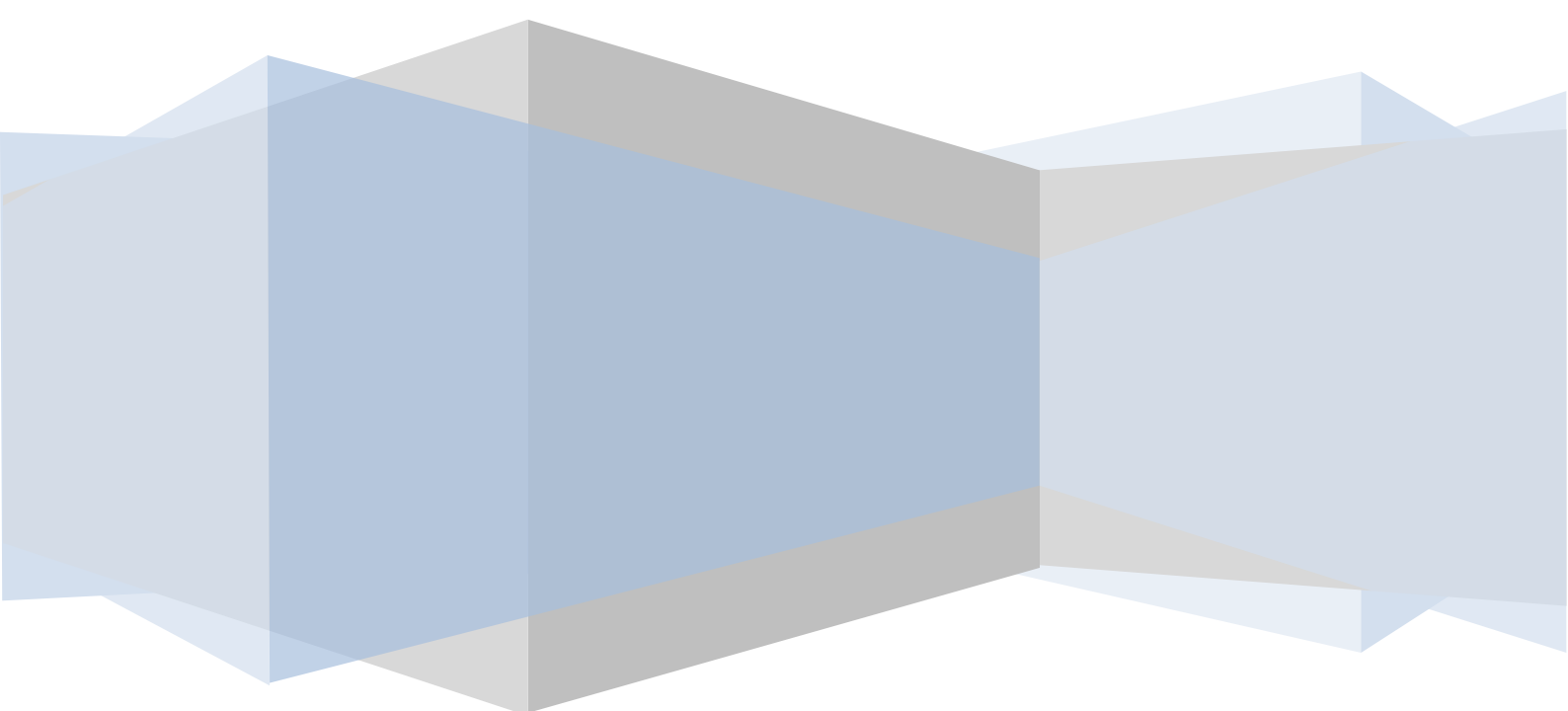


Chapter 7: Agriculture Extension

Short Answers

CSM 05: Agriculture

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This chapter contains:

- Agri-tourism
- Mushroom Cultivation as an Enterprise
- Agricultural Extension
- Changed Role of Agricultural Extension
- Extension System
- Human Resource Use Efficiency
- Information & Communication Technology
- Empowering Women for Income Enhancement
- Strengthening Technology Backstop Institutions
- Research & Development for DFI

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1. Agri-tourism

Agriculture in India is not just an engagement, but determines largely its cultural essence. With increasing aspirations, particularly among the youth, the farmers are well set to transition, beyond traditional farming to generate income via various forms of direct on-farm marketing and farm based non-agriculture business. Tourism is now well recognized as an engine of growth in many countries. The strength of tourism lies in its capacity to generate large scale employment and additional income for the skilled and unskilled. India with its tourism growing at a rate of 8.4 per cent is one among the top 10 tourism destinations of world according to Conde Nast Traveller – a leading European Travel Magazine. In contrast, the world tourism growth rate is just 2.5 per cent.

Agri-tourism is the latest concept in the Indian tourism industry, with agricultural farms as its fulcrum. It leverages the tourists' hunger for an authentic contact with the rural life, local cuisine and familiarity with various farming landscape. The ambience helps tourists to relax and revitalize themselves in a natural way beyond the humdrum of urban life, which has become mechanical and brought in anomy. The target client encompass both domestic (urban inhabitants) and foreigners. In addition to exposing the visitors to the kaleidoscope of the vast and complex agricultural spectrum, the civilizational & cultural efflorescence that include traditional food, handicraft, culture, music, dance and drama that offer them an intense but stress-bursting experience.

Agri-tourism benefits: Generating multiple benefits, of which some are construed below:

- It ensures cash flow during the off season.
- It creates opportunity to sell the experience of agricultural venue.
- It provides opportunity to sell products grown and harvested through agricultural operations.
- It generates employment to a part of rural population.
- It helps in conserving and communicating the values of rural life and agriculture.
- It builds two way communication enabling exchange of information and knowledge between rural and urban inhabitants.

Agri-tourism in India

Agri-tourism has been growing as a niche activity, particularly in the western world over the last century. As a concept, it is therefore not new. In India too, there have been some

beginnings, but is yet to blossom as a mature activity. The scope for its growth in India is provided by the following advantages:

- i. India's ecological diversity and geographical vastness are its strength. These enable varied and unique experience to the tourists. India's multiple agro-climatic conditions provide scope for more than 3000 crop varieties, apart from varied forms of animal husbandry activities. The geography is a multi-faceted prism with deserts, mountains, valleys, coastal systems and islands.
- ii. It has a rich tapestry of people and cultures, each representing uniqueness and highest stage of evolution.
- iii. The propensity of the busy-bee professionals and frayed nerves of the city-bred for nonurban tourist spots, is increasingly visible. This can be taken advantage of to build agritourism centres in remote and off-track locations. This will require creation of basic infrastructure, civic amenities and market promotion. The scope for this is now better, thanks to rapidly improving connectivity and other infrastructure.

Business of Agri-tourism

Agri-tourism businesses take advantage of the following three basic principles.

- i. Have something for visitors to SEE

Animals, birds, farms and nature are few things which could be offered to the tourist. Apart from these, local culture, dress, festivals and rural games could create enough interest among the agri-tourists.

- ii. Have something for visitors to DO

Participating in agricultural operations, swimming, bullock cart riding, camel riding, buffalo riding, cooking and participating in the rural games are few activities to quote, for those seeking something alien to their own life system.

- iii. Have something for visitors to BUY

Rural crafts, dress materials, farm gate fresh agriculture products, processed foods are the few items which tourist can buy as memento for remembrance.

Furthermore, an increasing awareness in urban citizens of their disconnect with nature, and their desire to connect with more natural lifestyle systems is a key driver. Most of the Indian urban population can still boast of their agrarian background, only a generation or two away and agri-tourism is an opportunity to reconnect with their antecedents.

Recommended Strategies

- i) Establish 'Quality Standards' - For agri-tourism in India to be credible, specific efforts are needed in developing a quality standards system. These are standards which should guide general business requirements (i.e. meeting health standards) as well as relate to customer service and products sold. Several of Indian tourism businesses have developed various 'Codes of Conduct', which can be actively promoted.
- ii) Encourage use of 'Quality Standards' - The key to ensuring the effectiveness of this initiative is training and awareness of what constitutes a quality product. The apex organization in association with agri-tourism operators should build a consensus around a standard code of conduct and ensure adherence in delivery of agri-tourism products and services. As part of the establishment of quality programs, an industry based assessment program to audit quality of on-site safety and health environment could also be developed.
- iii) Develop and promote thematic images of Indian farm experiences - The creation of a world-wide image of Indian agri-tourism experiences will help strengthen growth opportunities and provide new marketing avenues. Such an approach was successful for other tourism sectors including Incredible India, Kerala Tourism, Goa Tourism, etc.; specific to agritourism, the Maharashtra region has been successful in increasing the awareness of its farm touring experiences.
- iv) Create marketing materials - To support the image of Indian farm experiences, innovative marketing materials will need to be developed for distribution and awareness generation.
- v) There are media avenues that individual farmer and agri-tourism associations can use to reach a wider marketplace. Examples include TOURISM DEPARTMENT website, or toll free number or call centre which can be easily accessed by the public; product guide placed at all visitor information centres; and regional tourism association brochures. Similarly, communication channels can be developed between agri-tourism operators and consumers.
- vi) Conflict management programmes - While agri-tourism can create business opportunity for the farmers, it can also generate conflict between primary farming pursuits and leisurely travel activities. This has to be handled sensitively. There can be issues of noise, smell, farming practices, annoyance of behaviour, and disease control. In each of these situations, it is important to establish clear communication strategies on what should be expected on-site with respect to the character of the agri-tourism experience. It calls for developing policies and guidelines for agri-tourism that address effective ways of managing public relations associated with such events.

2. Mushroom Cultivation as an Enterprise

Mushroom cultivation- an ancillary activity for livelihood security - is emerging as an important agri-business avenue for educated farmers and entrepreneurs. Diversification in farming systems by integrating novel components like mushroom cultivation adds to economic and ecological benefits as mushroom cultivation generates wealth from the waste, and further the agro-wastes get completely recycled as the substrate left after growing mushroom gets utilised as manure.

Further, the areas with rice-wheat cropping system of India are facing several challenges including the tougher one relating the disposal of crop residues. Black carbon emission from bio-mass burning in these regions is one of the important causes of severe air pollution in the National Capital Region. The GOI, through the Ministry of Agriculture, Department of Agriculture Cooperation and Farmers Welfare (DAC&FW), had drawn the National Policy for Management of Crop Residues 2014, which envisaged the adoption of technical measures, including diversified uses of crop residues. It emerges, that declining arable land for agriculture, challenges of handling huge crop residue and changing climate, focus on mushroom entrepreneurship to generate additional jobs and income for the farm families' merits special emphasis. Mushroom entrepreneurship using agriculture residue as raw material requires lesser land area to produce more protein per unit of area compared to many field crops.

Since mushroom cultivation is not capital intensive, farmers with poor financial resources, including those with no land of their own can practise mushroom growing. It is worthwhile to note, that young and aged people are more likely of considering mushroom enterprise as an economic activity. As an enterprise mushroom cultivation is well suited to the educated rural youth. The lean period of agriculture activity in between rice-wheat cropping system offers the farming community a scope to use their labour as well as unutilised crop residue resources to get gainful returns through mushroom cultivation. Income enhancement for the farmers can be achieved by thinking beyond the conventional methods of monetary returns in agriculture. Mushroom cultivation with its potential for monetisable output by using agricultural wastes can become an important avenue for utilization of a farm family's slack time.

Input use efficiency

The profitability of agriculture is influenced by the input costs and input use efficiency. Agriculture is rendered risky and less profitable on account of high cost of inputs. However, in case of mushroom cultivation, the use of agriculture residue which otherwise is not appreciated except as animal feed is used to prepare the substrate/ compost to grow the mushrooms. Hence, unlike in other agriculture and agri-related enterprises, cost of

cultivation is less in mushroom cultivation. Mushroom cultivation is least dependent on costly chemicals for plant protection measures. This is an added advantage.

Small scale cultivation of some mushroom species as a seasonal activity does not require much investment. Mushrooms are grown on abundantly available raw materials - agro wastes; to harvest protein rich quality food stuff. The water required to produce one kilogram (kg) of mushroom is about 25 litres, possibly the lowest required by any commercial crop.

Post-harvest Management and Processing

Considering that mushrooms have short shelf life, the issues of post-harvest management and options for processing are of paramount significance. For the fresh market, mushrooms benefit from cold-chain to capture maximum value. A value adding activity for the producer, the coldchain for mushrooms requires prior cleaning, packaging and preconditioning the mushrooms for connecting with the consumer through retail outlets. However, most mushrooms still have a comparatively lower marketable life, even when using the cold-chain. However, there are also a number of possibilities of making mushrooms marketable in a processed form.

The processing of mushrooms by preservatives, canning or converting into other food items helps to generate additional revenue. Conventionally, mushrooms are canned and some can be sun-dried. The ICAR-Directorate of Mushroom Research has developed many processed products such as pickle, murabba, samosa, etc. and mushroom fortified products like biscuits and noodles which are becoming popular among the consumers (Shirur and Sharma, 2016). Many entrepreneurs have achieved commercial success in mushroom processing enterprises by their innovative models and recipes of mushrooms. Through this venture, the farmers can realise higher returns over their fresh mushrooms, besides eschewing the losses on account of post-harvest losses that may arise out of inability to market due to short holding life of mushrooms.

Marketing

Many nutritional and functional food products are vying for market and face competition from substitutable products. Simultaneously, monopoly by any single product is also not good. Hence, it is important to diversify the agricultural activities including within horticulture. Mushrooms constitute one such component that not only impart crop diversification but also help in providing nutritious food within a short span of time by utilizing agro-wastes, which are otherwise not used economically. On the other hand, mushroom cultivation strengthens the livelihood of poor and marginal farmers by generating constant farm income and reduces the vulnerability to poverty. Since mushroom cultivation does not require access to land, it is treated as a viable and attractive activity for both rural farmers and peri-urban dwellers.

Cost of Cultivation of different Mushrooms

Mushroom cultivation is a highly skilled and capital-intensive activity under controlled conditions. It involves investment depending on the size of the unit/production targets. However, by introducing tropical and sub tropical mushrooms in the production cycle, the yearround mushroom production can be achieved successfully with high monetary returns. In Haryana and Punjab region, mushroom growing is a seasonal activity for marginal and small farmers around cities. These farmers prepare compost either through a long drawn process or purchasing from composting units and sell the fresh mushrooms in nearby market. The temporary structures after cultivation of white button mushroom are lie vacant and remain unproductive. These can be used for cultivation of tropical mushrooms during the warm seasons. Hence, the calculations on cost of cultivation were done on the premise of growing mushrooms in temporary structures (two cropping crops) as per the prevailing climatic conditions. Even in the prevailing circumstances where farmers take just one crop of button mushroom in the huts in the winter months, a farmer earns on an average Rs 50,000 per hut and an acre of land can accommodate 8-10 huts including area for compost preparation. Within four months, the farmer can earn Rs 4-5 lakh per acre, which is much higher than any other crop. The substrate left after growing mushrooms is ploughed back to the fields and it adds to soil health and better production of vegetables and other crops. Chang, 2015 reports, that in China, the economy of villages was totally transformed within few years by adopting better techniques of mushroom cultivation; and that there was 5.5 times increase in the income of farmers between 1991 to 1997 in Biyang region of Henan province, China.

Measures to Promote Mushroom Entrepreneurship

In view of the existing and foreseeable huge opportunities that exist for mushroom enterprise in India, following policy recommendations are suggested.

- Mushroom entrepreneurship must be treated as an agriculture activity for all purposes.
- Two to three KVKs in each state must be identified and strengthened through capacity development and necessary infrastructure to serve as the Centre of Excellence (CoE). It should also be centre for production of spawns.
- Commercial spawn production centres must be incubated, at SAUs, KVKs and public private partnership (PPP) establishments.
- Start-up entrepreneurs must be promoted with right incentives to venture into postharvest technology and value addition in mushroom sector.
- Supply chain management should incentivise the supply of fresh mushroom producers and attract investments in mushroom products through financial support.

- Mushroom as part of the integrated farming system should be encouraged through input supply and subsidies by the development departments.
- Farmer producer associations (FPOs) and cooperative farming must be promoted by bringing the stakeholders associated with mushroom cultivation, marketing and processing.

3. Agricultural Extension

Agricultural Extension- Empowering Farmers to Help Themselves

India is bestowed with large number of agricultural research institutions spread across the country covering agriculture and allied sectors. As many as 113 Research Centres/Institutes of Indian Council of Agricultural Research (ICAR), 77 State Agricultural Universities (SAUs) – Central Agricultural Universities (CAUs), Water and Land Management Institutes (WALMI), in various states and research institutions of various Commodity Boards, as also their related Ministries/Departments are involved in the generation of transferable technologies encompassing multiple aspects of the agricultural sector along its long chain of pre-production, production and post-production stages including marketing. This research system is supplemented with 700 Krishi Vigyan Kendras (KVKs) located in all the districts of the country for validating & acclimatising the technologies for local conditions.

More than 50,000 dedicated agricultural scientists are working to address field level problems and to evolve technological solutions. However, all the technologies developed by these scientists have not always reached all the farmers. In addition, there are many technologies and practices developed by individuals and corporate bodies in the private sector. Agricultural Extension is, responsible to transfer various technologies and farm management practices developed at research institutions under National Agricultural Research System (NARS) to the fields of the farmers, along their specific value chain, to improve their productivity, production and profitability, besides making this happen on sustainable basis and also negotiating several risks that the agricultural sector is vulnerable to. The research & development outputs become barren, if they do not reach the intended user, namely, the cultivator, the dairy farmer, the fishery farmer, the plantation grower and others engaged in various agricultural and allied activities. Besides playing an important role in transfer of technologies from research institutions to the doorstep of the farmers, agricultural extension also communicates the benefits of developmental programmes of government to the farmers; disseminates information on inputs, credit & insurance facilities, infrastructure, processing, post-harvest technologies and marketing. Such information and education, bring about desirable behavioural changes

Concept behind Agricultural Extension

The term “extension” was first used in the United States of America (USA) and United Kingdom (UK) in the first decade of the 1900s to imply the extension of knowledge from land grant colleges to the farmers, through the process of informal education. In India, extension work was primarily started by F.L. Brayne (1920) in the State of Punjab. The term community development and extension education became more popular with the launching of community development projects in post-independent India in 1952, and with the

establishment of the National Extension Service in 1953. Since then, community development has been regarded as a programme for all-round development of the rural people and extension education as the means to achieve this objective. Agriculture, the dominant rural activity has been the core of the Extension Projects.

Agricultural Extension tries to enhance agricultural production by providing the knowledge necessary to make improvements in agricultural practices, and by removing constraints which may hamper the process of increasing farm production (Rivera W.M. 2001). In its role of providing knowledge related inputs for enhancing agricultural production, agricultural extension can be loosely defined as 'a service to "extend" research based knowledge to the rural sector to improve the lives of farmers' (Kapoor, 2010).

As per Anderson, 2008, Extension could aim at bridging technology gap or management gap or both, in the knowledge base of the farmers

- Technology gap bridged by providing better inputs like improved seeds, fertilizers, machinery etc.
- Management gap bridged by providing better farm management practices such as quantity & timing of applying inputs, ways of preparing land for cultivation etc.
- Agricultural Knowledge and Information Systems for Rural Development (developed by FAO and World Bank).

Redefining Agricultural Extension for Doubling Farmers' Income (DFI)

The various definitions brought out in the previous section, as also the prevalent emphasis in India, have largely been production-centric in nature. The approach towards Extension and its focus as well are required to evolve as per the evolving needs of the farmers. Agricultural Extension has, through the decades since Independence, demonstrated its ability to be dynamic and is therefore amenable to its reorientation to meet the current mandate of 'doubling farmers' income'. It is in the light of this contemporary need, that the DFI Committee offers the following definition:

"Agricultural Extension is an empowering system of sharing information, knowledge, technology, skills, risk & farm management practices, across agricultural sub-sectors and along all aspects of the agricultural supply chain, so as to enable the farmers to realise higher net income from their enterprise on a sustainable basis".

The definition brings into focus, the all-important issue of farmers' empowerment through information, knowledge and skilling, in consonance with the popular Chinese proverb, "Don't offer a person with a fish a day, but teach him how to fish." The farmers in India today prefer to be empowered than offered merely a temporary succour. And knowledge

empowerment is vital to manage and exercise agriculture as an enterprise that generates targeted profits.

Agriculture Technology Management Agency (ATMA)

Extension services have evolved through the decades, in step with the changing dynamics of India's agriculture. The last major initiative as regards agricultural extension has been National Agricultural Technology Project (NATP), under which Agriculture Technology Management Agency (ATMA) was pilot tested during the period of 1998-2004 in twenty eight (28) districts across seven (7) states. The results in these 28 districts were encouraging and found to significantly drive improvements. These reforms were decentralized decision making; bottom up planning; linking farmers to market; ICT in agriculture; public-private partnership; promotion of farmer's organisations; and gender mainstreaming. Buoyed by this, the Government introduced this concept in 252 districts in Phase I in the year 2005 and subsequently upscaled it to all the then 652 districts. ATMA is a multi-agency platform with emphasis on procedural as well as institutional reforms, leading to effective extension delivery.

Strengthening and reforming ATMA to meet DFI challenges

While ATMA continues to remain a platform of relevance, the outcomes realised have been less than it's potential on account of some dilutions, discussed below:

- Poor participation and commitment on the part of senior officials
- Lack of clear understanding about the principles and practices of ATMA
- Lack of convergence among flagship programmes/schemes under agriculture and allied sectors
- Untimely release of funds from State to ATMA (district unit) and block units
- Diversion of ATMA functionaries into non-core activities
- Capacity building of extension functionaries was not sustained
- Inadequate infrastructure support to extension
- Attrition ridden and unstable contractual manpower; also allied activities like animal husbandry & fishery sector did not receive required manpower
- Absence of effective monitoring mechanism at district level through the mandated ATMA Governing Body (GB)

- Extension services needed to be made more outcome oriented, with a balanced emphasis on both production and post-production activities. This did not happen to levels of satisfaction
- Farm school concept of Farmer-to Farmer extension not fully operationalised
- Poor quality of interaction among members of Farmers Advisory Committee (FAC)
- Lack of integration of agripreneurs with ATMA activities
- Non-evolution of effective Public Private Partnership (PPP) models
- Quality of Strategic Research Extension Plan (SREP) less than desired
- Poor efforts in promotion and sustenance of farmers groups (FIGs, CIGs, SHGs, FPOs, etc.)
- Ineffective linkages between ATARIs and SAMETIs at the state level and ATMAs and KVKs at the district level and below

4. Changed Role of Agricultural Extension

Indian Agriculture – Current Context

India is among the fastest growing major economies of the world. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture as a sector contributed 13.5 per cent to the nation's Gross Value Added (GVA) in 2015-16. Within the sector, the sub-sectors of horticulture, livestock and fisheries have been contributing a larger share of value to agri-GVA since the last decade. Agricultural development continues to remain critical for economic growth, poverty reduction and ensuring food and nutritional security of the country besides meeting other mandates of the agricultural sector.

Green Revolution which brought sufficiency on the food production side, was due to a combination of technologies viz., hybrids and high yielding varieties, fertilizers, improved agronomic practices, assured irrigation and price support policy. This revolution was made possible through an organised and committed effort of Agricultural Extension System (AES). The high production levels achieved is a sufficient evidence of the success of the system that ably supplemented the input intensive production interventions, by transferring modern technologies and farm management practices to the farmers.

However, the interventions mainly benefited irrigated regions and resourceful farmers, bypassing the larger segment of rainfed farming and resource poor farmers. The current phase of agricultural development aims at greater inclusiveness and equitable transformation, whereby all farmers are able to reap economic benefits. The DFI Committee is guided by the fact that more than 85 per cent of the farm holdings are small and marginal, and are economically challenged. To achieve income growth, there is a need for deploying scales of operation, and therefore, the need for promoting new generation farmer collectives, such as Commodity Interest Groups (CIGs), Farmer Producers Organisations (FPOs) and Village Produce Organisations (VPOs) – in the form of Cooperatives, Companies and Societies.

Indian agriculture continues to face challenges, some new and some old, such as:

(i) declining availability/quality of soil, water and other natural resources; (ii) decreasing size of farm holdings; (iii) inefficient use of inputs and their increasing costs; (iv) scarce and more costly agriculture labour; (v) drudgery in farming operations; (vi) growing risks in farming at all its stages from pre-production to production to marketing; (vii) increasing information gap, knowledge gap and skill gap; (viii) poor access to credit and investments; (ix) slow diffusion of relevant technologies; (x) competitiveness of quality and prices in domestic & export markets; (xi) inadequate focus on processing and value addition; (xii) inadequate

rural infrastructure; (xiii) regional imbalances; (xiv) problems in retaining rural youth in agriculture; (xv) poor access to resources and services for women in agriculture; (xvi) weak institutional/sub-system linkages and convergence; and (xvii) extreme events of climate change on the rise.

Extension Support required by Farmers

Agricultural Extension has to meet changing demands of dynamic agricultural system. Majority of the farmers have successfully shifted from subsistence to commercial agriculture i.e. they now generate surpluses that not only meet family consumption needs, but are available for markets. Thus, farmers increasingly seek market oriented information such as market preference for crop and variety, market demand and prices on real time basis, details on buyers, availability of logistics (aggregation, transport, storage facility, etc.). These constitute business enabling information, which has not been traditionally addressed by public extension. In a way, this has remained a structural weakness which needs to be addressed and reorient and capacitate extension system to take these to the farmers.

The size of the land holdings is gradually reducing which can make the production commercially unviable. The situation demands alternate ways to bring in scale of operation by adopting contract farming and/or establishment of farmer producer organisations, either as companies/cooperatives/societies. Whereas, small land holdings are amenable to operation in a more efficient manner, the movement of produce to markets requires aggregation for logistical efficiency, besides cost effective purchase of inputs. Farmers therefore need details on agri-business companies providing specialised services and possessing interest in contract farming, ways and means of establishment of farmer producer organisations and their linkage with the extension, credit institutions, common infrastructure, processing opportunities etc. This demands new set of information, knowledge and skill on the part of farmers, as also reoriented approach to extension on the part of the extension system.

Migration of people from agriculture into urban areas combined with wage spiralling on account of wage labour under MGNREGA, as also other economic activities in the rural areas, has engendered labour shortage and high labour cost. But, these changes in the rural structure are inevitable and welcome too from the perspective of welfare of rural society. This is also a reflection of the slow growth in economic returns from agricultural activities and its inability to compete.

Water is a scarce commodity which needs to be used judiciously by farmers. Information relating to method of irrigation, quantity and quality of water, time of irrigation, water use efficiency by adopting micro-irrigation systems and sensors, besides crop alignment etc. now need to constitute the new context of advice that the Extension machinery is expected to offer to the farmers.

Negative Impact of Imperfect Information Dissemination

Lack of good and reliable information could result in:

♣ high yield gap; ♣ low seed & varietal replacement rate; ♣ poor crop nutrient management; and ♣ widespread use of spurious/low quality agricultural inputs.

The reduced presence of public sector extension in agricultural extension system beginning with 1990s, the era of economic liberalisation in the country, has adversely impacted the flow of information among farmers. Presently, less than half of the farmers have access to agricultural information, and there exist other aspects like large farmers having access to better sources of information and greater focus of information on fertilizers and insecticides, with lesser attention to other stages of agricultural production. Poor access to information has caused inappropriate adoption of agricultural practices leading to major yield gaps in field crops.

Likewise, in case of pesticides, the problem of spuriousness has been attributed largely to weak law enforcement. While weak enforcement is an issue, spuriousness is as much a result of failure on the part of public & private extension systems. Spuriousness of inputs is a serious problem, because not only does the concerned input (seed, fertilizer etc.) not yield the promised potential, but also adds to the farmer's cost of production without him accruing any additional yield and income.

Public Private Partnership (PPP) in Extension Services Delivery

Krishi Vigyan Kendra (KVK) has facilities and hires Subject Matter Specialists (SMS) to actively implement mandated activities i.e. technology assessment, refinement and frontline extension. Besides, each KVK is in possession of about 50 acres of land. This provides ample opportunity for Agri-business activities on a Public Private Partnership (PPP) mode, supported by KVK by providing space and technical support, whereas production, processing and marketing are done by Agri-preneurs.

A sharing arrangement between KVK and Agri-preneurs, can be agreed upon. This system will ensure income generating activity in the vicinity of KVK which is a demonstration in itself, augmenting financial resources for KVK, and most importantly, providing additional extension service to farmers for enhancing their income. Activities such as custom hiring, milk chilling unit, nursery, bio-fertilizer, bio-pesticide, honey processing, fish fingerlings production, processing etc., can be taken up in PPP mode. This may be initiated on pilot basis in selected 50 KVKs representing all States including A&N Islands and ATARI Zones and scaled up thereafter to cover all the KVKs.

In fact, the amendments effected to the RKVY Guidelines will be financing agri-entrepreneurship and establishment of incubation centres at various research

institutions including KVKs. This provision can be made use of in promoting enterprise activities by the KVKs and Agricultural Technology Management Agency (ATMA).

The guiding principle of ATMA provides opportunities for promotion of Public Private Partnership in agricultural extension delivery mechanism. A minimum 10 per cent of the funds of ATMA are already earmarked for public private-partnership (PPP) initiatives. However, in the field, this provision has not been utilised well. There is scope to make this possible, as conceptually it bears merit. Some of the important reasons for poor performance of PPP in the field are:

(a) Absence of credible inventory of private extension service providers in the district (b) Non-operationalisation of GoI guidelines for implementation of PPP models (c) Absence of decision making powers at district level on PPP projects (d) Generic inhibition (mental block) in public system for initiating PPP (e) Non-availability of rigorous monitoring mechanism in place to ensure PPP activities (if any) at district level.

To impart the needed clarity to operationalization of PPP projects, successful models and best practices may be catalogued and popularized. Decentralization of PPP decisions to District level and a progressive National Level Ranking Frame Work (NLRFW) for Extension Service Providers (Public and Private) also need to be put in place. The MANAGE and ICAR Extension Division may work together and publish such NLRFW, through wider consultation.

5. Extension System

Inputs received by the DFI Committee indicate that at each level - national, state and district, a large number of research and extension institutions working in parallel, tend to target the same set of individual farmers. In doing so, the spread of extension remains limited, with multiple resources duplicating one another's efforts, besides professing variant technologies, resulting in a discordant atmosphere and questionable output. There is need for strong linkages between and among extension sub-systems, and convergence required among the various actors. In this direction, there is need to redefine the management and administrative aspects to promote an inter-linked mechanism in agricultural extension.

Centralised Management of Decentralised Activities

Research System linkage with MANAGE at national level

With large presence of ICAR centres/institutes numbering a high of 113 spread across the country, a wide range of technologies is generated across the multiple sub-sectors of agriculture. It is observed that the ICAR extension units of these Institutes/Centres are by and large confined to a limited geography in their close proximity. While they cannot be expected to own responsibility for all the agri-production regions, diffusion of technology amongst wider farming audience has to be ensured. Ideally, new information and knowledge relevant to a crop or sector, once standardised, should preferably be introduced into the mainstream extension system without delay. It is recommended standardised extension approaches and technologies reach an integrated platform at the national level, from where the same can be disseminated to EEs and SAMETIs for further diffusion into mainstream extension i.e. state agriculture and line departments. An appropriate platform for this purpose be developed. The same procedure may be adopted in case of commodity boards, namely, Coffee Board, Tea Board, Spices Board, Tobacco Board, Silk Board, Coconut Development Board, etc. and other Central Government Research Institutions.

Converging all standardised practices and technologies on a common extension platform can happen through national level repository of knowledge, proposed as an 'e-National Bank for Agricultural Technologies (e-NBAT)'. Simultaneously, the technologies generated by private sector research organisations and international organisations may also be deposited at "eNBAT". This repository can be managed by a national institute like National Institute of Agricultural Extension Management (MANAGE).

Empowered Directorate of Extension (DOE)

The fast changing role & responsibilities of and expectations from agricultural extension warrant redefining the role of Directorate of Extension (DoE), which is currently a subordinate office of Department of Agriculture, Cooperation and Farmers' Welfare (DAC&FW). It provides technical backstopping to the Extension Division for execution of various extension initiatives. The organisation with its current status does not enjoy the needed autonomy to look beyond the implementation of various extension initiatives.

The changing role of extension from implementation to facilitation, requires conceiving of new ideas that focus on empowering farmers to approach their core activities from a business perspective. This calls for designing and pilot testing of new strategies and models for effective outreach of key initiatives of the department. The DoE can function as a promoter and propagator of innovations in agricultural extension programs executed by both central & state governments, as also private sector & NGOs. It can also undertake concurrent monitoring and evaluation of these programmes. This is possible if DoE is offered greater autonomy and concurrent flexibility in deciding and implementing its activities.

Right technologies for Right people in Right time

MANAGE is mandated to assist state and central governments in strengthening of agricultural extension management. It is to carry out training, research, extension, consultancy, documentation and dissemination of knowledge in the field of agriculture extension management and policy advocacy. It is also responsible for building international bridges and promote two way exchange of extension related knowledge.

The basic responsibility of MANAGE is to assist Government of India in formulating sound extension policies. The assistance is provided based on brainstorming, workshops, research studies, surveys etc. Similar services are also provided to state governments as agriculture is a State subject. It also services private sector organisations as per demand. The Institute also enables proper implementation of programmes by the extension agencies under public (both central & state) and private systems. This support is offered by way of undertaking studies and offering feedback that serves to make necessary corrections.

Linkage amongst MANAGE, EEI and SAMETI

It is important to bring in organic linkage among national level apex body, namely, MANAGE, Regional level EEIs and State level SAMETIs to streamline agricultural extension management. Suggestions made in this regard are as follows:

- i. The Director General, MANAGE may be brought in as Co-chair in the Governing Board / Executive Committees of EEIs and SAMETIs.

- ii. MANAGE to evolve an institutional mechanism for mentoring activities of EEs and SAMETIs, especially in identification of training priorities, preparation of training modules, aligning its training calendar and ToT (Training of Trainers) component with capacity building needs of EEs / SAMETI faculty, training evaluation etc., thereby reorienting the reforms process in the States towards enhancing the farm incomes.
- iii. All financial proposals of EEs and SAMETIs to DAC&FW may receive inputs from MANAGE.

Repositioning the EEs

Given the need for adopting market led extension, it is time that the Extension Education Institutes (EIs) move beyond their traditional role of capacity building of extension functionaries in their respective regions. Since, the SAMETIs are increasingly expected to function as extension arms of MANAGE in the States, the EEs cannot afford to continue with their 'me too' role. In order to differentiate themselves as institutions that can add greater value to the extension services within their jurisdiction, niche set of competencies not currently available in the national extension system should become their new mandate. This would transform the EEs into Centres of Excellence, each specializing in areas relevant to their locational priorities and agro-climatic conditions.

Research System linkage with SAMETI at state level

The State Agriculture Universities (SAUs) are tasked with a triple agenda comprising academics, research and extension. Their extension outreach programme is defined by validation and popularisation of technologies and farm management practices developed by them within their service areas. Obviously, they are not expected to connect with every farmer, in their service area, which is primarily the mandate of the state extension machinery. However, SAUs can provide technical backstopping and capacity building support to mainstream extension.

State nodal cell (SNC) and its role

The State Nodal Cell (SNC), facilitated by State Nodal Officer, State Coordinator, State Gender Coordinator and supporting staff, should ensure timely receipt of District Agriculture Action Plans (DAAPs) and formulation of State Extension Work Plan (SEWP) with duly incorporated farmers' feedback obtained through State Farmer Advisory (SFA) Committee and further ensure its approval by the State Level Screening Committee (SLSC). The SNC should also focus appropriately on monitoring the implementation of the approved SEWPs by the SAMETI (at state level) and ATMA (at the district level).

ATMA to mantle the extension delivery at district level

ATMA receives e-District Bank for Agricultural Technologies (e-DBAT) from SAMETIs. It is further strengthened by pooling technologies received from private sector research organisations at District level and technologies identified by SREP. e-DBAT provides inventory of all the relevant technologies required for the district after being customized as location-specific technologies in consultation with KVKs.

6. Human Resource Use Efficiency

Factors in Manpower Requirement in Agricultural Extension

Adequacy of manpower is an important factor in effective delivery of extension services. The manpower requirement has typically been determined on factors such as geographical area, net cultivated area, crops and cropping pattern, number of households/operational holdings and system of cultivation-irrigation or rainfed.

The existing sanctioned strength of extension functionaries, vis-à-vis the positions filled, and relative strength of private extension service providers, determine the total manpower available. The manpower deployed in extension services includes agri-preneurs, DAESI (Diploma in Agricultural Extension Services for Input Dealers) trained input dealers, paratechnicians, NGOs, agri-business companies, Farmer Producer Organisations (FPOs), Cooperatives, etc. Besides, extension is supported through modes such as mass media network, Kisan Call Centre (KCC), network of Krishi Vigyan Kendras (KVK), State Agricultural University (SAU), Central Agriculture Universities (CAUs), credit personnel of various financial institutions, Indian Council of Agricultural Research (ICAR) extension outreach programs etc.

Conventionally, manpower based extension has been the primary vehicle for engagement with the clientele. In an environment where, the level of literacy among the farmers was low and they suffered from long held and strong belief system, that always defied the behaviour change interventions, face to face interface between the extension functionary and the farmer was more credible and effective. Since manpower was always a constraint and other forms of medium had their own advantage in communication, alternatives like traditional art forms and modern forms like print, audio, video and electronic form since the advent of television as a pilot in mid 1970s and more substantively since 1980s came to describe the extension methodology.

Status of Manpower in Public Extension

Indian extension is dominated by public extension. As agriculture is a state subject, majority of the extension functionaries come from agriculture and allied departments of the state. To strengthen ATMA, additional manpower is provided to states by the central government.

As per the information culled out in the year 2012-13, while there were 13.83 crore operational farm holdings, the agricultural extension manpower in position in the country was 1,19,048, which worked out to 1162 operational holdings served by one extension functionary. This ratio applies to the broad agriculture sector and will further vary from one agricultural sub-sector to another, and unfortunately to the disadvantage of emerging domains like animal husbandry.

Assuming that each operational land holding belongs to one farmer/farm family, the ratio is unfavourably much poorer compared to the ratio specified under Training & Visit system of extension. The previously ascertained ratio ranged from 250 to 800 farm families per extension functionary under T&V. In hilly areas, the recommended ratio was one (1) extension functionary per 250 farm families, in irrigated areas it was 400 farm families, and in areas practicing dryland agriculture, it was 800. There are several national institutes under different divisions of the Agriculture Ministry, which are involved in providing various services to farming community, but have limited manpower for extension purpose. Commodity Boards under Ministry of Commerce and Industry i.e. Coffee Board, Tea Board, Spices Board, Rubber Board etc. have their own extension systems which work almost independently; and so is it in case of Central Silk Board under the Ministry of Textiles.

The Department of Animal Husbandry, Dairy and Fisheries (DAHDF) hosts National Fisheries Development Board (NFDB) and National Dairy Development Board (NDDB), under its umbrella which too have their own limited manpower for extension purpose.

All the ICAR centres have their own extension wing with limited extension reach. Further, all the SAUs and CAUs have separate Directorate of Extension, with their own extension manpower to provide extension services in their designated service area. Even though Krishi Vigyan Kendras are meant to provide technology backstopping, they too are involved in extension functions. The Ministry of Food Processing Industries, Department of Rural Development, Ministry of Small and Medium Enterprises (MSME) and Indian Council of Medical Research (ICMR), have their own institutions with limited manpower for extension of technologies generated by them. The Ministry of Science and Technology actively provides value added extension services through ISRO, NRSA and CFTRI. IGNOU has hundreds of programmes meant for different stakeholders in agriculture value system. The Ministry of Finance caters to farmers' credit needs through NABARD, Public Sector Banks, RRBs. Several Inter-Governmental Institutions like FAO, USAID, GIZ, ICRISAT etc. also provide specialized services through their limited manpower. The Ministry of Information and Broadcasting has its own farmers' outreach programmes through Doordarshan, DD Kisan, All India Radio, Community Radios and Directorate of Audio Video Publicity. A listing of public and private extension service providers in India, shows the availability of large number of national level institutions, that provide direct and indirect support to agricultural extension. This is in addition to various state level organisations of similar nature, which also are large in number.

It is important to recognize the following recent developments in the country which have impacted agricultural extension positively. They are:

- Improved literacy rate
- Increased reach of mass media
- IT and mobile revolution
- Deepening internet penetration
- Enhanced road connectivity to villages
- Increased mobility of extension functionaries
- Increase in reciprocal calls and visits of farmers to

extension functionaries • Improved awareness bench mark of the farmers • Vigorous outreach mechanism of central and state governments • Aggressive marketing and extension approaches adopted by private extension service providers • Presence of large number of NGOs working in rural areas and serving agriculture and allied activities. • Institutionalised Corporate Social Responsibility (CSR)

In view of the changed scenario, the DFI Committee is of the opinion, that the required minimum ratio of extension service provider to farming family can be revisited. Based on its analysis, the Committee recommends that ratios between Extension functionary to Farm families desired are as follows:

(i) Hilly areas – 1:400 (ii) Irrigated areas – 1:750 (iii) Rainfed areas- 1:1000

Manpower for ATMA

In order to strengthen the state extension manpower, ATMA scheme was modified in 2014 to put in place a committed team of extension functionaries at state, district and block levels. The ATMA Guidelines provide for manpower at different levels as follows:

- District level (Project Director-1; and Dy. Project Directors -2; Supporting Staff (Accountant and Computer Operator)
- Block level (BTM-1 and ATMs-2) for each ATMA.

This works out to a Technical Manpower strength of about 33 for ATMA in a district having on an average 10 Community Development Blocks. As per the total sanctioned strength of each state in line with its eligibility, a total of 27,937 positions were sanctioned across different states. However, as on 15.4.2017, only 13,672 positions were filled, while 14,265 were reported vacant. If these ATMA vacancies are filled up, total number of extension functionaries in the country will go up to 1, 33,313 (ATMA + Regular extension staff) which will improve the ratio of farmers served by each extension functionary from 1162 to 1037. Happily, there exists scope to further improve this ratio, only if all the existing 30 per cent of state extension staff is filled up by all the state and UT governments. In such an event, the ratio will improve from 1037 to 798.

7. Information & Communication Technology

With the introduction of National e-Governance Plan-Agriculture (NeGPA) during last phase of the 11th plan, twelve clusters of services came to be identified. These includes pesticides, fertilisers & seeds, soil health; information on crops, farm machinery, training and Good Agricultural Practices (GAPs); weather advisories; information on prices, arrivals, procurement points, as also providing interaction platform; electronic certification for exports & import; information on marketing infrastructure; monitoring implementation / evaluation of schemes & program; information on fishery inputs; information on irrigation infrastructure; drought relief and management; livestock management.

Policy Interventions on ICT in Agricultural Extension

The National Policy for Farmers (2007) indicated that the potential of ICT would be harnessed by establishing gyan chaupals (Knowledge Centres) in villages. Further, the Common Service Centres (CSCs) of the Department of Information Technology, Ministry of Communications and Information Technology, Government of India and those set up by the state governments and private initiative programmes will be evolved for inclusive broad-based development. Last mile and last person connectivity would be facilitated with the help of technologies such as broadband internet, community radio or internet-mobile phone synergies (NPF, 2007).

The Document of ICAR Framework for Technology Development and Delivery System in Agriculture (2008) outlined the need for the construction of Agri-India knowledge portal – a single electronic gateway to be developed through a peer review process with the help of 15 content accreditation centres from 15 agro- climatic regions of the country. Each of these accreditation centres can coordinate with other Agricultural Universities and agricultural institutions in their region for development of content in regional language as well as in English. The data may also be validated and may be collected in the central data warehouse integrated in the knowledge portal. The portal may also optimally serve as a platform for facilitation of interaction among researchers and extension personnel in the KVKs through high speed server intranet.

Accordingly, a range of ICT initiatives/schemes aimed at providing information to the farmers on various value adding activities in the agriculture were introduced and are implemented by DAC&FW. These initiatives have been integrated in a manner that farmers are able to get real time information to facilitate their decision making. Such information is intended to be provided to farmers through multiple channels such as through public portals like Farmer Portal, m-Kisan Portal; Kisan Knowledge Management System, Portal on Crop Insurance Scheme, Portal on Soil health Card; and the latest being electronic National

Agriculture Market; Kisan Call Centres, Internet Kiosks, USSD (Unstructured Supplementary Services Data) and SMSs etc.

Major ICT Interventions of DAC&FW

Various ICT interventions have given a new look extension services, both- in terms of improving the outreach as well as the quality of information and knowledge being imparted to farmers. These interventions are discussed below.

- (i) Kisan Call Centre Service: Farmers are empowered to seek information by contacting the Kisan Call Centres (KCCs) currently located at 14 stations in different parts of the country through a Toll free no.1800-180-1551. A study report on decision oriented information system for farmers through KCC and Kisan Knowledge Management System (KKMS), m-kisan portal and farmers portal conducted by Centre for Management in Agriculture (CMA), IIM, Ahmedabad in association with AgroEconomic Research Centre, Directorate of Economics & Statistics submitted in August 2017 has revealed that KCC was the most important source of information to the farmers followed by fellow farmers, input dealers, Kisan melas etc. The most sought for areas of information included weather, plant protection, government schemes, market information, fertilizer use/ availability and that on varietal choice. The study also reveals that majority of the farmers expressed that there is a positive impact of KCC information on their production and income levels.
- (ii) Crop advisories in the areas of crop management, weather, market price, nutrient management etc. are being sent to more than 1.9 crore registered farmers throughout the nation. It is the KVKs, and District Agriculture Office of the state governments normally send these advisories every week. However, its customization for each district is in pipeline.
- (iii) Innovative Technology Dissemination Components like Pico Projectors, Hand-Held devices etc. have been added as an important part of extension reforms process already being implemented through the Scheme 'Support to State Extension Programmes for Extension Reforms'.

Impact of ICT for Agricultural Extension in India

Some impact studies on application of ICTs for agricultural extension have indicated, that the adoption of certain agricultural practices had increased seven-folds with use of ICT over the conventional extension approaches; and Digital Green project showing to be almost ten times more effective per unit of money spent. Further, 85 per cent of adoption of improved technologies achieved through ICT was 85 per cent as against 11 per cent in case of traditional extension methods.

ICTs can effect a paradigm shift in the agriculture sector if brought into the extension system. Such a scope exists in multiple fields including crop production, crop protection,

disaster management, market information, market participation, financial institutes and information, natural resource management, fishery, weather information, e-Governance, land administration, livestock management, food security, forestry, sericulture, input management, input availability etc. Alongside this, ICT is also making the farmers more aware and informed about their rights. It is giving voice to their thoughts and is bringing them together, if not always physically but virtually and enable among them a common goal and synergy of efforts.

Suggestions for Promoting ICT in Agricultural Extension

Modern communication technology has proven itself adequately in providing real-time information to farmers on such parameters as weather, market prices, pest and disease status, crop area and production etc. Greater use of ICT systems in extension will make agricultural extension more efficient. Some suggestions in this regards are made as under:

(i) e-Agriculture Policy of national and state governments. It is necessary to adopt appropriate policy, and explore and outline the possibilities of leveraging ICT for efficient agricultural extension services. (ii) Deployment of ICT in extension system will enhance the its out-reach and efficient monitoring. (iii) Human Resource Development: Creating awareness on ICT potentials, ICT using skill and capacity development among the extension personnel of the public and private extension systems, and also among farmers and other stakeholders in the extension systems will facilitate efficient usage of ICTs. Hence, a comprehensive national eLiteracy Campaign may be organized covering all the stakeholders. (iv) Strengthening ICT Infrastructure: Extension organisations and extension personnel need to be equipped with ICTs for facilitating farm information among the agricultural stakeholders. Management information system be used in ATMA & KVKs. (v) Localisation and Customisation of content: Research & educational institutions and extension systems should continuously labour on content localisation and customisation as per the demand of the farmers and other stakeholders. (vi) Integration of ICTs with Public-Private Extension System: Appropriate ICTs to be identified and deployed in the extension system to complement ongoing extension efforts of the public and private extension systems. (vii) Collaboration among Farm Research and Developmental Institutions: Establish strong working collaboration among the ICT initiatives of the research and developmental institutions (IT solution providers). The leading research and educational institutions in agriculture and information technology solution providers should join together to leverage ICT penetration for agricultural extension. (viii) Convergence of Communication Methods & ICTs: For effective agricultural extension service delivery, the convergence of traditional extension communication methods (personal contact methods, print media, radio and TV) and new ICTs need to be blended optimally. (ix) ICTs & ICM: Integrating ICTs and Information and Communication Management (ICM) in agricultural extension will accelerate the pace and intensity of knowledge absorption among various stakeholders including

farmers. (x) Social Networks & Open Source Material: Promotion of appropriate use of social networks and open source material to disseminate information among agricultural stakeholders needs emphasis. (xi) Promote Leadership and Find Champions: ICT interventions need leadership. The champions are needed to push projects forward and make them visible and interesting to the agricultural stakeholders. These leaders must operate from local to national level (xii) Provide adequate infrastructure such as, LCD Projector/ Pico Projectors, Tablets, Computers, Internet, Video conferencing facility etc to various extension functionaries operating at different levels.

Areas that are recommended for immediate ICT intervention are as follows:

- Setting up of an Integrated Portal on Agricultural Marketing by integrating websites of: e-NAM, AGMARKNET, APEDA, APMCs, CWC, SWCs, CACP, CCI, DMI, FCI, JCI, KVKs, MPEDA, NAFED, TRIFED, NCDC, NDDB, NHB, SAMBs etc.
- Establishment of AGMARKNET nodes at KVKs and Panchayats using BharatNet connectivity.
- Strengthening of FMC's efforts in disseminating AGMARKNET information through Electronic Display System in Public Places.
- Introduction of technologies for scientific grading of agricultural commodities and electronic records at Village level / Panchayat level.
- Digital access to timely agricultural credits facilities for small and marginal farmers, at reasonable rate of Interest by financial institutions.
- Operationalisation of ICT enabled market-led Extension at farm level.
- ICT enabled Life Long Learning of Farmers (L3F) for their Livelihood.
- Establishment of e-National Bank for Agricultural Technology (e-NBAT) at MANAGE, e-State Bank of Agricultural Technology (e-SBAT) at SAMETIs level and e-District Bank for Agricultural Technology (e-DBAT) at ATMAs level to converge and disseminate appropriate technologies to farmers
- Connecting and facilitating FPOs, SHGs and other farmers' collectives with ICT enabled platforms for e-marketing.
- Enhancing digital competencies of farmers and extension personnel

8. Empowering Women for Income Enhancement

Rural women form the most productive work force in the economy of a majority of the nations, including India. Agricultural sector is the single largest production endeavour in India contributing 16 per cent of the GVA and is increasingly seeing women come to the forefront. Agriculture including various sub-sectors employs 80 per cent of all economically active women; they comprise 33 per cent of the agricultural labour force and 48 per cent of self employed farmers. About 18 per cent of the farm families in India, according to National Sample Survey Organisation (NSSO) Reports, are headed by women. Beyond the conventional market-oriented narrower definition of 'productive workers', almost all women in rural India can be considered as 'farmers' in some sense, working as agricultural labourers, unpaid workers in the family farm enterprises or combination of the two.

The direct contribution by women across all the sub-sectors of Agriculture is often underreported and inadequately reflected in macro-level data system. Several micro-level studies point to the fact, that women's participation in agriculture in India is anywhere between 60-75 per cent in most of the farm related activities, such as seed preparation for sowing, raising nurseries for seedlings, thinning, sowing, transplanting, weeding, preparation of fertilizers as well as application of fertilizer, in gap filling, winnowing, grading, shifting produce to threshing floor, cleaning and processing the grain etc. Some micro-level studies have even reported, that in selected activities such as cutting, picking, cleaning and drying of grains; and storage and processing, women's participation is almost 100 per cent. Several activities, such as weeding performed primarily by women, are recurrent daily activities lasting from time the seed is planted until it is harvested. This cascades into several hours of work investment by the women folk.

Even in respect of other sub-sectors of agriculture, like animal husbandry, fisheries and vegetable cultivation, women are involved in the core activities including in the marketing of the produce. In the dairy sector, almost 5 million women are active members of the milk cooperatives and as of 2016 there were 32,092 'women only' dairy cooperative societies.

Women Ownership in Agriculture

Despite significant presence of women in agriculture, figures from various data sources present, that their ownership of land in rural households ranges just between 6-11 per cent. Data from the latest Agricultural Census of 2010 indicates, that women's holdings account for 12.79 per cent of all holdings, representing about 10.36 per cent of the total operated area.

Rural women are mainly engaged in agricultural activities in three different ways depending on the socio-economic status of their family and regional factors. They work as:

(i) Cultivators doing labour on their own land. (ii) Managers of certain aspects of agricultural production by way of labour supervision and participation in post-harvest operations. (iii) Paid Labourers on others' farms.

National Sample Survey (NSS) data shows, that there has been steady decline of men in agriculture over the last three decades with their engagement coming down from 81 per cent to 63 per cent as compared to women, in whose case it has come down only marginally from 88 per cent to 79 per cent. This trend can be conveniently termed as "Feminization of Indian Agriculture" As more and more men have moved to non-farm work in the industrial and service sectors, women have remained in agriculture in substantive manner.

Women's contribution on farm and even in home is, however, not computed in monetary terms, thereby by-passing them to a large extent, in planning schemes & programmes, and also in developing strategies to successfully implement them. This paradigm assumes greater significance due to lack of gender dis-aggregated information and data. This is perhaps one of the key reasons for women's limited access to productive resources such as capital and credit; facilities and support services; land & markets; research and technology development etc.

Women in Agriculture - Constraints in their Contribution

Gender Bias: Women suffer from a statistical purdah as a result of which, their contribution is not recognized. They often have heavier workloads than men and bear virtually sole responsibility for family welfare and household management. However, they have either no or at best limited control over productive resources. This is also rooted in gender biases in labour markets and wage rates and has even resulted in their inadequate access to information about rights, opportunities, and support programmes etc. Increasing feminization of agriculture and the agricultural workforce, with little recognition of their role in land and livestock management, has meant that women have largely remained invisible to the government in terms of agricultural policies, schemes, programmes and budgets as well as formal support system such as credit, extension, insurance and marketing services.

Development Bias: Despite the contribution of women in the production process, persistent bias of development planners in treating them primarily as consumers of social services rather than producers, kept them away from the development programmes in agriculture and allied sectors. Some of the new agricultural technologies are reported to have affected farm women adversely. Green revolution had led to the dispossession of small women landholders, forcing them to join the ranks of wage earners. Wherever the new agricultural technology has led to multiple cropping, the work load of women has increased too. While a number of tasks performed by men have been mechanized, the tasks usually allotted to women continue to be manual and suffer from drudgery. Even where improved techniques

have been found for the women's activities, there is not sufficient access to training in such techniques.

Limited Access to Resources: Many of the constraints that rural women are confronted with are similar to those that all resource-poor farmers confront, such as lack of access to land, credit, training, extension and marketing facilities. But, for social and economic reasons, women's constraints are more pronounced and, in general, development interventions that seek to remove constraints for poor farmers do not reach women. Consequently, the development of technologies specifically tailored to women-centric occupations and the involvement of women in technology development and transfer have received inadequate attention from both scientific and administrative departments of governments.

Inadequate access to Markets: Women engaged in agriculture, forestry and fishery tend to produce small quantities and have poor access to organised marketing and cooperatives. Therefore, women sell mainly to private traders and have low bargaining power. Institutions which promote women's group access to market need to be strengthened. Successful examples are of SEWA, Gramin Bank, SHG Federations etc.

Lack of technology refinement for women: Women only benefit from agricultural support programmes if the information, technology and methods imparted are relevant to their production activities. However, agricultural research is generally much less oriented towards adapting technologies to women's physical status or towards addressing their tasks. Women's low productivity stems mainly from lack of appropriate technologies suited to their work.

Inadequate Extension Support: Women farmers also suffer from inadequacy of efforts in terms of content appropriateness and reach. The need for innovative changes in extension programmes for women farmers is felt. The experience of implementing central sector scheme "Women in Agriculture" and various externally aided programmes by the Department of Agriculture, Cooperation & Farmers' Welfare and Mahila Kisan Sashaktikaran Pariyojna of Ministry of Rural Development, has been encouraging as seen from the results and warrants up-scaling of these efforts and strategies. The need for capacity building and skill up-gradation of farm women has now begun receiving the priority it deserves. Special extension and technology dissemination programmes for women are being implemented. However, the span of attention and pace of execution need to be consistently intense, to catch up with the lagging status of women.

Budgetary allocations for Women in Agriculture

DAC&FW has been earmarking allocations to an extent of at least 30 per cent for women under its flagship schemes such as sub-mission on Agricultural Extension (SMAE), National Food Security Mission (NFSM), National Mission on Oil Seed and Oil Palm (NMOOP), National Mission on Sustainable Agriculture (NMSA), Sub-Mission for Seed & Planning

Material (SMSPM), Sub-Mission on Agricultural Mechanisation (SMAM), Mission for Integrated Development of Horticulture (MIDH) and Pradhan Mantri Krishi Sinchai Yojana.

However, evidence from various empirical studies suggests that this is not enough.

- Firstly, the growing presence of women in the agriculture sector over the years, has not been matched with equally substantial increase in the allocations for women farmers. The allocations in some of the beneficiary oriented schemes have been pegged at around 30 per cent without any specific rationale or basis to substantiate the same; these are not in proportion to the number of women involved in the particular sectors. This is only a good beginning and now needs to be refined and allocations made in consonance with the women's share under each scheme.
- Secondly, a look at various schemes of the DAC&FW shows, that as on date out of 55 odd schemes (subsumed now broadly under 7 missions), only around 14 schemes have specifically earmarked allocations for women. Significantly, there are no special schemes under the department that are either meant for women farmers exclusively or those which seek to address the special challenges of women farmers in difficult conditions (e.g., rainfed agriculture) across the country.

Women and Research

Along with an in-depth understanding of women's involvement in agriculture all along its value system, suitability of available technological options for them is an equally important issue. In order to reduce drudgery of work and improve work efficiency of women in agriculture, the technology designing and agronomics have to keep their specific issues in mind. As such, research on gender issues in agriculture and allied sectors including technology refinement in favour of women has to be an ongoing and gender sensitive activity.

The Central Institute for Women in Agriculture (CIWA), Bhubaneswar is the only centre mandated to push research agenda for women by way of participatory action research in different technology based thematic areas involving rural women. The Centre has been assessing suitability of available technologies for them and suggesting measures to make them women friendly. It also works to catalyse and facilitate R&D institutions to bring in farm women's perspective in their programmes. Besides, an All India Coordinated Research Project (AICRP) on Home Science 12 coordinating centres spread across the country as in operation with a view to developing a strong base for research and extension in State Agricultural Universities for improving the quality of life of rural families. This type of project initiated during the VI Five Year Plan Period, was subsequently merged with the then DRWA (Directorate of Research for Women in Agriculture) in XI Five Year Plan Period. The DRWA is now known as CIWA.

The AICRP on Home Science basically integrates all the five components of Home Science namely, Foods and Nutrition, Clothing and Textiles, Family Resource Management, Human Development & Family Studies and Home Science Extension Education. Each discipline has a specific thrust area of research that has been interwoven to focus on empowerment of women in agriculture. At present, the AICRP on Home Science is being implemented through its 12 Centres located at different State Agricultural Universities of the country, with their focus currently being on –

- Food & Nutrition security in selected farming system
- Drudgery assessment and mitigation
- Mitigating occupational health hazards
- Capacity building of agrarian families
- Empowerment of women

However, most of the times such research studies are highly location-specific thereby constraining their applicability across nation. Also, for the research work taken up under AICRP through identified 12 Centres, there is no formal mechanism to share the outcome and recommendations with the development agencies for its popularization among women farmers of different States. It is, therefore, essential to take up need based research activities linked in principle to feedback received from development agencies based on its adoption and performance in the field.

9. Strengthening Technology Backstop Institutions

Agricultural advisory services are intended to respond meaningfully to farmers, to transfer relevant knowledge and provide advice on diverse demands ranging from on-farm activities to off-farm, finance, business and market related issues. The ideas, advice and information so provided influence the decisions of farmers.

The reality however is that the rural population, especially farm women still have difficulty in accessing crucial information. The challenge is not only to improve the accessibility of information but also to make it available to the fellow women farmers. Modern communication technologies when applied to conditions at grassroots level can help improve communication, participation disseminating of information and sharing of knowledge and skills.

In addition to providing focussed support to farmers through public extension system which is largely man-power intensive, there exists potential to optimise the use of mass media for agricultural extension, which may have to follow the "lab-to-lab; lab-to-land; land-to-land; & land-to-lab modes of network and communication.

Lab-to-Lab & Lab-to-Land Communication

The process of technology generation and refinement is a continuous process. The National Agricultural Research System (NARS) of India is highly expansive and all-encompassing across all the sub-sectors and crop commodities of the sector of agriculture. It may not however be addressing all components of the agril. value system in a secular manner. It now needs to bring due focus on post-production aspects of the system.

There is a need to ensure parallel flow of information related to technology generation and its pooling at one level before the research outcome is translated into an extension message to be shared with farmers. As indicated in Chapter 3, a system has to be developed where research related outcomes flow parallelly and are pooled at the national level to ensure standardised extension approaches. Similarly, regional & state level research institutions viz. ATARIs and SAUs may have to work in tandem to ensure lab-to-lab flow of information and provide requisite extension support through State Department of Agriculture (SDA) & State Agricultural Management and Extension Training Institutes (SAMETIs).

A platform of this nature will also promote multi-directional communication among different laboratories and suggest a concrete partnership on different topics, which may have varying degrees of commonality. This will help in achieving a more comprehensive solution to the field problems, which may be more beneficial to the farmers. It will also bring in optimisation of resource use, namely, men, material and finances, besides saving

time. An institutional mechanism for promoting partnership between and among related labs on common farmer related problems would be highly useful, if put in place.

Land-to-Land & Land-to-Lab Communication

Land-to-land system of information dissemination may include individual Contact Methods – e.g. farm and home visits by ESP; Group Contact Methods – e.g. training, demonstration where a group of farmers are educated; and Mass Contact Methods – e.g. television, radio whereby large number of farmers can be reached.

Mass media involves the channels of communication which can expose large numbers of people to the same information at the same time; these are largely used at awareness and interest stages of adoption. These include media which convey information by sound (radio, audio cassettes); moving pictures (television, film, video); and print (posters, newspapers, leaflets).

Land-to-lab refers to conscious effort to identify field concerns and issues and escalate them to the scientists for research in their laboratories. In particular, problem-solving approach will get immediate attention and bring solutions to farmers' field problems. The laboratories will be engaged in real issues and not 'blue sky' research, which may not always be relevant in applied science.

Mass Media in Agricultural Extension

- Spreading awareness of new ideas and creating interest in farming innovations
- Giving timely warnings about possible pest and disease outbreaks, and urgent advice on what action to take
- Multiplying the impact of extension activities - A demonstration will only be attended by a small number of farmers, but the results will reach many more if they are reported in newspapers and on the radio & tele-visions
- Sharing experiences with other individuals and communities - The success of a village in establishing a local tree plantation might stimulate other villages to do the same if it is broadcast/telecast over mass media like radio & TV. Farmers are also often interested in hearing about the challenges/problems of other farmers and how they could overcome them
- Answering questions, and advising on problems common to a large number of farmers
- Reinforcing or repeating information and advice - Information heard at a meeting or passed on by an extension agent can soon be forgotten. It will be remembered more easily if it is reinforced by mass media. Memory gets strengthened through repetition

- Using a variety of sources that are credible to farmers has its advantages too. Instead of hearing advice from the extension agent only, farmers can be brought into contact with successful farmers from other areas, respected political figures and agricultural specialists, when mass media is deployed

Farm Journalism - Vehicle for Extension Services and Outreach

Mass communication and Journalism education assume new significance in the age of globalisation and communication. Mass media are an agent of information education, entertainment and motivation. They open up the farmers to accepting agricultural innovations and technology and therefore serve as a vehicle for such transfer.

Agricultural extension is essentially a communication process, and it conveys improved or recommended or alternate practices to farmers with a view to improving their methods of agricultural production and marketing of their produce.

Professionalising Agricultural Extension through Agri-preneurs

Agri-Clinics and Agri-Business Centre is another public sector mode of providing extension services to farmers, the difference being, that it is on payment basis. These Centres can be utilized to support agricultural extension. These can become effective paid extension service centres run as enterprises by agricultural science graduates.

The selected trainees can be provided agri-preneurship training for a period of two months by MANAGE through identified Nodal Training Institutions in various states, which will also offer handholding support for one year. NABARD can offer the credit support to Agri-Clinics through Scheduled Banks. Such a provision exists and credit-linked back-ended subsidy at 36 per cent has been approved under the scheme. The subsidy is higher at 44 per cent in respect of candidates belonging to SC and ST, as well as women categories and those from Northeastern and Hill states.

Agri Start-ups by Farmers: Stream II of AC&ABC

Considering the vast farmer population of the country and the potential that exists in the process for information dissemination through AC&ABCs and in line with the Government's aim of doubling the farmers' income by 2022, it is suggested to enhance the scope of the AC&ABC.

An additional stream can be created, wherein, farmers with hands-on-experience in agriculture and allied areas but without any formal education in agriculture & allied sciences are also provided training under the AC&ABC scheme, and encouraged to start agri-ventures and join the process of information dissemination. This will provide additional momentum to the creation of self-employment opportunities in the agriculture sector.

Evoking Individual Social Responsibility (ISR)

More than 250,000 agriculture science professionals are working in various public and private research, academic and developmental organisations across the country. Many of these professionals do entertain a desire to contribute to farmers' welfare in the form of individual social responsibility. An appropriate policy support and institutional mechanism can help in channelizing this productivity in a systematic and professional manner and offer farmers an additional service window.

There is need for developing appropriate Operational Guidelines for implementing Individual Social Responsibility (ISR) initiatives for all those working in both public and private institutions. The Guidelines may highlight policy support and incentivise them by offering leave provision, transport allowance and nominal expenses required for implementing individually committed ISR activities.

The ISR activities to begin with may be by free volition of the individuals. Based on learnings from the initial pilots, an element of mandatoriness can be considered. Thus, even small initiatives such as adoption of individual farmer family or a village, large number of professionals will be mentoring the farmers to become more professional and entrepreneurial. These initiatives may be of limited nature, more profitably linked to transfer of knowledge, skills, attitudinal change etc.

10. Research & Development for Doubling Farmers' Income

From Science of Discovery to Science of Delivery

Science and technology, with the support of pragmatic policies, outcome oriented budgetary allocations and convergence of schemes based on agro-ecologically focused growth engines, will be key to realizing the vision of doubling farmers' incomes (DFI) by 2022. This calls for a change in the mindset on how the research is undertaken – an approach that is holistic, uses modern day knowledge transfer technologies to enable rapid cycle innovation among agri entrepreneurs and farmer organisations, to translate effectively the 'Science of Discovery to the Science of Delivery'.

Indian farmers are presently vulnerable to impacts of climate change, water scarcity and land degradation. In addition, increasing fragmentation of holdings, extreme weather events, rising input costs and post-harvest losses pose an enormous challenge to sustaining agricultural growth. Modernisation of research systems draws strongly on Spatial Data Integration (SDI), especially cloud computing capabilities to integrate data assets across organisations. This will help support modern breeding programs, model priorities and track progress using geo-spatial analytics and apply machine-learning to distil complex data into actionable and relevant recommendations for farmers.

There has been considerable expansion and change in the research and extension system, but the key questions remain: 'Is this sufficient to double farmers' incomes by 2022? Is there a need for a different mindset to ensure that agriculture science empowers farmers to reach their full economic potential? Can this be achieved while delivering nutrition to the nation as well as within the ecological boundaries of India's natural resources?' It is important to note, that 'Demand-Driven Innovation', that leverages participatory research to engage farmers to optimise their individual value chain, and key supply chain actors to design, develop and deliver relevant income centric solutions, takes on a sense of urgency. The core to this modern approach is compressing the time to deliver technology and knowledge at scale and to ensure desired outcomes are achieved.

WHY is a Change in Research Mindset Needed?

Although the Indian agricultural Research & Development (R&D) system has been one of the pioneering systems among developing countries, there are many complexities restricting it from realizing its full potential. Though there has been considerable change in the research and extension system in India, many issues persist. Farming is not generating sufficient income opportunities, with 48 per cent of the population generating only 15 per cent of the nation's Gross value added (GVA). This situation does not support welfare of agriculture dependent population. This requires innovation to reduce production costs and market

systems to increase unit prices of farm produce, with both integrating appropriate technology and services to reduce production and market risks. Only if these issues are addressed, will farmers have an opportunity to double their incomes and youth (future farmers) see agriculture as a viable commercial enterprise.

Science of Delivery needs to be Rewarded

Science of Delivery is focused on HOW to realize large and sustained impact that draws on knowledge management and diverse methods of sharing that include large-scale demonstrations to inform decisions, adapt approaches and changed mindsets that accelerate the innovation cycle and ensure local conditions, context and culture are considered in developing and delivering products and services. It also helps compress timelines from discovery to delivery.

The process of understanding how delivery works in agriculture needs to be informed by a broad range of partners across sectors and regions and new tools like social media that aid immensely in this endeavour. Better understanding of delivery challenges and failures will significantly improve system ability to achieve consistent and transformational impacts in farmers' fields and consumers' plates. It needs to be recognized that soft skills are required to work effectively in the domain of delivery, but these are neither taught in agriculture science curricula nor are there incentives within institutions to hone these critical skills.

Compressing Science of Discovery to support Science of Delivery

The first mile (discovery) needs to have the last mile (delivery) in mind. In this regard, the National Agricultural Research System (NARS) should be committed to reducing the time for discovery science to reach farmers' fields. ICRISAT and its partners have adopted this approach in modernization of crop improvement programs to accelerate the development and release of new varieties.

Assessing the status of breeding programs is the entry point for modernization based on best practices used in public and private sector breeding programs. Based on this assessment, prioritised investments were made and implementation of best practices were monitored. New tools included the adoption of a cloud-based breeding management system (BMS), standardized trait ontologies, bar-coding to reduce data error, high throughput genotyping to support marker-assisted breeding, early generation multi-location testing, and crop modelling to target product development and release.

Development of the molecular tools to integrate multiple traits is supported through international and national partner networks that are now utilizing genome sequences to resequence a wide diversity of crop germplasm to develop molecular markers in service of developing diverse, robust and nutritious new varieties.

Another area of rapid innovation is in the integration of modeling, remote sensing, advanced geo-spatial analytics, cloud-computing, internet-of-things and mobile phones. Integration of these tools is providing timely and targeted insights for farmers, agri-business, markets and policy makers. However, the research community is in the early stages realizing the potential of integrating this domain with that of modern crop improvement and farming systems to optimize variety development in the context of farming systems and market demands.

Leverage DFI Agenda to Drive Convergence

The national mandate on Doubling Farmers' Income (DFI) is an opportunity to drive convergence across Ministries (State and Union), schemes, local farmers, supply chain actors, value adding processes, and to accelerate the adoption of sustainable (economically, socially, and environmental) options to empower farmers and produce nutrition to a growing nation. Research and innovation for impact are most important, where, challenges are greatest and the best solutions are delivered by diverse teams – this is true of Indian agriculture. Fortunately, India has been putting in place the digital infrastructure to deliver personalized interventions to farmers through Aadhaar, alongside a wide range of policy support measures to create an enabling environment for farmers and a clear goal to work towards.

In this context, the agenda of research and development needs to be changed to crowd in greater efforts on integrating research and development through active public-private partnerships that are demand-driven and based on sustainable economic growth engines for rural communities. This will require a framework to prioritize research within each agro-ecology and state to frame convergence of schemes, institutions (public and private) and disciplines that include new areas such as nutrition, health and education to deliver on both short- and longer-term development goals of India.
