduction of diversified crop rotations) increases soil organic matter. A no- or low-tilled soil conserves the structure of soil for fauna and related macrospores (earthworms, termites and root channels) to serve as drainage channels for excess water. Surface mulch cover protects soil from excess temperatures and evaporation losses and can reduce crop water requirements by 30 per cent. Special attention must be given to the situation of indigenous communities, risk-coping production systems resilient to land and water.

(ix) Information and communication technology (ICT)

The role of ICT to enhance food security and support farming cannot be ignored. Its role in agriculture which includes use of computers, Internet, geographical information systems, mobile phones, radio and television was endorsed at the World Summit on the Information Society 2005. Agricultural decisions on timely land preparation, planting, weeding, irrigation, harvesting, storage and marketing have always been central concerns to agricultural stakeholders. ICT especially mobile telephones can speed the way farmers in rural areas get, exchange and manipulate information. They rework the way farmers interact with markets and cities. A variety of innovations that integrate ICTs into the dissemination of agricultural information to farmers (Farmers Information Services FIS) have been developed at local, national and regional levels. The use of Kisan Mobile Advisory services (KMAS) by Krishi Vigyan Kendras in which the farmers get message for the relevant crop pest attack or use of various technologies during growth stage of the crop is the example in this respect. The use of Annapurna Krishi Prasara Seva ANGRAU and PJTSAU in Andhra Pradesh and Telangana states is another successful case to meet the information needs of framers.

Why extension rather than another institution for climate change?

Gathering information is expensive. Extension has proven itself to be a cost effective means of bringing about greater economic returns for farmers with significant and positive effects on knowledge, adoption and productivity. Studies of extension productivity report rates of return from 13 to 500 per cent.

A recent study demonstrated that receiving at least one extension visit in Ethiopia reduced smallholders' likelihood of being poor by 10 per cent and increased consumption growth by 7 per cent. Extension is thus a cost-effective tool that can play an important role in dealing with climate change while at the same time helping to increase productivity and reduce poverty.

Recommendations

Extension has a major role to play in helping farmers adapt to and mitigate climate change. To capture this potential role adaptation and mitigation funds could be used to support extension efforts that deliver new technologies, information and education about increasing carbon sequestration and reducing GHG emissions. Traditionally extension has worked to promote new technologies and management techniques, educate farmers and act as a facilitator for rural communities. Now too extension can help link practice in the field to new policies regarding climate change. Considerable 'expert judgment' or accumulated experiences are available in farming communities who live with climate risks over time. The availability of usable science-based climate prediction information needs to be tailored to farmer needs by matching it with traditional practices and incorporating existing local knowledge.

Other Suggested Strategies

- Climate clubs: To promote weather based Agro – Advisories
- Focus should be on sustainable small farm agriculture, especially in rainfed areas, through integrated farming systems approach incorporating components of natural resource management minimizing external costs and maximizing realization through value addition in crops, horticulture, livestock, fisheries etc.
- Full potential of KVKs shall be harnessed for location, farmer and field constraint specific best technology solutions independent of source of technology generation.
- Fully leverage power of ICT for continuous contact with farmers shall be established to provide knowledge & information, empower & facilitate them to demand & access services; redress their concerns & grievances; and capture ground reality for use in policy making & improving delivery through (a) farmers portal (b) Kisan Call Centres (c) Common Service Centres (d) short message services (e) community radio stations etc.
- IIDS (AKPS) - IIDS is a pull and push based system where agriculture related information can be pulled by the farmers using the mobile phones. There is a mobile interface at front end and web interface at the back end. Data would be transmitted through voice, text, images and videos from both end (farmers to expert and back). This system will provide the options to the farmer to subscribe for the various services. Farmer will receive information for only those services for which he has subscribed and has an option at a later date to either select some more services or unsubscribe to some of the existing services. The system will be connected to a centralized database, which would have all information of farm, farmer and previous transactions. Presently this is being used successfully in Telangana and Andhra Pradesh states.
- Convergence of Extension services :– there is a need to identify a village level yield gaps and address the yield gaps using convergence of various departments' services in the identified villages. For each district 2 to 3 adopted villages can be identified and use convergence approach and make them as Pilot Houses.
- Path Breaking methods such as Kalajathas, Extension buses, other folk media shall be used on large scale to deliver the messages effectively
- Public Private Partnerships in the areas of

- Distance Education
  - ✓ Phone in Live Programmes in TV channels
  - ✓ Agriculture news on Daily news papers
  - ✓ Popular articles in monthly agriculture Journals
- Capacity building of Input dealers, NGOs
- Networking of Innovative farmers

CONCLUSION:

Indian agriculture today faces a multipronged set of challenges pressured simultaneously by several sectoral and non-sectoral demands. All this is further aggravated by the extreme weather variations that are being experienced. The majority of farmers are small and marginal landowners who are resource-poor. They are most affected due to their low adaptive capacity and risk-taking ability. By incorporating various adaptation measures in the agriculture system one can increase the resilience and adaptive capacity of the small land holders. Agriculture in a climate change context requires a multi-sectoral and multi-agency approach. Government policies, and the various departments and development agencies need to synchronize their efforts towards achieving sustainable agriculture productivity and food and nutrition security, particularly for the small and marginal farmer.

The ill effects of natural resource exploitation, indiscriminate use of fertilizers and pesticides are well documented and known to the stakeholders. Similarly the scope of up scaling the eco-friendly farm practices for resilient agriculture is also well demonstrated and reported. The strategies for promotion of adaptation measures are also readily available. Only thing required is to connect the dots. Coordination, convergence of activities, participatory planning and preparedness coupled with hand holding support is required by all the stakeholders to convince the small farm holders towards the climate resilient agriculture.

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Sustainable Fodder Resource Management Strategies Adapting to Climate Change – Critical analysis

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Abstract:

India is an agrarian country and generates a large quantity of agricultural wastes in terms of crop residues. Majority of residues are used as animal feed and at the national level, out of 574.3 million tons of dry matter available to livestock, 62.5 per cent is accounted by crop residues. However, a large portion of the crop residues is not utilized and left in the fields. To clear the field rapidly and inexpensively, the crop residues are burnet in situ. Farmers opt for burning because it is a quick and easy way to clear the large quantities of crop residues and prepare the field for the next crop well in time. Biomass burning is a global phenomenon and can be an important contributor to poor air quality worldwide. The present study was under taken to assess the production, requirement and analyzing gap between production and requirement of fodder in India using secondary data from NATP and 19th livestock census. The results revealed that the fodder requirement in India is 883.95 Mt of green fodder and 583.66 Mt of dry fodder whereas the estimated fodder production is 664.73 Mt of green fodder and 355.93 Mt of dry fodder. Hence to minimize the existing gap of 218.22 Mt of green fodder and 227.73 Mt of dry fodder, adequate policy and research level initiatives have to be taken to strengthen the existing fodder

resources. Apart from production shortage of dry fodder, the other reason that reduces the fodder availability to livestock is burning of crop residues. According to IPCC (Intergovernmental Panel on Climate Change) , 25 per cent of the crop residues are burnt on farm. In the states of Punjab, Haryana and Himachal Pradesh 80 per cent of rice straw was burnt in situ followed by Karnataka (50%) and Uttar Pradesh (25%). Among crops rice straw contributed 40% of the total residue burnt followed by wheat straw (22%) and sugarcane trash (20%). The crop residue burning has environmental impact as it causes atmospheric pollution. Enhanced investments in agriculture and allied sectors could achieve a higher annual growth rate. Though Govt. has implemented some of fodder conservation and management schemes - Yet fodder scarcity is the major concern of the hour. Hence this paper elaborates on various administrative, research and extension strategies for strengthening the existing fodder resources in India.

Introduction:

As per 19th livestock census, India has 512.05 million livestock population of which 190.90 million of cattle, 108.70 million buffaloes, 135.173 million goats and 65.1 million sheep population. One of the notable characteristics Livestock feeding system in India is that almost, two third of feed requirement is met from crop residues. Total available cultivated land is only 152.793 M Ha and where as net sown area is around 141.219 M Ha as of 2012-13 (Agricultural. Statatistics, 2015**).** At the national level, out of 574.3 million tons of dry matter available, 62.5 per cent is accounted by crop residues (Raju, 2011). Land allocation to cultivation of green fodder crops is limited and has hardly ever exceeded 5 per cent of the gross cropped area (GoI, 2009). Hence, the supply of feed has always remained short of normative requirement (GoI, 1976; Singh and Mujumdar, 1992; Ramachandra *et al*.,2007). Birthal *et al*. (2005) have found feed scarcity as the main limiting factor in the task of improving livestock productivity. In production aspect it has been found that the demand for milk by 2020 would be 135-156 Mt (Delgado *et al*., 2001; Parthasarathy *et al*., 2008) whereas the actual milk yield of bovines is reported to be 26-51 per cent below the attainable yield under field conditions (Birthal *et al*., 2005), which otherwise could have been realized with better feeding, breeding and disease management.

Fodder Demand and Supply Scenario in India

Fodder pedestal, cheaper forage and feed techniques are requisite to increase livestock produce as the fodder only comprises 70 per cent of the milk creation rate. Presently, there is stress on accessibility of sum of forage and feed, as cultivated land obtainable for fodder cultivation has been declining. India, currently is facing a mesh shortfall of around 64 per cent feeds, 61.1 per cent green fodder and 21.9 per cent dry crop residues (Dhananjoy Datta, 2013). Most of the studies estimated the gap between feed availability and requirement based on nutritional requirement of livestock (GoI, 1974; Hazra and Rekib, 1991; Singh and Mujumdar, 1992; Pandey, 1995; Singh *et al*., 1997; Ramachandra *et al*., 2007) but yet were not focused on fodder availability from different sources.

As per the computed data from NATP and 19th livestock census it revealed that India is facing fodder scarcity and was observed that the available fodder quality is not good enough and does not meet the feeding standards.

Calculating Fodder Requirement using 2012 livestock census and NATP database:

As per the National Agricultural Technology Project (NATP), which is carried out jointly by the National Centre for Agricultural Economics and Policy Research (NCAP) and the Society for Economic and Social Research (SESR), Delhi, the design of the feed consumption survey was developed. Based on the survey, per day feed requirement of different species of livestock in terms of green fodder, dry fodder and concentrates was calculated and depicted in Table 1. Though estimated feed requirement rates (Table 1) appeared to be small, total quantity of each type of feed when estimated for country's entire livestock population turned out to be enormous. Based on 19th Livestock Census and feed requirement rate (Table 1) for different species, a total feed requirement in terms of 883.95 Mt of green fodder, 582.66 Mt of dry fodder and 57.61 Mt of concentrates was arrived. The feed requirement in terms of dry matter, green fodder, dry fodder and concentrates for different livestock species is given in Table 2.

Table 1. Consumption value of different species of livestock (Kg/animal/day)

Species		Green fodder	Dry fodder	Concentrates
Cattle	In-milk	4.75	5.50	0.64
	Dry	3.40	4.02	0.4
	Adult	4.06	6.03	0.33
	Young	2.18	2.13	0.18

Buffalo	In-milk	5.69	6.34	1.05
	Dry	5.44	4.95	0.52
	Adult	4.04	7.47	0.36
	Young	2.29	2.22	0.19
Goat		1.04	0.20	0.06
Sheep		1.01	0.20	0.04
Others		2.35	6.72	0.49

Source: NATP project database.

Table 2. Requirement of dry matter, green fodder, dry fodder and concentrates for different livestock species (Mt/Year)

Livestock		DM Mt / year	GF Mt/year	DF Mt/year	Concentrate
Exotic Cattle	In Milk	36.59 (04.69 %)	30.90 (03.49 %)	28.71 (04.92 %)	3.34
	Others	68.93 (08.83 %)	69.23 (07.83 %)	52.79 (09.06 %)	4.49
Indigenous Cattle	In Milk	75.86 (09.72 %)	64.06 (07.24 %)	59.52 (10.21 %)	6.92
	Others	306.1 (39.23 %)	302.11 (34.17 %)	238.91 (41.00 %)	17.19
Buffalo	In Milk	118.40 (15.17 %)	118.80 (13.43 %)	84.63 (14.52 %)	14.01
	Others	146.65 (18.79 %)	185.67 (21.00 %)	103.73 (17.80 %)	7.75
Sheep		14.48 (01.85 %)	39.18 (04.43 %)	4.51 (00.77 %)	0.95
Goat		13.09 (01.67 %)	74 (08.37 %)	9.86 (01.69 %)	2.96
Total		780.10	883.95	582.66	57.61

Source: Computed from 19th Livestock census and NATP database.

The calculated feed requirement (Table 2) revealed that percentage of feed requirement is high in bovines as it requires half (52.73%) of the green fodder and 65 per cent of the dry fodder. Of the total feed required by the cattle milch cows (in-milk and dry) accounted for around 20.36 per cent of the green fodder and 15 per cent of the dry fodder.

Green Fodder production in India:

Source of green fodder in India is from cultivation of agricultural land, greens produced in forest and from fallow lands. For calculating the availability of greens, five per cent of the gross cropped area is assumed to be used for fodder cultivation and the average yield of 55 t / ha has been considered for the study (Raju, 2011). Hence out of 194.40 total grossed cropped area (Agri. Stat., 2015), 5 per cent will account to 9.72 M Ha, hence 534.6 Mt of green fodder is available. The availability of greens from forest land has been assessed based on the average production potential of 3 t/ ha (Raju, 2011). The green fodder from forest lands is 238.26 Mt obtained from 79.42 million hectare of forest and tree cover (India State of Forest Report (ISFR), 2015) of which 119.13 Mt (50 %) is only available for livestock. The green fodder availability from fallow land is 1 t / ha (Raju, 2011). Fallow land in India is around 11 M Ha, and fodder from fallow will be 11 Mt. Hence, the total green fodder availability from all three sources (cultivation, forest and fallow land) is around 664.73 Mt.

Crop residues contribution to dry fodder in India:

Crop residues are bulky and contain more than 18 per cent fiber. Crop residues comprise straws and stovers obtained after harvesting the crops. Crop residues are the major feed resource for feeding of livestock across all states. Sahai *et al.* (2011) have estimated 253 Mt of crop residue generation in the year 2010, the scenario is not expected to drastically change in near future. The availability of dry matter through crop residues was 176.69 million tons in 1980-81 has increased to 355.93 million tons in 2011-12 registering an increase of 101 per cent over a period of 30 years. In spite of the fact that the Net Sown Area has been constant (142 million hectares), the availability of crop residues has increased over the years. This could probably be attributed to the cultivation of crops of HYV’s, irrigation and other package of practices. The starting of green revolution heralded the introduction of HYV’s of wheat and paddy throughout the country in general and in the states of Punjab, Haryana and Uttar Pradesh in particular resulting in higher grain production and consequently higher availability of straws from these crops. Availability of dry matter through crop residues for the period 1980-81 to 2011-12 is presented in table 3.

Table 3: Dry matter through crop residues for the period 1980-81 to 2011-12 (million tonnes)

Crop Residues (types)	**1980-81**	**1985-86**	**1990-91**	**1995-96**	**1999-00**	**2005-06**	**2011-12**
Fine Straw	95.43	117.03	136.54	145.95	172.70	205.56	252.16
Coarse Straw	62.46	56.38	71.25	62.57	67.28	62.63	44.26
Leguminous Straw	18.80	29.66	35.33	33.35	29.99	50.15	59.51
Total	176.69	203.07	243.12	241.87	269.97	318.34	355.93

Source: NIANP, 2013

Analyzing the Gap between Requirement and production:

Based on feed production and feed requirement calculated as above, India falls short by 219.2 Mt of green fodder and 226.73 Mt of dry fodder. Apart from production shortage of dry fodder, the other reason that reduces the fodder availability to livestock is burning of crop residues. (Sidhu *et al*., 1998, Gadde *et al*., 2009, Mehta, 2004; Pathak *et al*., 2006; Pathak *et al*., 2010). The crop residue burning has environmental impact as it causes atmospheric pollution (Raison, 1979; Ponnamperuma, 1984; Lefroy, 1994). According to IPCC, 25 per cent of the crop residues are burnt on farm. In the states of Punjab, Haryana and Himachal Pradesh 80 per cent of rice straw was burnt in situ followed by Karnataka (50%) and Uttar Pradesh (25%), which can be attributed to the mechanized harvesting with combine harvesters (Gupta *et al*., 2003).

Sustainable Strategies:

Fodder trees and intensive cultivation of fodder crops as resource:

Shrubs and leguminous trees are good source of digestible crude protein (DCP) for supplementary feeding to farm animals. Tree leaves are useful as protein supplements to straws and low protein fodder. Tree leaves are good sources of calcium but low in phosphorus. The nutritive value of shrubs and tree species vary widely due to varying inherent nutritive value between species and within species because of climatic and edaphic conditions, cutting and grazing strategies and the soil in which the plant is growing. Among fodder trees *Sesbania grandiflora* has highest CP content (29.88%) on DMB. With respect to intensive cultivation of fodder trees, *Sesbania grandiflora* with line spacing of 3 ft x 3 ft (12,000 – 12,500 saplings/hectare), produced 7.8 kg/tree/year or 93.6 MT per year per hectare. Further this fodder was fed to lactating crossbred cows under study @ 5 kg fresh forage/day/cow. And there was overall increase in milk yield of 11.97 per cent was observed compared to milk yield without sesbania feeding to the 54 same set of cows. (Pramila, 2014). Hence fodder tree is good source of green throughout the year.

Intensive cultivation of crop can also increase the yield per hectare. With respect to yield the average green fodder yield of lucerne varied from 80-120 t/ha/year, but intensive cultivation has recorded 150-200 tonnes/ha/year or 80-120 kg/gunta/cut at Line spacing of 30 cm apart between rows on ridges (Kantha raju M.K., 2015). Hence sensitizing farmers on intensive cultivation should be carried out.

Policies regarding strengthening sustainable fodder resource in India

1. Karnataka Livestock Development Policy -2010

   Term of coverage of policy is 10 Years. Its main objectives are, qualitative and quantitative improvement in fodder, popularizing and enrichment of crop residues, popularizing silvipasture development through incentives, fodder densification units /fodder banks to be established through PPP models, local bodies/gram panchayats to be supported for establishing fodder tree nurseries and for silvi-pasture development (Government of Karnataka-2010).

2. National fodder policy

   India has proposed a national fodder policy to address the problem of fodder shortages and to boost domestic production. Main agenda of project is to address fodder shortage and framing laws to control crop burning as this would help not only to increase fodder supply but protect environment as well. (Anon., 2017)

3. Establishment of Silvi-pasture system in the bio-mass production:

   The scheme extends financial and technical assistance for the development of Silvipasture on private lands (KisanVana). It has been possible to increase land productivity from 0.5-1.5 tonnes/ha/year to > 10 tonnes/ha/year (10-year rotation) by developing silvipastures.(ICAR, 2010)

4. Development of National Grazing cum-Fodder and Pasture Management Policy- 2013:

Main objective is to ensure optimum productivity of fodder on sustainable basis and to guide focused and effective implementation of pasture management action plans. (NITI Aayog, 2012)

Administrative and research Strategies for strengthening existing fodder resources in India:

The information on fodder resource is important from the perspective of animal nutrition, and also for planning the production/supply of different feed ingredients. So Government has to take necessary steps in Management, conservation and development of fodder and pastures/ grasslands in forests.

Policy Level: The absence of pasture management and grazing policy at national/ state level have rendered the pasture lands, including village common lands and uncultivable waste lands as unproductive. Hence policies to govern the fallow and uncultivable waste land should be implemented.

Institutional Level: There is no designated agency to steer the management of grazing lands and fodder resources in the country. The Forest Departments, in their endeavor to bring 33 per cent land area under forest cover, have been busy in closing the grazing lands for raising plantations – mainly of commercial tree species like Eucalyptus, etc. (NITI Aayog, 2011). Better institutional framework and linkage between institutes with same moto of fodder sustainability should be done.

Resource Level: There is acute deficit of fodder in the country with livestock, especially for those dependent upon open grazing, getting less than 1/5th of the healthy fodder requirement per day. As per estimates, the country's pastures have reduced from about 70 million ha in 1947 to just about 38 million ha in 1997 (NITI Aayog, 2011). Conservation of natural fodder resources like pasture lands should be encouraged.

Research Level: There are a number of research studies pertaining to the productivity and carrying capacity of the grazing lands. However, most of these studies are fragmented and are difficult to apply and not concentrating on drought situations in India. Hence researcher should concentrate on developing drought resistant fodder crops and grasses.

Mapping of ecologically sensitive pastures and development of rehabilitation packages: The ecologically sensitive pastures like the alpine/ subalpine, shola, eastern ghats, arid zones are facing the highest threat due to unsustainable biotic interference. There is lack of records on decrease in these sensitive zones and reason for decrease of same. Hence encouraging mapping technology gives a record on future fodder shortage that can be mitigated by adequate mitigation measures.

Extension Point of View to strengthen Fodder Resource

- Intensive cultivation of crop is good source of fodder at low cost and high yield in small area. Though the average green fodder yield of lucerne varied from 80-120 t/ha/year, but intensive cultivation has recorded 150-200 tonnes/ha/year or 80-120 kg/gunta/cut at Line spacing of 30 cm apart between rows on ridges (Kantha raju M.K., 2015). Hence sensitizing farmers on intensive cultivation should be carried out.
- Intensive cultivation of fodder trees can also be advised to get greens throughout the year and also increase productivity of livestock. Action research on intensive cultivation of *Sesbania grandiflora* with line spacing of 3 ft x 3 ft (12,000 – 12,500 saplings/hectare), produced 7.8 kg/tree/year or 93.6 MT per year per hectare. Further this fodder was fed to lactating crossbred cows under study @ 5 kg fresh forage/day/cow. And there was 12.51 per cent increase in milk yield on feeding sesbania to the lactating cows in the first trial, 11.40 per cent in the second trial and with overall increase of 11.97 per cent compared to milk yield without sesbania feeding to the 54 same set of cows. (Pramila, 2014). Hence fodder tree is good source of green throughout the year.
- Enrichment can increase the nutritive value of the crop residues that can contribute to productivity of animals. Enrichment of straws with molasses(10%), urea(1%), minerals(1%), common salt(1%) and feeding them @5kg per animal can support body maintenance of adult animals (NDDB). Hence providing knowledge on enrichment can increase the utilization of crop residues.

Conclusion:

It is time that a comprehensive National Fodder and Pasture Management Policy is put in place, updated and developed in the form of a concrete scheme under the NITI Aayog towards rehabilitation and enhancement of pastures and fodder resources in the country.

Further in many parts of the country while feeding straws/stover, chaffing practice is not adopted thus leading to wastage as well as more energy expenditure in chewing the unchaffed straw/stover. Mechanism for chaffed feeding should go a long way in reducing the wastage and energy conservation and use for other physiological functions of animals (Ramachandra *et al*., 2005).

Sustainable strategies like intensive cultivation of fodder trees and fodder crops, enrichment of crop residues and new innovative fodder conservation policies should be encouraged.

Enhanced investments, agriculture and allied sectors could achieve a higher annual growth rate. As of now 3.64 per cent annual growth rate was observed during the course of XI plan due to the implementation of 5768 projects in the 11^{th} plan, against a growth rate of 2.46 per cent per annum in the X plan period (RKVY, 2014).

Though Govt. has implemented some of fodder conservation and management schemes - Yet fodder scarcity is the major concern of the hour. Hence more intensive activities need to be planned by GOI and under PPP models - to accelerate growth of livestock population by providing scientific nutrient inputs.

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Climate Change Adaptation and Mitigation – Role of Extension

- *AVR Kesava Rao, Suhas P Wani and Mukund D Patil*

Introduction

Evidences over the past few decades show that significant changes in climate are taking place all over the world as a result of enhanced human activities in deforestation, emission of various greenhouse gases, and indiscriminate use of fossil fuels. Global atmospheric concentration of CO_2 has increased from pre-industrial level of 280 parts per million (ppm) to 400 ppm in 2014. Global projections indicate higher temperature of 1.5 to 4.5°C by the year 2050, as a result of enhanced greenhouse gases. Climate change predictions for India indicate that warming is likely to be above the global mean and fewer very cold days are very likely. Frequency of intense rainfall events and winds associated with tropical cyclones are likely to increase.

The global average surface temperature in 2015 broke all previous records by a strikingly wide margin, at 0.76±0.1°C above the 1961-1990 average. For the first time on record, temperatures in 2015 were about 1°C above the pre-industrial era, according to a consolidated analysis from the World Meteorological Organization (WMO, 2016).

Under the threat of increased greenhouse gases and resultant higher temperatures and uncertainty in rainfall regimes, there is a critical need to communicate climate change scenarios, adaptation and mitigation strategies to all stakeholders particularly farmers and agricultural extension personnel to enhance resilience and also to reduce greenhouse gas emissions.

Climate variability and change in India

Various studies show that climate change in India is real and it is one of the major challenges faced by Indian Agriculture, more so in the semi-arid tropics (SAT) of the country. India ranks first among the countries that practice rainfed agriculture in terms of both extent and value of production. Rainfed agriculture is practiced under a wide variety of soil types, agro-climatic and rainfall conditions. Rainfed agriculture supports nearly 40% of India's estimated population of 1.21 billion in 2011 (Sharma, 2011). The rainfed agro-ecologies cover about 60 per cent of the net sown area of 141 million ha and are widely distributed in the country (DOAC, 2011). Even after achieving the full irrigation potential, nearly 50% of the net cultivated area may remain dependent on rainfall. Changes in climate would affect agriculture directly through abiotic stresses and indirectly through biotic stresses.

Climate change is seen as changes in temperature, increased variability in rainfall, enhanced carbon dioxide concentrations. Climate change is likely to make changes in the length of the rainfed crop-growing period. Rainfed agriculture in India plays a crucial role in ensuring food security for the larger and poorer segment of the population but often it coincides with a high incidence of poverty and malnutrition. Reduction in yields due to climate change is likely to be more prominent in rainfed agriculture and under limited water supply situations. Crop yields in dryland areas of the country are quite low (1-1.5 t ha^{-1}) which are lower by two to five folds of the yields from researchers' managed plots (Bhatia et al., 2006). Current rainwater use efficiency in dryland agriculture varies between 35-45% and vast potential of rainfed agriculture could be unlocked by using available scientific technologies including improved cultivars.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is one of the 15 Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR). It recognizes that opportunities for sustainable productivity increases in the SAT will be firmly anchored on Integrated Genetic and Natural Resource Management (IGNRM) strategies, improved input-output market delivery systems for agricultural produce, and knowledge dissemination through capacity building.

Due to anthropogenic activities, a steady increase in atmospheric turbidity is observed in India. Indian annual mean (average of maximum and minimum), maximum and minimum temperatures showed significant warming trends of 0.51, 0.72 and 0.27°C 100 y^{-1}, respectively, during the period 1901–2007 (Kothawale et al., 2010). However, accelerated warming was observed in the period 1971–2007, mainly due to intense warming in the recent decade 1998–2007. Mean annual temperature of India in 2010 was +0.93°C above the 1961-1990 average and the India Meteorological Department (IMD) declared that 2010 was the warmest year on record since 1901. Mean temperature in the pre-monsoon season (March-May) was 1.8°C above normal during the year 2010.

At the country scale, no long-term trend in the southwest monsoon rainfall was observed, although an increasing trend in intense rainfall events was reported. Goswami et al., (2006) analysed gridded rainfall data for the period 1951-2000 and found significant rising trends in the frequency and the magnitude of extreme rain events, and a significant decreasing trend in the frequency of moderate events over central India during the monsoon seasons. The seasonal mean rainfall does not show a significant trend, because the contribution from increasing heavy events is offset by decreasing moderate events. They concluded that a substantial increase in hazards related to heavy rain is expected over central India in the future. Increased frequency and intensity of extreme weather events in the past 15 years were reported (Samra et al., 2003 and 2006).

A study carried out by ICRISAT under the National Initiative on Climate Resilient Agriculture (NICRA) project described a net reduction in the dry sub-humid area (10.7 m ha) in the country, of which about 5.1 Million ha (47%) shifted towards the drier side and about 5.6 Million ha (53%) became wetter, comparing the periods 1971-1990 and 1991-2004 (Kesava Rao et al., 2013a). Results for Madhya Pradesh have shown the largest increase in semi-arid area (about 3.82 Million ha) followed by Bihar (2.66 Million ha) and Uttar Pradesh (1.57 Million ha). Relatively little changes occurred in AP; semi-arid areas decreased by 0.24 Million ha, which were shifted to both towards drier side (0.13 Million Ha under arid type) and wetter side (0.11 Million Ha under dry sub-humid type). Results indicated that dryness and wetness are increasing in different parts of the country in the place of moderate climates existing earlier in these regions.

Climate change impacts on agriculture

Due to global warming, length of the growing period (LGP) is likely to increase, however due to increase in day and night temperatures, physiological development is accelerated resulting in hastened maturation and reduced yields. Increased nighttime respiration may also reduce potential yields. With global climate change, rainfall variability is expected to further increase. When decrease in rainfall coupled with higher atmospheric requirements due to elevated temperatures, the LGP is likely to shorten. At Nemmikal watershed in the Nalgonda district of Telangana, the LGP has decreased by about 15 days since 1978 and the climate has shifted to more aridity from semi-arid (Wani et al., 2012). Shift in the length of growing period, if not understood by the farmers, generally results in more crop failures due to late season drought (Fig. 1). Present popular varieties of maize and pigeonpea are likely to produce lower yields more often in future.

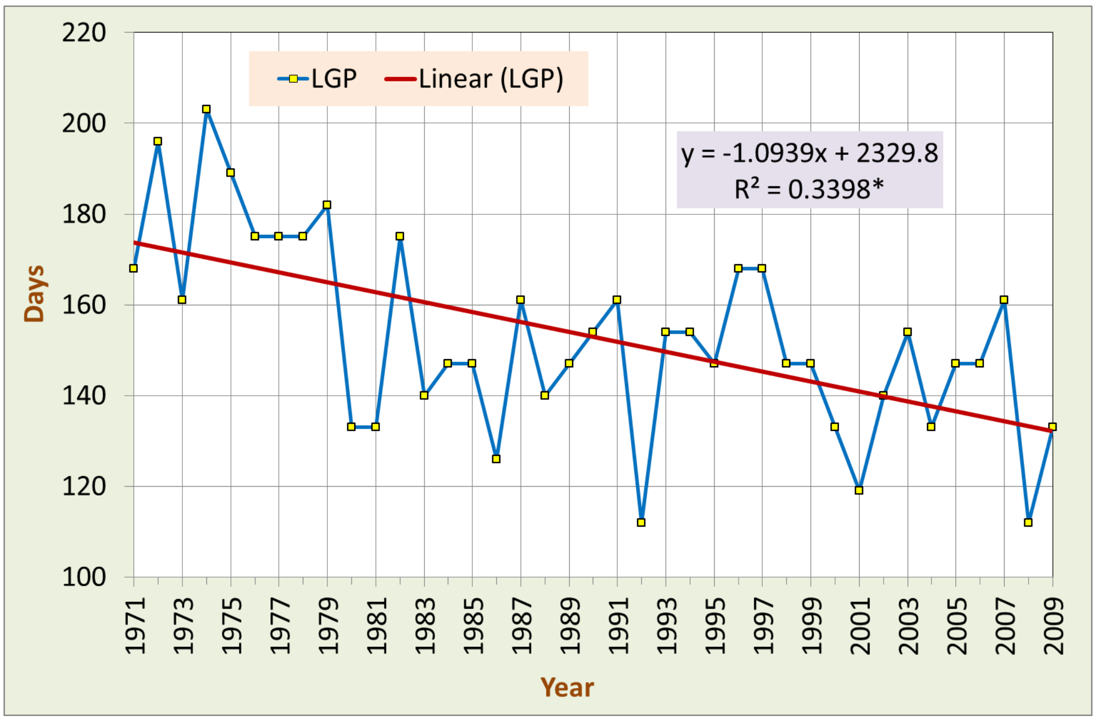

Fig 1: Shift in Length of Rainfed Growing Period at Nemmikal, Nalgonda district

In the Eastern Dry Agroclimatic Zone of Karnataka (consisting of Bangalore and Kolar districts and parts of Tumkur district), there is a perceptible shift in rainfall pattern from July to August and also from September to October (Rajegowda *et al.*, 2000). If sowing is done in July, crops would suffer from moisture stress due to the reduction in rainfall during September and also the crop grown would be caught in October rains causing considerable loss in the grain yield. Thus, sowing of crops (long duration variety crops of about 115 days) could be done during August preparing the land using June and July rains. In the years of early onset of southwest monsoon, sowing can be recommended during last week of July also. Crops sown during August would reach the grand growth period during October. As October receives higher rainfall the crop in its grand-growth period would not suffer for want of moisture and higher crop yields are expected.

Rise in the mean temperature above a threshold level will cause a reduction in agricultural yields. A change in the minimum temperature is more crucial than a change in the maximum temperature. Grain yield of rice, for example, declined by 10% for each 1 °C increase in the growing season minimum temperature above 32 °C (Pathak et al., 2003). Climate change impact on the productivity of rice in Punjab (India) has shown that with all other climatic variables remaining constant, temperature increases of 1 °C, 2 °C and 3 °C, would reduce the rice grain yields by 5.4%, 7.4% and 25.1%, respectively (Aggarwal et al., 2009).

Field experiments and lab analyses were conducted at IARI, New Delhi in 2005, with five high-yielding rice varieties including aromatic and non-aromatic types, exposed to twelve different diurnal temperature (day/night) and radiation regimes to ascertain the impact of diurnal temperature and radiation changes on yield and yield components of aromatic and non-aromatic rice varieties in the field conditions and to document their effect on the grain and seed quality. Salient results indicate that the grain yield of all the five varieties was most significantly influenced by MNT ($P < 0.001$), followed by radiation ($P < 0.001$), explaining 87% and 77% of the yield variation respectively (Anand et al., 2015). Highest yields were recorded around a very narrow optimum temperature of 23°C to 24°C, with subsequent increase in temperature even by 1°C or 2°C, significantly reducing the grain yield.

Surface air temperature and diurnal temperature ranges are likely to increase along the high-ranges of the Western Ghats region of India and under such conditions; there is a threat to thermo-sensitive crops like black pepper, cardamom, tea, coffee, cashew and other plantation crops.

ICRISAT studied the effects of climate change on crop growth, development and productivity using crop models (DSSAT and APSIM) under different climate change scenarios. The simulation outputs indicate that climate change in the dryland regions characterized by existing high temperature will reduce crop sorghum crop duration by 15 days in Maharashtra. Increase in temperature causes reduced radiation interception, harvest index, biomass accumulation and increasing water stress in plants as a result of increased evapotranspiration demand. Temperature increase of 3.3°C, which is expected to take place by the end of this century, is likely to reduce sorghum crop yields by 27% at Parbhani, Maharashtra.

Groundnut modelling results at ICRISAT, Patancheru have shown that in SAT Alfisols, if a dry spell occurs for more than 15 consecutive days, during the 25-day period between 35 and 60 days after sowing, groundnut yields could be reduced by 35-38 per cent of the potential yield. Crop-growth simulation studies at ICRISAT have shown that groundnut pod yield would reduce by 9 to 13 per cent under projected climate scenarios (Table 1). Crop growth simulations using Agricultural Production Systems Simulator (APSIM) showed that in Gulbarga, Karnataka increase in temperature by 2°C could reduce pigeonpea yields by about 16% (Kesava Rao et al., 2013b). Rainfall decrease of 10% from present coupled with 2°C increase in temperature could reduce yields further by 4%, making the total reduction to be at 20%. Crop-growth simulationhas shown that pigeonpea yields would reduce by about 11 per cent under projected climate scenarios. In both crops, more runoff is likely which will lead to more soil erosion and nutrient loss.

Table 1: Impacts of projected climate on groundnut yields at ICRISAT

CC Scenario	**Pod / Seed yield (kg ha^{-1})**	**Change in Pod / Seed yield (%)**	**Total Dry Matter production (kg ha^{-1})**
Groundnut on Alfisols			
Current	2000	-	5430
HadGEM2-ES	1820	-9	5410
GFDL-CM3	1830	-9	5350
CNRM-CM5	1750	-13	5250

At Guna, Madhya Pradesh, grain yield of soybean would reduce by 14% with increase in temperature by 2 °C and further reduce by 5% when coupled with reduced rainfall of 20%. At Guna, wheat crop duration would reduce by 10 days with increase in temperature of 2 °C. The increase in temperature by 2 °C would reduce the grain yield by 29%.

Climate change affects dynamics and interaction among species and it will affect and change the pattern of pest damage and pest control strategies. Increase in temperature may increase the need for application of pesticides and may reduce pesticide effectiveness and increase residues. Using the 'Rice FACE' facility in northern Japan, Kobayashi et al., (2006) studied the effect of 200–280 ppm above-ambient CO_2 on rice blast and sheath blight disease for three seasons. Severity of leaf blast (*Magnaportheoryzae*) was consistently higher at the elevated CO_2 levels in all the three years assessed at two different stages of rice growth. Global warming will lead to earlier infestation by *Helicoverpa armigera*(Hub.) in North India (Sharma, 2010), resulting in increased crop loss. Rising temperatures are likely to result in availability of new niches for insect pests. Climate change is likely to make sleeper weeds to become invasive and favours expansion of weeds into higher latitudes and altitudes.

Pest-warning systems are key elements of Integrated Pest Management (IPM) efforts to reduce excessive use of chemical pesticides. The five components of an IPM program are prevention, monitoring, correct disease and pest diagnosis, development and use of acceptable thresholds, and optimum selection of management tools (Das et al., 2011). The management strategies available include genetic control, cultural control, biological control, and chemical control. Weather based pest and disease forewarning systems help farmers to avoid the risk of outbreaks of economically damaging crop pests and diseases by applying pesticides and fungicides, only when it is absolutely essential.

Climate-smart Agriculture (CSA)

Climate-smart agriculture (CSA), as defined and presented by the FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, contributes to the achievement of sustainable development goals. Climate-smart agriculture is a way to achieve short-and-long-term agricultural development priorities in the face of climate change and serves as a bridge to other development priorities. It seeks to support countries and other actors in securing the necessary policy, technical and financial conditions to enable them to:

1. Sustainably increase agricultural productivity and incomes in order to meet national food security and development goals
2. Build resilience and the capacity of agricultural and food systems to adapt to climate change
3. Seek opportunities to mitigate emissions of greenhouse gases and increase carbon sequestration

These three conditions (food security, adaptation and mitigation) are referred to as the "triple win" of climate-smart agriculture. Climate-smart agriculture includes practices and technologies that sustainably increase productivity, support farmers' adaptation to climate change, and reduce levels of greenhouse gases. Climate-smart approaches can include many diverse components from farm-level techniques to policy and finance mechanisms.

Climate adaptation refers to the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, to take advantage of opportunities, or to cope with the consequences. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

Climate adaptation

Adaptation strategies need to be identified properly for increasing resilience of agricultural production to climate change. Several improved agricultural practices are evolved over time in various regions of the country. Management practices that are being followed under conditions of weather aberrations could also become potential adaptation strategies for climate change.

Resilience to climate change requires identifying climate smart crops and management practices and degree of awareness of community. Intercropping with grain legumes is one of the key strategies to improve productivity and sustainability of rainfed agriculture. Productive intercropping options identified to intensify and diversify rainfed cropping systems are:

- Groundnut with maize

- Pigeonpea with maize
- Pigeonpea with soybean

Some of the other initiatives are ridge planting systems; seed treatment; Integrated Pest Management (IPM); adoption of improved crop varieties and production technologies; promoting community-based seed production groups and market linkages. Farmers need to be encouraged to practice seed treatment with Trichoderma spp. and fungicides for managing seedling diseases and IPM options for controlling pod borer in chickpea and pigeonpea. Improved water use efficiency through IWM is the key in rainfed agriculture. Alternative sources of irrigation water are the carefully planned reuse of municipal wastewater and drainage water.

Climate mitigation

Strategies for mitigating methane emission from rice cultivation could be alteration in water management, particularly promoting mid-season aeration by short-term drainage; improving organic matter management by promoting aerobic degradation through composting or incorporating it into soil during off-season drained period; use of rice cultivars with few unproductive tillers, high root oxidative activity and high harvest index; and application of fermented manures like biogas slurry in place of unfermented farmyard manure.

Methane emission from ruminants can be reduced by altering the feed composition, either to reduce the percentage which is converted into methane or to improve the milk and meat yield. The most efficient management practice to reduce nitrous oxide emission is site-specific, efficient nutrient management. The emission could also be reduced by nitrification inhibitors such as nitrapyrin and dicyandiamide (DCD).

Direct Seeded Rice (DSR) is an alternative method that can reduce the labour and irrigation water requirements. In the face of increasing population and growing demand for food, the upgrading of rainfed areas through DSR can help in soil and water conservation and deal with risks arising from climate change. Conservation agriculture technology helps to cope up with climate change impacts.

Legume-based systems are more sustainable than cereal only systems on Vertisols. Several soil and crop management practices affect C sequestration in the soil. Among them, conservation tillage, regular application of organic matter at high rates, integrated nutrient management, restoration of eroded soils, and soil and water conservation practices have a relatively high potential for sequestering C and enhancing and restoring soil fertility in the longer-term.

Leaf Colour Chart (LCC) is an easy-to-use and inexpensive tool for determining nitrogen status in plants. Use of the LCC promotes timely and efficient use of N fertilizer in rice and wheat to save costly fertilizer and minimize the fertilizer related pollution of surface water and groundwater. It is a promising eco-friendly and inexpensive tool in the hands of the farmers.

Renewable energy and farming are a winning combination. Wind, solar, and biomass energy can be harvested forever. Among various renewable sources of energy, biomass, which is produced right in the villages, offers ample scope for its efficient use to carry out domestic, production agriculture, livestock rising and agro-processing activities through thermal and bio-conversion routes. Usage of solar energy is slowly increasing in rural India for solar cookers for cooking, solar drier for drying agriculture produce, solar water heaters and solar photovoltaic systems for pumping devices which are used for irrigation and drinking water.Farmers can lease land to wind developers, use the wind to generate power for their farms, or become wind power producers themselves.

ICRISAT's Hypothesis of Hope to address climate variability and change

ICRISAT's research findings showed that Integrated Genetic and Natural Resources Management (IGNRM) through participatory watershed management is the key for improving rural livelihoods in the SAT (Wani et al., 2002, 2003 and 2011). Even under a climate change regime, crop yield gaps can still be significantly narrowed down with improved management practices and using Germplasm adapted for warmer temperatures (Wani et al., 2003, 2009 and Cooper et al., 2009). Some of the climate resilient crops are short-duration chickpea cultivars ICC 96029 (Super early), ICCV 2 (Extra-early) and KAK 2 (Early maturing); wilt resistant pigeonpea hybrid (ICPH 2671) with a potential to give 80% higher yields than traditional varieties and short-duration groundnut cultivar ICGV 91114 that escapes terminal drought.

Integrated Watershed Management (IWM) comprises improvement of land and water management, integrated nutrient management including application of micronutrients, improved varieties and integrated pest and disease management for substantial productivity gains and economic returns by farmers. The goal of watershed management is to improve livelihood security by mitigating the negative effects of climatic variability while protecting or enhancing the sustainability of the environment and the agricultural resource base. Greater resilience of crop income in Kothapally, Ranga Reddy district (Telangana) during the drought year 2002 was indeed due to watershed interventions. While the share of crops in household income declined from 44% to 12% in the non-watershed project villages, crop income remained largely unchanged from 36% to 37% in the watershed village (Wani et al., 2009).

Agroclimatic analysis at watershed level (Rao AVRK et al., 2008) coupled with crop-simulation models, and better seasonal and medium duration weather forecasts, help build resilience to climate variability / change. Farmers need to be encouraged to enhance soil quality and fertility through composting of organic wastes; and to promote cultivation of Leucaena, *Hardwickiabianta* and Glyricidia on farm bunds. Governments may also consider promoting and incentivizing the soil and water conservation measures taken by farmers. An improved agromet advisory service at the local level along with associated weather insurance packages is a sure way to enhance the resilience of poor farmers in the context of climate change. Policy interventions are needed to mitigate the climate change effects and Governments have to be proactive in developing adaptation strategies for those sectors like agriculture, water resources, forestry and biodiversity which are highly exposed to the future climate changes and have a significant impact on livelihoods.

ICRISAT's principle to improve the livelihoods of small-holder farmers even under future climate change scenario is built on the concept of Inclusive Market Oriented Development (IMDO), which is a Dynamic Development Pathway consisting of innovative environment, inclusive and market oriented.

Innovative Extension Systems for Climate Resilient Agriculture

Climate change adaptation involves adjustments to decrease the vulnerability of agriculture to current climate variability and to future changes. Farmers have traditional knowledge on sowing and harvest times and crop management practices. Farmers may not have the necessary information of possible climate adaptation options without an effective network of extension services that can filter knowledge gained through science to grass roots. In addition, it is necessary that farmers possess the necessary skills to implement an alternative production technique. Under the climate change scenario, due to uncertainty in rainfall conditions and occurrence of extreme weather, farmers need to be supported with both climate and weather information for sustainable crop production.

Agriculture extension system plays very important role in enhancing the knowledge and skills of farmers for improving agricultural productivity as lack of awareness among farmers about good agricultural practices is always been a key limiting factor for improving productivity levels. Thus, there is a clear and distinct role for strengthening extension services in agriculture to enhance farmer awareness of potential adaptation response options. Agricultural extension personnel are the main stakeholders to communicate with the farmers on how to cope with climate change through adaptation strategies. There is a need to develop appropriate training modules for the agricultural extension staff on the science of climate change and the various adaptation and mitigation strategies available in the universities, research institutes and the government departments. In this way, extension personnel will be acquainted with knowledge on climate change. Seminars / Workshops need to be organized frequently on climate change and extension personnel should be given the privilege to attend so that they can acquire required skills to help farmers.

The other dimension of extension system is knowledge delivery pathways (KDP). The tradition ways to delivery information are through announcements, info-graphics (wall writing or banners), and scheduled programs on television and radio, which still are effective option for mass communication. Often, farmers require information about weather, good agricultural practices, insect/pest identification and their control, where to purchase the input and where to sell the produce. But, this information should come at the time when it is actually needed, for which the traditional KDP are inadequate to provide this solution. Therefore, it is important to rejuvenate the existing Agricultural Extension Systems with innovative ICT models for knowledge generation and dissemination to make them truly innovative.

Information communication tools have provided the wide range of options to assist extension agents as well as farmer for getting up-to-date knowledge. Government of India and private companies are transforming the AES. There are several technologies are being used for information dissemination. For example, Government of India has Kisan Call Center (KCC) facility to satisfy information request as per farmers demand in 22 local languages. Karnataka State Natural Disaster Management Center is provider service to its subscribers in state to receive daily weather update including alert about abnormalities in weather. In addition to Government, private companies are also providing innovative solutions for agriculture extension. For example, IFFCO Kisan Sanchar Limited has introduced voice messages for agro-advisory system and Thomson Reuters introduced mobile based integrated agro-advisory system 'Reuters Market Light'. Information updates obtained from such advisory system allow farmers to take decision regarding various farm operations, which eventually help farmers to cope to climate variability and change.

Thus, the key strategies required for climate smart agriculture include training of extension staff to acquire the new knowledge and skills in climate risk management, setting up of emergency management unit by extension agencies, dissemination of innovations strategic research on best practices and building resilience capacities of vulnerable people in climate risk management, providing feedback to government and interested agencies with situation reports on various causes of climate change and its effects (Iqbal Singh and Jagdish Grover, 2013). Adaptation to climate variability and change must become an important policy priority to the Government and effectively be mainstreamed into national, provincial, local and sectoral development agendas (IPCC, 2011). There is a clear and distinct role for strengthening extension services in agriculture to enhance farmer awareness of potential adaptation response options. For an effective extension system a combination of on-field demonstration through farmers' participation, dissemination of results through conventional delivery pathways, and advance ICT for faster and interactive service is required so that gap between available information on climate change mitigation option and farmer impacted by climate change will be reduced. Enabling the farmers on the options to adapt also requires that other factors first be in place. In particular, investment in institutional support to promote the dissemination of knowledge through extension is important (Kurukulasuriya and Rosenthal, 2013).

Paris Agreement to combat climate change

The United Nations Framework Convention on Climate Change came to a landmark agreement on December 12, 2015 in Paris. The Paris Agreement was signed by 196 nations and is the first comprehensive global treaty to combat climate change, and will follow on from the Kyoto Protocol when it ends in 2020. It will enter into force once it is ratified by at least 55 countries, covering at least 55% of global greenhouse gas emissions.

The agreement commits nations to keep temperatures well below 2 °C above the pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C. The French foreign minister Laurent Fabius, President of the COP21 summit has stated that “This agreement is differentiated, fair, durable, dynamic, balanced, and legally binding”.

In order to create more vibrant and resilient communities and natural resources-dependent economic sectors able to mitigate and adapt to the risks associated with climate variability and change, there is a critical need to develop a “climate-literate society.” People must gain a better appreciation of how a changing climate is likely to impact their own lives, local ecosystems, regional industries and society at large (Sea Grant Climate Extension Summit Report, 2013).

Let us join together to strengthen the Extension System to help manage the risks posed by climate variability and change for achieving sustainable agricultural production and better livelihoods.

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Theme V Peace and wellbeing of Farming Communities

NEVER BLAME THE NATURE

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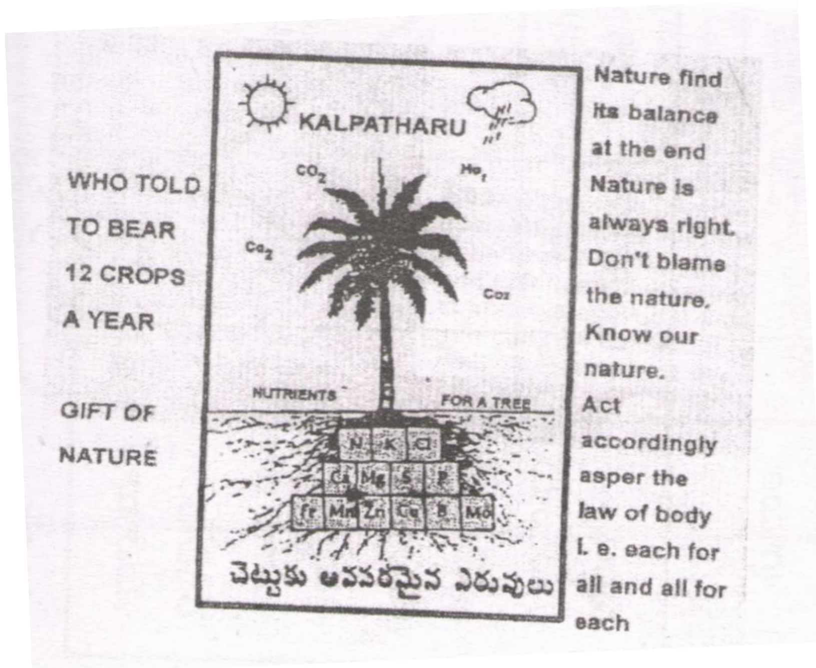

The most important part of being a good facilitator is having the right attitudes and behaviour. Honesty, humility, open mindness, sincerity, compassion and respect; the key qualities which are difficult to define or measure and much more difficult to instill in a person. People carrying out participatory activities are in need of attitudinal and behavioural change. Education for all and forever" is the need forever.

Education approach is the answer: the imbalance cum improper doses of fertilizers is not only leading to high cost but also result in environmental pollution including the produce. why this highly imbalanced fertilization with very high doses of n and p and very little or nil doses of k. Because of unhealthy competition, false prestige, over ambition, lack of conviction coupled with lack of proper knowledge and understanding the need and importance of balanced fertilization. Even some of the farmers do not know the difference between an advertisement and a recommendation, result in over doses due to attractive advertisement with incentives, forgetting the principles of diminishing returns. All the extension activities be educative in nature. The extension has to play the role of a saint in helping the society through educating the masses on spiritual, moral, technical aspects in a harmonious way for overall development.

Always remember and fallow the four great principles of extension as per Mildred Harton.

To reach the higher levels of living, people must be educated and trained to meet their responsibilities in relation to GOD, to their Neighbors and to themselves.

Fertilizer adoption pattern to paddy, sugarcane, cotton, chilli, groundnut and wheat

Crop- Village-District	Nutrients applied in kg/ha (recommended)			
	Nitrogen	**Phosphorous**	**Potassium**	**Total**
Paddy-Tubadu-Guntur	153(100)	115(60)	12(60)	280(220)
Paddy-Julepally-Kurnool	290(160)	240(60)	53(60)	583(280)
Paddy-Reddypalem-Mahaboobnagar	190(80)	105(40)	0(30	295(150)
Paddy-Near Anakapalli-Visakapatnam	168(80)	52(60)	15(50)	235(190)
Paddy-KVK Villages-Srikakulam	115(60)	38(30)	10(30)	163(120)
Paddy-Dhalian-Ludhiana	195(120)	43(30)	37(30)	275(180)
Paddy-Nadathara-Kerala	222(90)	50(45)	125(45)	397(180)
Sugarcane-Near Anakapally-Visakapatnam	252(112)	50(100)	23(120)	325(332)
Sugarcane-Komari-Srikakulam	310(112)	57(100)	150(120)	517(332)
Cotton-Tubadu-Guntur	152(120)	202(60)	50(60)	404(240)
Cotton-Komarada-Vizianagaram	160(120)	75(60)	37(60)	272(240)
Chilli-Tubadu-Guntur	420(160)	307(60)	30(60)	757(280)
Chilli -Chinamurapaka-Srikakulam	250(150)	90(50)	50(60)	390(260)
Groundnut-Kusalapuram-Srikakulam	62(30)	67(40)	0(50)	129(120)
Groundnut-Vadada-Srikakulam	80(30)	57(40)	0(50)	137(120)
Wheat-Dhalian-Ludhiana	172(120)	72(60)	0(30)	244(210)

Fertilizer adoption pattern to paddy in Tubadu village

Time of application	Nutrients applied in kg/acre (range)			
	N	P	K	Total
Basal	20 (9.6-34)	18(9.6-34)	0.4(0-9.6)	38.4
First dose	25.2(8.4-33.2)	16.5(0-34)	2(0-25.5)	44
Second dose	14.4(0-33.2)	11.2(0-23.2)	2(0-12)	27.6
Third dose	1.6(023.2)	-	0.4(0-12)	2.0
Total	61.2	46	4.8	112
Recommended	40	24	24	88
Difference	21.2	22	-19.2	24

“ALWAYS RESPECT AND LOVE THE NATURE AND NEIGHBOR”

"Ethics and values in Extension services" –Some thoughts and considerations in the changing paradigm

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Introduction:

Agriculture, which is a key contributor to human livelihood in most parts of the world has undergone significant changes from simple cultivation of crops and rearing of livestock, and has today become intertwined with technological advances such as the "new biotechnologies" – genetic engineering, cell fusion, tissue culture and cloning. On a daily basis we encounter innovative technological discoveries which come with the promise of increased efficiency and productivity resulting from products and processes derived from research and consequently they have become high-priority issues in shaping the future of agriculture.

Today many large corporations, undertaking pioneering research, contribute to a large body of agricultural inventions. However, the implementation of these technologies has met with considerable controversy and concern to many people across the world. Not only are the views and opinions conflicting at a scientific level, but also in terms of ethical and moral issues surrounding their use. Ethical issues are of particular interest with respect to genetic engineering and animal cloning. Existing values and systems and traditional concepts of nature and human identity are being challenged. Because agriculture is characterized by practices that involve both social and ecological systems, ethical issues and practices in agricultural research have gained prominence.

With the advancements in biotechnology, that provide scientists with the means to irreversibly change 'human nature', ethical issues and concerns are far reaching, as they concern nature and environment, human health, animal welfare, sustainabilityof modern agriculture, socio-economic development, access to resources, and professional and scientific responsibility for research.

Ethics and values in definition:

When most people think of ethics (or morals), they think of rules for distinguishing between right and wrong, such as the Golden Rule ("Do unto others as you would have them do unto you"), a code of professional conduct like the Hippocratic Oath ("First of all, do no harm"), a religious creed like the Ten Commandments ("Thou Shalt not kill..."), or a wise aphorisms like the sayings of Confucius. This is the most common way of defining "ethics": **norms for conduct** that distinguish between acceptable and unacceptable behavior.

Most people learn ethical norms at home, at school, in church, or in other social settings. Although most people acquire their sense of right and wrong during childhood, moral development occurs throughout life and human beings pass through different stages of growth as they mature. Ethical norms are so ubiquitous that one might be tempted to regard them as simple commonsense.

Ethics, simply put, refers to the rightness or wrongness of actions. Persons, groups, or institutions act ethically when they do “the right thing,” and act wrongly when they do “the wrong thing.” Ethical criteria are distinct from the law, although laws frequently follow or embody certain ethical criteria (e.g., laws against murder or against “cruel and unusual punishment”). Other people find the basis of ethics in customs or culture. But there are things certain people condone that are not ethically permissible on any rational criteria (e.g., torturing some citizens for the entertainment of the masses or engaging in slave trade). There also are activities some people engage in that are culturally “wrong” but not unethical (e.g., not removing one’s shoes when entering a traditional Japanese home).

Yet other people want to base ethics on religion. Historically, ethics and religion have been aligned closely because the ethical values of many cultures have evolved within religious traditions. These traditions have been prime repositories, incubators, and champions of virtue and moral character. But what is ethically right or wrong is not necessarily identical to what a particular religion teaches. Thus, although many ethical prescriptions and proscriptions may be taught and fostered through religions, there are ethical “rights” and “wrongs” that are independent of any religious tradition.

Bioethics

In the field of ethics, moral standards that govern the appropriate conduct for an individual or group of individuals are termed bioethics, and can be defined as: “a method, procedure, or perspective, or norms of conduct that distinguishes between acceptable and unacceptable, right or wrong, behaviour”. This subfield of ethics, known as bioethics, is an integrated discipline that addresses ethical issues in life sciences.

The four fundamental principles of bioethics include:

1. Beneficence which refers to the practice of good deeds;

2. Non maleficence which emphasizes an obligation to not inflict harm;

3. Autonomy which recognises the human capacity for self-determination and independency in decision-making; and

4. Justice which is based on the conception of fair treatment and equity through reasonable resolution of disputes.

Research ethics

Research ethics can be described in terms of ethics of the topics and findings (morality) and secondly as ethics Agricultural ethics is an emerging discipline which is principally concerned with topics involving public policy. Agriculture – ethical approaches contrasts the traditional concept of moral philosophy and applied ethics. When we try to face specific ethical challenges in complex societies and comprised systems for example agriculture, the traditional concept of moral theory fails to bring forward adequate solutions to the identified problem. Therefore, ethical designs are necessary which take the problem's specific characteristics and its given normative implications into consideration (applied ethics).

Reasons for ethics

There are several reasons why it is important to adhere to ethical norms in research.

First, norms promote the aims of research, such as knowledge, truth, and avoidance of error. For example, prohibitions against fabricating, falsifying, or misrepresenting research data promote the truth and minimize error.

Second, since research often involves a great deal of cooperation and coordination among many different people in different disciplines and institutions, ethical standards promote the values that are essential to collaborative work, such as trust, accountability, mutual respect, and fairness. For example, many ethical norms in research, such as guidelines for authorship, copyright and patenting policies, data sharing policies, and confidentiality rules in peer review, are designed to protect intellectual property interests while encouraging collaboration.

Third, many of the ethical norms help to ensure that researchers can be held accountable to the public. For instance, federal policies on research misconduct, conflicts of interest, the human subjects protections, and animal care and use are necessary in order to make sure that researchers who are funded by public money can be held accountable to the public.

Fourth, ethical norms in research also help to build public support for research. People are more likely to fund a research project if they can trust the quality and integrity of research.

Finally, many of the norms of research promote a variety of other important moral and social values, such as social responsibility, human rights, animal welfare, compliance with the law, and public health and safety

Ethical Principals

The following is a rough and general summary of some ethical principals that various codes address:

1. Honesty
2. Objectivity
3. Integrity
4. Carefulness
5. Openness
6. Respect for Intellectual Property
7. Confidentiality
8. Responsible Publication
9. Responsible Mentoring
10. Respect for colleagues
11. Social Responsibility
12. Non-Discrimination
13. Competence
14. Legality
15. Animal Care
16. Human Subjects Protection

Method for Addressing Ethical Issues

There are three main secular ethical traditions, or what ethicists refer to as theories because they provide justifications/explanations. Whereas scientific theories justify/explain facts, ethical theories justify/explain the rightness or wrongness of certain kinds of actions.

1. Rights theory. This theory holds that individuals have rights (i.e., justifiable claims against others that others do or do not treat them in certain ways). Rights theory is based on the idea that individuals are entitled to not be harmed against their will— "harm" meaning both physical harm and damage to property and interests. If an action causes or will cause harm to individuals, rights theory declares this action unethical, and no benefits (or a very limited set of benefits) can override this determination.

2. Utilitarian theory. Utilitarianism is a "consequentialist" theory, which means that right and wrong are determined not by appeal to some absolute limit (e.g., rights), but by taking into account all the consequences of action. There are different interpretations of what counts as a good or bad consequence, but in its most general sense, utilitarianism holds that persons should always act to maximize beneficial consequences and minimize harmful consequences. As it is sometimes put: Ethical actionsproduce "the greatest good for the greatest number of potentially affected living beings." In practice, this usually means attempting to produce "net benefits"—more beneficial consequences than harmful ones. This "caveat" is based on the recognition that most (if not all) actions have some potentially harmful implications, even if unintended.

3. Virtue theory. This theory holds that ethically we ought to act in accordance with a set of ideals or character traits—the kinds of traits a just, fair, good person would exhibit through his or her actions. An action that either fails to follow these ideals, or puts other people in a position such that they cannot follow their ideals, is wrong. Indeed, not following virtues, or preventing others from following virtues, is harmful to oneself and others.

Ethical theorists differ about which of these three theories provides the best standard or criterion for judging right and wrong. Sometimes, differences are overcome using the following procedure. Choose one of the three theories; using it as a basis, determine its implications for an action about to be taken. Then, apply a second theory. Determine what it implies about the action. Repeat the procedure with the third theory. If all three theories converge on the same conclusion, there are good reasons to think that that conclusion is the ethically justifiable one.

Basic values:

Mutual esteem and partnership is the ethical frame of reference. To be authentically human in the spirit of our great religious and ethical traditions means the following: we need mutual respect, partnership, and understanding, instead of patriarchal domination and degradation, which are expressions of violence and engender counter-violence. Every individual has intrinsic dignity and inalienable rights, and each also has an inescapable responsibility for what she or he does and does not do.

Values and principles

Utilitarianism

There is an acknowledged tendency to apply utilitarian ethics in the approach to agriculture and natural resource policy - for a century agricultural research has been implicitly defined by the values of productivity and efficiency, values typical of the utilitarian model of moral responsibility.

Human Rights

According to a different approach the individual and their rights should be a starting point for any kind of moral consideration. This is the so-called “rights based approach” that stresses the importance of human rights. Respectively, a rights based approach to food holds that people have a fundamental right to be free from hunger. The right to adequate food is realized when every man, woman and child, alone or in community with others, has physical and economic access at all times to adequate food or means for its procurement.The right to food is related to the concept of food security. According to the Rome Declaration of 1996 food security will exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Other principles based on fundamental rights and freedoms include those enshrined in the Charter of the Fundamental Rights of the European Union. These are: dignity, freedoms, equality, solidarity, citizen’s rights, and justice.

Other principles

Other principles, important for the field of food and agriculture, are: the principle of sustainability and precaution, both referred to in the Rio Declaration on Environment and Development.

Ethical Matrix

The ethical “checklist” established by Professor Ben Mepham, the so-called Ethical Matrix, relies on the following ethical values: wellbeing, autonomy and justice.One, more widely recognised tool, is the “Ethical Matrix” established by Professor Ben Mempham for the Food Ethics Council. It is a “checklist of concerns, structured around established ethical theory.” It uses a “principled” approach to ethics first developed by US medical ethicists, Beauchamp and Childress.

The Ethical Matrix is based on three ethical principles, respect for wellbeing, for autonomy and for justice. These three principles are not mutually exclusive and they cannot be said to exhaust every legitimate ethical concern. However, most common ethical concerns can be expressed in terms of wellbeing, autonomy or justice. Arguably, they capture key elements of the ‘common morality’, the norms and assumptions that underpin contemporary society. It follows that the common morality is good starting point for discussing ethical issues in food and agriculture. In a sense, it is the lowest common denominator – because few people would disagree with the principles of respect for wellbeing, autonomy and justice – so it can provide a meeting place for different perspectives. But it is important to note that the common morality is the just the starting point, it is not where ethical reasoning ends. The principles provide reference points against which agreements and disagreements, factual uncertainties and differing assumptions can be identified and tested.

Respect for	WELL BEING (Health & Welfare)	AUTONOMY (Freedom & Choice)	JUSTICE (Fairness)
People in the food industry	Income and Working conditions	Freedom of action	Fair trade laws and practices
Citizens	Food safety and quality of life	Democratic, informatics choices	Availability of affordable food
Farm animals	Animal welfare	Behavioural freedom	Intrinsic value
The living environment	Conservation	Maintenance of biodiversity	Sustainability

Fig. 1. Ethical Matrix.(Source: www.foodethicscouncil.org/system/files/Ethical)

Methods of work of extension service

Extension work is realized in application of several methods: individual, group and mass extension methods.

• Individual extension methods represent intensive method of extension work. They are applied in form of house visits and advisory discussions, talks (visit to the farm, field, etc.), practical demonstration methods, farmer going to the extension office, etc.

• Group extension methods provide relatively broad spectrum of influences on beneficiaries of extension services. Types of group extension methods are diverse: expert lectures, group discussions, “field days”, and group extension work in training centres for villagers and farmers, working groups for farmers and so called “extension clubs”, different types of demonstrations of experimental results and new work techniques, expert excursions and trips, mutual (informative) meetings, etc.

• Extension work by way of mass media includes use of television and radio stations, expert brochures, expert articles in newspapers, leaflets, internet, etc. Each of the new media has its own specific traits and depending on these traits they can be used for informing and educating potentially large groups of agricultural producers.

Four paradigms of agricultural extension

Any particular extension system can be described in terms of both how communication takes place and why it takes place. It is not the case that paternalistic systems are always persuasive, nor is it the case that participatory projects are necessarily educational. Instead there are four possible combinations, each of which represents a different extension paradigm, as follows:

• Technology Transfer (persuasive + paternalistic). This paradigm was prevalent in colonial times and reappeared in the 1970s and 1980s when the "Training and Visit" system was established across Asia. Technology transfer involves a top-down approach that delivers specific recommendations to farmers about the practices they should adopt.

• Advisory work (persuasive + participatory). This paradigm can be seen today where government organizations or private consulting companies respond to farmers' inquiries with technical prescriptions. It also takes the form of projects managed by donor agencies and NGOs that use participatory approaches to promote predetermined packages of technology.

- Human resource development (educational + paternalistic). This paradigm dominated the earliest days of extension in Europe and North America, when universities gave training to rural people who were too poor to attend full-time courses. It continues today in the outreach activities of colleges around the world. Top-down teaching methods are employed, but students are expected to make their own decisions about how to use the knowledge they acquire.

- Facilitation for empowerment (educational + participatory). This paradigm involves methods such as experiential learning and farmer-to-farmer exchanges. Knowledge is gained through interactive processes and the participants are encouraged to make their own decisions. The best known examples in Asia are projects that use Farmer Field Schools (FFS) or participatory technology development (PTD).

Ethics in agriculture and in agricultural research

Ethical issues in the field of agriculture have gained prominence largely due to the fact that agriculture is characterised by practices that involve both social and ecological systems. According to experts, agriculture has become an issue of moral concern because of the mismatch between global food supplies and human nutritional needs, the impact of agribusiness on rural employment, the consequences of modern agricultural biotechnologies for human and animal welfare, and the effects of intensive production systems on the sustainability of the global environment.8

Agricultural ethics may be defined as the "systemic thinking about the values and norms associated with the food system – farming, resource management, food processing, distribution, trade and consumption. Agricultural ethics incorporates elements of philosophical ethical analysis with concerns that arise in connection with the food system."

Other authors distinguish between Ethics in Agriculture and Agricultural Ethics. The first approach tends to follow the traditional concept of moral theory. It formulates moral principles and afterwards applies them to aspects of agriculture. As a result the object of investigation (here: agriculture) is subordinated to the abstract moral theory. Although Ethics in Agriculture "succeeds in identifying morally relevant issues by applying abstract concepts like justice, sustainability, responsibility and so forth, it fails to bring forward adequate solutions to identified problems. Its deficiencies are its abstract nature and the lack feasibility which leads to counterintuitive solutions when we try to face specific ethical challenges in complex societies and comprised systems like agriculture."

The other approach (Agricultural Ethics), on the other hand, does not neglect the society's complexity and societal changes. It focuses on the object of investigation, which "is the investigation's center and it frames and conceptualizes the philosophical work". Agricultural ethics, according to this approach, should, principally, be concerned with topics involving public policy. Its aim "should be to devise a coherent and unified ethical framework, which is relevant to the formulation of public policy within the context of a social contract." One example of such a framework is the Ethical Matrix.

Ethical Approaches in Agriculture:

Basically, two different ethical approaches towards agriculture can be found in the relevant literature. Whereas one has the tendency to follow traditional moral theory and apply well reasoned norms to the field of agriculture, the other tries to focus on the subject first in order to frame the debate starting from the object of investigation. The first shall be called Ethics in Agriculture, the second Agricultural Ethics in the following.Authors, who work on Ethics in Agriculture, tend to follow the traditional concept of moral theory. They justify and formulate moral principles on rational grounds and apply them to aspects of agriculture. Roughly spoken, abstract moral theory prevails and the object of investigation appears subordinated. The basic assumption seems to be that well founded norms need application only without adjusting the method of justification to the object of investigation. Although this approach succeeds in identifying morally relevant issues by applying abstract concepts like justice, sustainability, responsibility and so forth, it fails to bring forward adequate solutions to the identified problems. Its deficiencies are its abstract nature and the lack of feasibility which leads to counterintuitive solutions when we try to face specific ethical challenges in complex

The second approach takes society’s increasing complexity and radical societal changes into account. It stresses that we are in need of theoretical designs which take the problem’s specific characteristics and its given normative implications into consideration. Thus, this approach focuses on the object of investigation. It is the investigation’s center and it frames and conceptualizes the philosophical work.

Consequences of Ethical Approaches in Agriculture:

It is of growing concern how often research integrity is currently being challenged, and how common “unprofessional” behaviour seems to be in research today. Research misconduct involves fabrication, falsification, plagiarism and misappropriation. Researchers knowingly or intentionally ignore some of the most fundamental rules of research. Experimental designs and analyses are biased, results are reported inaccurately or incompletely or are fabricated, and improper credit is given to colleagues. Institutions take allegations of research misconduct seriously and have formal procedures to investigate such allegations. Potential misconduct is regarded with seriousness and requires in-depth investigation.

In research that involves animals, adherence to a code of practice that ensures the ethical and humane care and use of animals used for scientific purposes is imperative. It is generally accepted in the scientific community that when animals are used, the principles of replacement, reduction and refinement (3Rs) should be taken into account:

- Replacement requires that wherever possible, techniques that totally or partially replace the use of animals for scientific purposes must be sought;

- Reduction requires that research projects must use no more than the minimum number of animals necessary to ensure scientific and statistical validity and should not be implemented at the expense of greater suffering of individual animals. The use of animals must not be repeated unless essential for the purpose or design of the project; and

- Refinement requires that animals must be suitable for the scientific purpose and that their welfare should be of primary consideration in the provision of their care. Projects should be designed to avoid both pain and distress in animals. If this is not possible, pain or distress must be minimised.

Recommendations:

Here are five recommendations APA's Science Directorate gives to help researchers steer clear of ethical quandaries:

1. Discuss intellectual property frankly
2. Be conscious of multiple roles
3. Follow informed-consent rules
4. Respect confidentiality and privacy
5. Tap into ethics resources

CONCLUSION

Ethical concerns have always been important in agriculture. It is fair to say, however, that ethics has not always been given an explicit place in the structure of organizations dedicated to agricultural leadership, decision making, education, and research. Debate is as essential to good applied ethics as is vigorous peer review and critique to good science. Everyone needs to be affirmative to this issue.

No best practice program in health or interpersonal behavior is formatted as a single-shot, 2-hour information-focused session. If behavior change is the goal of extension education, then knowledge-focused programming must be expanded to include personally relevant, problem-focused, experiential, active learning practices focused on skill building. This will demand that Extension programs move from single session offerings to multi-session series that offer enhanced opportunities for practice, homework, and real-life application.

Itwillbeoneofthe great ironies of our civilization if it suffers great harms because the pursuers and custodians of knowledge chose to avoid admissions of uncertainty when the modesty of science would recommend caution. Without honest technical information, no agricultural ethics is possible. And public support of agricultural sciences may be damaged for many years should some harm come to the public due to exaggerations of scientific certainty.

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PEACE, HAPPINESS AND WELLBEING OF FARMING COMMUNITY

Prof. Dr. S.V.Reddy* and Prof.Dr. P. Venkataramiah**

Happiness is when what you think, what you say and what you do are in harmony – Mahatma Gandhi (Father of Nation). It is neither wealth nor splendor, but tranquillity and occupation, which gives happiness – Thomas Jefferson (American Founding Father)

No Matter how much turmoil and chaos takes place around you, there is always a place for peace, stability and safety at the core of your being. Let us unearth it.

Key words: Extension, Farmers Satisfaction, Peace, Wellbeing, ethics, Sustainability.

AGRICULTURE :PEACE, HAPPNESS & WELLBEING OF FARMING COMMUNITY :

People always aspire for a long, dignified and meaningful life. Some sufferings are unavoidable in every life though there are many external and internal barriers for enjoying happy life. However, better understanding of the nature of happiness and applying certain ideas can help to become happier, more so to provide peace, happiness and wellbeing of farming community.

Individual efforts and government policies in democratic set-up is to bring HAPPINESS. This calls for an attention to focus on research in extension henceforth should be diversified to address the challenges of 21st Century notably on farmers peace, happiness and welfare. May we expect SAUs, MANAGE, EEIs to design new policies and programmes in Agricultural Extension Research?

ROLE OF AGRICULTURE EXTENSION IS THE MISSING LINK:

Agriculture includes several other functions beyond it`s role of producing food and fibre has emerged as a key notion in scientific and policy debates regarding the future of agriculture. The missing link is the role of Agricultural Extension to attain peace, happiness and wellbeing of farming communities in terms of farmers distress,stress management, ethics – values in extension, psycho-social & spiritual awareness and by maintaining quality standards of extension service delivery and Life Style Management.

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HAPPY FARMERS & HAPPY FARMING

Mother earth is calling out for our love and connection to her.Cultivating the land, transforming the elements, harvesting the fruits of the season and observing the rhythms of nature are all practices of understanding, love and mindfulness.

When we sow the seeds, cultivate the land or water the plants we can be happy right at the moment; and the quality of harvest depends on our peace and happiness. The quality of our being, our peace and freedom iscrucial to the practice of farming.

Happy farmers practice to live together in harmony, building brotherhood and sisterhood while cultivating their own spiritual growth in finding meaning and purpose in life. For staying happy for ever, the role of several antidotes cannot be forgotten. Some of those include – Inner peace, positivity, courage, relationship, tolerance, goal setting, potential, life mapping, empathy, compassion and love, work, good friends, positive influence on others,comparison with others, be positive, happiness as a life style and HARMONY.

Happy farming is a collective effort. We practice to farm as a family, as a spiritual community, taking care of each others wellbeing and spiritual growth. Spiritual cultivation and mindfulness training are essential aspects of happy farmers:

The following are the issues / targets set by United Nations to achieve the Sustainable Development Goal (SDG) of peace, happiness and well being of farming community which are discussed in nut shell.

STRESS MANAGEMENT:

Everyone experience stress. Many things can trigger the stress reaction, including danger, threat, news, illness, death of a loved one. It can also come from within. It encompasses techniques intended to equip a person with effective coping mechanisms for dealing with Psychological stress.

COPING MECHANISMS:

1. Self Understanding
2. Self Management

3. Conflict Resolution
4. Adopting amore positive attitude
5. Self Talk
6. Breathing Exercises
7. Meditation
8. Exercise
9. Altering Your Diet
10. Talking more regular and effective rest

Farmers Distress: Farmers Suicides.

Farmers are committing suicides due to various reasons. Government is most concerned and analysing the problem from many angles. Supporting system need to be strengthened by drawing the required attention on the following:

1. Providing on Farm and off Farm Employment
2. Timely Availability and Access to Credit
3. Availability of Quality Inputs
4. Climate Management and Irrigation Input
5. Prices, Marketing and Storage Issues
6. Creation of Awareness among Farmers
7. Building Social Capital to Readdress Insecurity and Vulnerability
8. Access to Health Care and Education and
9. Revitalization of extension services

Mere providing money to the suicide families and rescheduling or wavering of loans etc., is not sufficient to solve the suicidal issue since it has to be looked holistic enough instead of piece meal by developing a new agricultural policy and a perspective sustainable agriculture sector management plan including productivity, management, credit, inputs, marketing etc, for people lead sustainable integrated development, which in turn add to the credibility of extension workers and extension system.

LIFE STYLE MANAGEMENT:

Life style management programme is also referred as a health promotion programme, health behaviour change programme, life style improvement programme or wellness programme. It can target a range of different health concerns and areas, such as physical activity, stress, smoking and nutrition. A health risk assessment is often used as starting point to identify health risks and then target appropriate programme based on results. If the result on stress is high, a stress life style management programme could be recommended to promote behavioural change and reduce the health risks. They can be delivered through a variety of mediums viz, online, telephonically or through a trainer or face to face with a health coach.

A life style including exercise, a well balanced diet and maintain a healthy body and weight reduction may reduce the risk poor health (reduces health risks), improve productivity, reduce the incidence and severity of chronic health conditions and reduces the medical and health costs.

TREATMENT:

Treatment Suggested: Yoga, Taichi or meditation

FARM TO YOGA:

Farm to yoga is an emerging movement. We build community by cultivating networks of collaboration between, yogis and local food enthusiasts. It helps to maintain the physical health and wellbeing of the people who take care of land. Learn techniques and suggested poses from Sadgurusetc., to improve body mechanics, core strength and maintain healthy range of motion in joints and muscles.

ETHICS, VALUES AND QUALITY EXTENSION:

Values and ethics are central to any organisation. Ethics refers to rightness or wrongness of actions. Persons, groups or institutions act ethically when they do the “right thing”, and act wrongly when they do the “Wrong thing”.

The core values in an organisation includes- integrity, professionalism, caring, teamwork etc., Values provide the basis for judgements about what is important for the organisation to succeed in its core business. To behave ethically is to behave in a manner that is consistent with what is generally considered to be right or moral. Ethical behaviour is the bedrock of mutual trust or the public trust for public officials.

Three qualities are important for an individual to Move ethical decisions:

1. Ability to recognise ethical issues and to reason ethical consequences of decisions
2. Ability to look at alternative points of view (reframe) and
3. Ability to deal with ambiguity and uncertainty.
   With this back-drop, encourage extension leaders to pursue their own moral development (Personality development) since they set the moral climate for the organisation of quality of extension services.

QUALITY EXTENSION SERIVCES:

Farmers who regarded as customers in the delivery of extension programmes desire quality benefits from the outcome of extension services. The extension officers are accountable for farmers level of satisfaction, quality and relevance of educational learning programmes. In enhancing farmersloyality and confidence, extension feedback is becoming increasingly paramount. Customer satisfaction survey remains an essential tool for measuring the quality of extension services and outcome of the programme.

PSYCHO-SOCIAL AND SPIRITUAL AWARENSS:

Psychological **:** Emotional, Love, Friendship, Personal

Social **:** Status, relationship, social activity and engagement.

Spiritual **:**Finding meaning and purpose in life

Spiritual awareness is the consciousness of spiritual matters. It is the connection of ones own soul. It is the knowledge of what is happening in the spiritual reaction all around us.

Five ways to increase your spiritual awareness considering the psycho – social factors in finding meaning and purpose in life.

1. Learn to communicate with soul
2. Get plenty of sleep
3. Spend time with nature
4. Stay positive and laugh often
5. Activate your pineal gland

More and more farmer groups be formulated and support the group with information to spread the awareness about the truth of various organisations.We are living amongst to offer new inspiring models, which in turn contribute to a growing awareness in the world. Their consciousness grows, their interestsevalve, the meaning of life changes for them in terms of their aspirations and inspirations, coupled with their desire to change themselves in turn with the changes in the world.

FARMERS WELFARE PROGRAMMES:

Farmers welfare is a multidimensional issue. As of today the lives of farmers are governed by decisions taken by the ministries of agriculture etc., The department of agriculture, co-operation and farmers welfare, Government of India, has been implementing various schemes and programmes for the benefit of farmers.throughState Governments.The statues also formulated number of programme to address farmers welfare.List of programmes are given under.

Following are someof the schemes / programme implementing to facilitate farmers welfare and to provide guidance to extension workers by the department of Agriculture & Co-operation, Government of India.

WELFARE PROGRAMMES:

1. Agricultural Insurance : PMFBY (PradhanMantriFasalBhimaYojana)
2. Irrigation : PMKSY (Prime Minister KrishiSinchaiYojana)
3. Agricultural Marketing : e-NAM (e-National Agricultural Market)
4. Organic Farming : PKVY (ParamparagatKrishiVikasaYojana)
5. Seeds, Plant protection etc : NMAET (National Mission on Agricultural Extension andTechnology (Sub-mission -Seeds, Plant ProtectionAgricultural Mechanisation and Extension)
6. Programmes related to Horticulture, Agricultural credit, farmers training, Sustainable Agriculture and many others……….

CONCLUSION:

Agricultural Extension as a profession is doing services to the farming community. But the services are still not reaching the neady farmers at right time in right form. In other words public agricultural extension services are not reaching the farmers. Extension workers have not realised that improving well being and happiness is the ultimate goal of development. Extensionists need to pay more attention to identity interventions that compliment local values where as extension researchers need to undertake research on harvesting happiness in view of bridging the gap between perceptions of farmers and extension workers, specifically regarding happiness and wellbeing from the farmers themselves. Further, farmers distress and receptive tendencies to new technologies influenced their lifestyle management. Suicidal deaths of farmers, disintegration of joint families, cast system etc., necessitated to cope-up with the winds of change blowing across the country by warranting committed extensionsists to act as farmers friendly Guide and Philosopher with Professional values and ethics.

Today farmers are not satisfied with the dividends they are getting from agriculture especially from rainfed areas suffering heavily due to climatically changes. This calls for radical changes in teaching, research and Extension, since it is high time to revitalise extension system to meet the demands of farming community. Let us hope for happy and peaceful farmer community, a rich wealth and pride for our nation as well as an effective index for National Development.

With the said frame of reference and back-drop, following issues need to be discussed in the working group of the conference to refine valid implementable recommendations.

ISSUES :

- What public polices one ought to adopt and implement regarding the influence of extension education on farmers happiness?
- Farmers distress and suicidal issues need to be looked holistic enough instead of piecemeal by developing an agricultural policy? Discuss.
- Discuss on factors affecting happiness and wellbeing ?
- Reorientation of extension education, research and services to prepare a new extensionist(s) who can take care of happiness and wellbeing of farming community.

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Farmers Suicides – A Development Dilemma

(A Study in Andhra Pradesh)

- Prof. S.V.Reddy[*] & Dr. M. Suryamani[**]

I. PREAMBLE

In the recent past about many farmers have committed suicide and many more than 30,000 farmers have announced through help lines that they are in distress and want to commit suicide if no help is forthcoming. Although the reasons for suicides are varied, yet a paramount challenge of 21st century, While the Government is most concerned and analyzing this problem from many angles, the participatory Rural Empowerment Network Society (PARENT), a network of 13 Non Government Organizations Working in 17 districts of Telangana and Andhra Pradesh has taken up a modest study to unearth the root causes for these maladies.

II. METHODOLOGY

About 30 farm families who have committed suicide /attempting to commit suicide and 30 knowledgeable persons (elected representatives, agricultural officers and farmers) drawn from 12 districts were interviewed by PARENT expert group through questionnaires and focused group discussions. The data were analyzed and presented below.

III. THE RESULTS

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The following causes and suggestions (expressed by majority) emerged out of the study. The causes reflect issues connected with social, economic, technical, environment, markets, supplies and services. They are also interlinked with each other and also linked up with the main causes ie indebtedness and insecurity.

a. Maladies

1. Crop failure due to prolonged drought and vagaries of monsoon.
2. Lack of availability of quality inputs
3. Increased indebtedness
4. Mismatch between earnings and expenditure
5. Lack of timely advise to farmers and limited outreach of extension services
6. No reasonable support price and timely procurement of produce
7. Increased unemployment
8. Lack of timely availability and access to Institutional credit
9. Erosion of social capital
10. Low access to health care and education
11. Lack of access to storage structures and regulated markets
12. Insecurity and vulnerability

b. Remedies

The following suggestions are given by the respondents and experts for redressing the causes and to remedy the situation. While some solutions can be of short term nature and the other have long term perspective. Besides, the remedies are interconnected and hence should be solved simultaneously with a system approach.

1. Revitalization of Agricultural Extension Services

- The present strategy of using Rythumitra groups to strengthen extension could be broad based to create demand driven farmers organizations (cooperatives) through lateral and horizontal networking and federation to promote private extension and agribusiness services. These associations can organize inputs needed for the members to be given on loan, buy the produce by fixing price at the beginning of the season. This can help the present suffering and distress of farmers. In addition NGOs Agripreneure could also be utilized as Extension Service Providers.
- The promotion of Farmers Field Schools (FFS) Farmers Life Schools (FLS) has lot of promise and potential for imparting science based education, Participatory research and building social capital and self-confidence. The FLS will specially develop analytical skills and courage of conviction to solve day to day emerging problems with the help of volunerable groups. If one school in a village in each cropping season / year is started, it can also help in addressing insecurity issues. This needs well-trained cadre of motivated extension staff at grass root level.
- Agricultural Extension should also promote sustainable development with moderate inputs (with low costs) since there is already signs of diminishing returns. Furthermore, the emphasis should be more on value addition, credit and marketing issues.
- Extension services both private and public are working parallel without convergence. There is need to establish linkages among the extension service providers and also to maintain synergy for rationalizing resources and increased outreach.

2. Providing on farm and off-farm employment

- The on farm employment can be doubled through crop diversification, integrated farming system approach, adding value to the products etc.
- The off-farm employment is more important since the returns from the off-farm employment is more in real terms of rupees compared to on-farm employment. Agribusiness, Agro-based industries, vocational occupations etc. could be thought of in this direction.
- This will also necessitate promoting food guarantee / security programmes and starting of more vocational training centers in the Districts / Mandals.

3. Timely Availability and Access to Credit

- Awareness among Banks and attitude of bankers need to be changed to be responsive to farmers needs.
- As mentioned earlier, farmers associations, cooperatives can play a vital role in establishing **Farmers Banks** in the pattern as Mahila Banks under Mutually Aided Cooperative Act. Government if necessary should provide some matching grant / revolving fund to assist in the process and also to ensure that the interest on lending to members should be reasonable but not prohibitive. This will help in reducing the exploitation by moneylenders, which is a root cause for rural indebtedness.
- Kisan credit cards need to be extended to as many farmers as possible.
- The loans extended to farmers should also have provision for spending part of it to cover other needs like education, health etc.,

4. Availability of quality inputs

- The farmers / Associations / Groups should be encouraged to produce their own seed, Botanical pesticides; Biological agents, Biofertilizers etc to meet their local needs. Farmer to farmer seed production and distribution as well as seed village concept could be encouraged in this direction. Furthermore, the farmer association / cooperatives, SHGs, educated youth groups can also be trained to handle the input supply.
- The unemployed agricultural graduates need to be encouraged to have agriclinics and agribusiness centers with well-equipped laboratories so that they can provide extension services while selling the quality inputs. Already this programme is in operation but needs future strengthening with some incentives.
- There should be strict enforcement of seed, Insecticide and fertilizers Acts.

5. Climate Management and Irrigation Input

- The major problem of crop failures is due to vagaries of monsoon / cyclone etc; Environment protection and climate management as a long-term strategy need to be promoted. The present initiative of Cloud seeding should be continued at least for another 2 or 3 years to get better and sustainable results.
- Establishing knowledge centers and Kiosks in rural areas with ICT communication can help to get reliable information on market trends, climatic changes, weather forecast, awareness on livelihood opportunities etc.
- Renovating traditional water harvesting structures, enforcing the tree and water act to ensure that too many bore wells are not coming up and promoting sustainable livelihood initiatives through watershed management are also important factors.

6. Prices, marketing and storage issues

- The major problem for the farmers is low (non remunerative) prices offered for the produce. It is important to offer reasonable support prices keeping in view the cost of cultivation and inflation for all crops. The support prices also need to be revised every two years.
- Regulated markets have to be strengthened so that farmer can get remunerative prices and escape from the clutches of middlemen.
- There is need to have cold storage and warehousing facility created in rural areas for farmers to store the produce and sell it when there is price hike. The RIDF under NABARD can be utilized for this purpose.
- Before the produce come to market FCI, CCI, Marketfed etc should prepare and be ready to buy the products. By this process, there will be competition among middle men (dealers) and farmers can get better prices.

7. Creation of awareness among farmers

- Farmers are not aware about many Government initiatives such as rescheduling of loans, moratorium on loans etc. Similarly many farmers are not aware about the Acts and Standard for judging quality inputs. Therefore it is suggested a massive Awareness Campaign could be undertaken by the Government in Partnership with Private Organizations, NGOs etc.
- Awareness also should be created on the need to mach the cost of living with the income earned by the family and also to cope up with the change.
- Awareness also can be created on the above subjects as special topics in Farmer Field Schools and Farmer Life Schools.

9. Building Social Capital to readdress insecurity and vulnerability

- Building social capital through social mobilization is important to inculcate the feeling of trust, reciprocity, network of support and security through peer groups, family members, extension service providers etc. Most often suicide is a kind of momentary decision occurring due to depression or when dignity and pride is at stake or helplessness due to collapse of supporting systems with in family and society at large.
- Crop insurance scheme need to be strengthened for paying reasonable compensation in case of crop failure. Village as a unit should be considered for the purpose and all major crops should have coverage under the scheme.This will also can help in providing security and redressing vulnerability

10. Access to Health Care and Education

- Some of the suicide families have reported that one of the reasons for their indebtedness is due to lack of access to quality health care and education. This is due to the fact that amidst the series of droughts and crop failures, they have borrowed money for higher interest rates to spend on health and education of children. It is therefore, suggested that the government should come out with a sort of health care (social security) scheme with affordable costs to help the poor.

IV. CONCLUSION

The above results and suggestions indicate that this problem has not only to be looked based on economic solutions (providing money to the suicide families, rescheduling / wavering of loans etc) but also from social and structural solutions. The green revolution has created a lot of hope among people only to see in their lifetime that it is snatched away. The developmental impact on some of these farmers has negative effect. Many farmers who were interviewed have big hope and aspirations, want to enjoy a life, which is competitively better than their neighbors and above their means and resources. The influence of media, cultural links of farmers with distant places due to marriages, business, migration etc, exposure to other places, the collapse of joint family and other support systems have all contributed to this tragedy. They are caught in the trap of high production costs and other living expenditure on one hand and low income from agriculture on the other resulting in growing vicious circle of indebtedness.

Social development has not kept pace with economic growth. The mindset of the people need to be changed. It is not enough giving cash to help suicide victims. There is need to find out a solution that can give sustainable income for the affected families. It is ironical to see the wider spread of poverty and indebtedness in the midst of global prosperity, which is both unsustainable and unacceptable. We are confident that with focus and perseverance, we can carry the movement for stopping suicides. *Can we not accept it as a development dilemma, which needs to be addressed through people lead sustainable integrated development?*

If yes, can we think over developing a new agricultural policy and a perspective sustainable agriculture sector management plan which can embrace all connected issues namely, productivity, management, credit, inputs, marketing etc instead of piece meal approach.

Can we make such a plan be conceived by farmers and driven by farming community?

Lifestyle Management of Farmers with Particular reference to their Peace and wellbeing

S. JAYARAMA REDDY

A large majority of population living in the countrywide of our county constitutes the farming community with agriculture as main occupation. They work on the fields that are around the villages. Indian economy is an agricultural one. So, the importance of the farmer is great.

Let us examine in brief, the lifestyle of an Indian farmer.

An Indian farmer is a very very hard working. He is very busy throughout the year. For him there is no rest. He is engaged in tilling the soil, sowing the seeds, watering the fields, reaping and harvesting the crops and their taking it to the market to sell it. And yet, he is poor. He is being explored by the money lenders, the middlemen and the government servants.

Usually, the Indian farmer gets up early in the morning, takes his plough, and with his cattle goes to his field even before it is full daylight. He works there all day without carrying of the hardships of weather winter, summer or rains, it is all the same for him. He can be found working on his field ploughing, sowing or reaping in biting cold and in the hot winds of summer as well. He works ceaselessly

He works ceaselessly till more, when his wife or children bouring for him his midday meal. He takes itunder the shadeof savetree. Having eaten his meagre food and having washed his hands with the cool water of a flowing broken or well, ha again resumes his work. Often he sings a song to break the uniformity of his hard labour.

Its only with the approach of darkness that he returns home. At the door of his humble cottage, he is greated by his children, some young and some a bit growup. Then he rests for a while and relaxes with a puff. This is the happiest day for him by being the king of his family. After taking his dinner, he goes to the village cultural place where all the villagers meet, chit – chats with fellow farmers, who, like him, came there for veneration. Many cut their jokes and narrate stories and exchange farming experiences. In this way, having spent an hour or two in laughing and talking, he returns home for his well earned rest.

Such is the typical day in the lifestyle of an Indian farmer. But his life is full of difficulties. Despite the hard labor, he lives a life of extreme poverty. It looks as though, he is @born in debt, lives in debt and dies in debt"

His crops are at the money of rains. The fruits of his hard labour are often taken away by calamities of nature like famines and floods besides devastation of pests and diseases still he falls ill, he finds that there are no medical facilities for his treatment. Often he dies entreated and uncovered for. Also, there are only a few schools for the education of his children's. The mud huts in which he lives often fall down during rain and his humble belongings rained as pucca houses are rare. People living in the cities cannot exam imagine the hardships of farmers life.

But this is only one side pasture. The life of the Indian farmer has a brighter side also. He enjoys fresh air and sunshine, the two great blessings of god. He gets more wholesome food than those who live in the cities. He enjoys pure milk and ghee which are not to be found in cities. Moreover, the villages are sympathetic and extend greater cooperation to each other in times of distress. Such follow – feeling and brotherhood are not heard in city, where even next door heard in city, where even next door neighbours do not know each other.

A member of reforms were made to make the life of our farmer happier and healthier. Indian farmer is suffering from various problems mainly due to lack of unity among themselves and no union to support them.

The life of farmer is much dependent upon the fokesof nature for agriculture, adequate mansoon is required. If rainfall is adequate, the agricultural output would be good. However, inadequate, the quote rainfall and long spell of scarcity of water may result into drought situation. As a result, agriculture may get negatively affected and there may be acute shortage of food leading to famines. Farmer becomes miserable if the crop fills and thereby leading to suicidal deaths.

It is in fitness of the context that a mention needs to be made on the pertinent reasons for the farmers suicides. In 2012, the National crime records bureau of India reported 13754 farmer suicides accounting for 11.2% of all suicides in India. Activists and scholars have offered a number of conflicting reasons for farmer suicides, such as mansoon failure, high debt burdens, genetically modified crops, government policies, public mental health, personal issues and family problems.

Government has introduced several schemes for the benefit of farmers through which their life style can be manageably impressed.

There is a need for certified professionals. Over mention needs a cadre of certified professionals who can interact with the farmers, farming communities and assist the farmers in taking appropriate decisions in relation to the problems they face.

Certified Professionals will have experience and regularly updated training in their field of specialised knowledge (soil and water management, integrated nutrient management, crop production, protection etc)

These professionals bring their specialised and interdisciplinary knowledge to bear upon solutions to the farmers problems in the context of farming system. This will ensure that the farmers have access to appropriate knowledge and are not burdened with ready made technologies.

In USA, American Society of Agronomy (ASA) has fulfilled this need for past several decades. They have also collaborated with other countries in developing such skills.

In India also, a few years back an effort was initiated by one of the NGOs to collaborate with ASA and it was believed that Dr. Satish Chandra was the key peruse to drive somehow, this effort was unfortunately disentimed.

Reviving this effort will be a significant service towards India`s farming community for which the National Level Professional NGO, PRDIS, Hyderabad, can strive in addition to undertaking several of the programmes arrived at the welfare, peace and prosperity of farming communities.

Apart from these, the Lifestyle Management can be accomplished if the 12 attractions of “KrishiUnnathiMela 2017” organised at New Delhi during March 15-17 could be followed implicitly.

They included:

- ❖ Live demonstration on production technologies of crops

- Farmers visit to experimental fields of IARI
- Technologies for protected cultivation of vegetable and flowers
- Display and sale of farm equipment and machinery by the ICAR Institutes and the private organisation
- Live demonstration of farm animals
- Sale of seeds of HYVs of crops saplings and seedlings by IARI and other public and private organisation
- Free soil and water testing
- Display and sale of innovative farmers products
- Kisangosthi
- Farm women empowerment workshop
- Free distribution of mela souvenir and farm literature and innovative farmers meet and their honour