

## Agriculture for jobs and income - Reorienting agricultural extension

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### ABSTRACT

*Over the last 74 years of her independence, India has successfully transformed the country from a severe food deficit status to one of food surplus. Today, India is recognised globally as one of the leading agri-producers. This has been the outcome of a triple-intervention, comprising technology, extension and policy framework relating to agriculture. Given, that agriculture is influenced by external factors like climate at the production stage, and markets at the post-production stage, it is expected to change from situation to situation. Today's environment vis-à-vis agriculture and farmer-producers is demanding a paradigm shift from production-centricity to an enterprise-approach. The visible demands on the agricultural system of the country are nutritional security for the consumers, income security for the farmers and sustainable production for the conservation of ecology. Agricultural extension system has always kept pace with the changing demands, and it needs reorientation once again to respond appropriately to the current context in India.*

### CONCEPT BEHIND AGRICULTURAL EXTENSION

The beginnings of agricultural extension can be traced back to word-of-mouth dissemination of knowledge and technologies by the farmers among themselves, as also attributable to personal observations by the farmers as they happened to visit other farms in the neighbourhood or close by villages. However, mobility in the olden days being limited, such personal observations may also have been circumscribed. The need for organised system of transfer of technology originated with formalised system of research and development in agriculture.

At the global level, the first formal research in agriculture commenced with various experiments undertaken on Rothemsted farms in England in the 16<sup>th</sup> century. Such research initiative then followed in various other countries, but mostly in the western part of the society. It was logical, that extension in agriculture would follow from these research initiatives. The term “extension” was first used in the United States of America in the first decade of 1900s to imply the extension of knowledge from the Land Grant Colleges to the farmers, through the process of informal education.

In case of India, formalised courses in

agricultural education began in the first decade of the 20<sup>th</sup> century, when 6 (six) agricultural colleges came to be established at Kanpur; Lyalpur (now in Pakistan), Coimbatore and Nagpur (all in 1905); Pune (1907); Sabour (1908) under the jurisdiction of General Universities. Some research institutions also came to be setup in the 1920s. However, it was basis the recommendations of the Royal Commission on Agriculture in their Report (1928), that a more broad-based agricultural research and education system took shape. The establishment (16<sup>th</sup> July 1929) of the Imperial Council of Agricultural Research (ICAR), renamed as the Indian Council of Agricultural Research after independence laid the firm foundation for agricultural education & research in India. It was logical that the new corpus of knowledge and technology needed to be transferred to the farmers, and that's how the seed of formal extension came to be sowed. It must be appreciated, that agricultural extension is part of a larger agricultural knowledge tripod comprising (i) agricultural higher education; (ii) agricultural research; and (iii) agricultural extension. This tripod interacts with farmers who are the primary stakeholders, and also with various other actors constituting the value chain, including the aggregators, traders (retail and wholesale), transporters, processors, exporters etc.

## Defining Extension

The concept of extension has evolved over a period of time. In order to appreciate its meaning and purpose, a survey of varying definitions of agricultural extension would be useful. Some of these are offered below:

- *Extension education is an applied science consisting of contents derived from researches, accumulated field experiences and relevant principles drawn from the behavioural sciences synthesized with useful technology, in a body of philosophy, principles, contents and methods focussed on the problems of out of school education for adults and youths. (Leagans. J.P)*
- *Extension is education and its purpose is to change the attitude and practices of the people with whom the work is done.*
- *Extension education is education for the betterment of people and for changing their behaviour i.e., knowledge, skill and attitude.*
- *Extension education deals with practical items of information which is useful for rural people which solve daily problems, especially, those related to agricultural production.*

These definitions showcase, that the purpose of agricultural extension is to change the people's (primarily farmers in this case) behaviour in terms of knowledge, skill and attitude, with a view to achieving the desired results in the domain of agriculture. A survey of the country's agricultural growth story will amplify, that the targeted goal(s) of agricultural extension has/have evolved in synch with the changing demands from time to time. In the twenty-first century, with cataclysmic changes in the production-pattern of agriculture, climate and the purchasing-power associated demands, the agricultural extension system will also need to metamorphose to influence the agricultural sector all along its value chain.

## Beginnings and Evolution of Agriculture Extension in India

It was Frank Lugard Brayne the Collector of

a district in the State of Punjab, who initiated agricultural extension in 1920. India, acutely aware of its state of food deficit in 1947 prioritised enhancing food production, and what followed logically as the first initiative was "Grow More Food Campaign" (GMFC, 1947). This marked the transition of sporadic, dispersed, local and voluntary agricultural advisory initiatives of pre-independent India to a more formal system of agricultural extension in independent India. A series of well organised and robustly structured systems of agricultural extension followed thereafter, as discussed below:

- Community Development Programme (CDP, 1952); National Extension Services (NES, 1953); Intensive Agricultural District Programme (IADP, 1961); and Intensive Agriculture Area Programme (IAAP, 1964-65). The first 2 (two) initiatives popularised the terms 'community development' and 'extension education'. India lived in its villages when the first five-year plan was launched in 1951. Even today, the rural population at 65 per cent of the country's total population makes India rural in character. Since the 1950s, while community development has been practised as an approach to all-round development of the rural society, extension education has been considered as the means to achieving this objective. Agriculture has always remained an important economic activity of the country, and has been more emphatic in the rural India with the majority depending upon it for livelihood. It is the dependence of the majority on agriculture directly and indirectly for its livelihood, that makes this primary economic activity a critical corner stone of the country's development and welfare strategy. This is notwithstanding the declining share of agriculture in the nation's GVA (Gross Value Added). As per Agricultural Statistics at a Glance, 2020 (ASG, 2020), the GVA in 2012-13 @ 2011-12 prices was 15.3 per cent of the nation's economy, and it has been experiencing a declining trend since 2013-14. The agricultural GVA in the year 2020-21 jumping up to 20 per

cent of the nation's GVA is an exception, as other sectors of the economy performed below par affected by corona-pandemic. The Census, 2011 shows that the total number of agricultural workers were 263 million in that year, which broke into 118.7 million cultivators and 144.3 million landless agricultural labour, which accounted for 45.1 and 54.9 per cents in terms of percentage. Clearly, the dependence on the agricultural sector for jobs and incomes is very high in the country. This provides the logic for orientation of both, the agricultural system and agricultural extension system to make generation of jobs and incomes as their principal mandate.

- The next phase of evolution began with the launch of Green Revolution (1965-67) and the programmes included National Demonstrations (1965); Farmers Training Centres (FTC, 1966); Small and Marginal Farmers Development Agencies (SFDA, 1971); Krishi Vigyan Kendra's (KVKs, 1974) and Lab to Land Programme (LLP, 1979).
- A turning point in the growth of agricultural extension system in the country came with the World Bank-assisted initiative called Training and Visit (T&V) system of extension. Till then, the ground level extension service was carried out by a multi-purpose worker who was in-charge of a bouquet of rural development activities including agriculture. In order to bring greater focus on agricultural development, a specialised cadre with agriculture service as the sole mandate was created under T&V approach, financed by the World Bank under the National Agricultural Extension Project (NAEP). The technology back-stopping to this project came from National Agricultural Research Project (NARP). Initiated as a pilot project in 1979, it was scaled up across the entire country between 1984 and 1995.
- The next phase of reforms imparted to agricultural extension came via the National Agricultural Technology Project (NATP, 1998),

which was scaled up across the country by 2005. This project aims at integrated extension through the district level Agricultural Technology Management Agency (ATMA). The KVKs located in the districts provided the technology back-stopping. While at the district level, the ATMA and KVKs are to work liaison, at the state level, it is the partnership between SAMETI (State Agricultural Management and Extension Training Institute) and ATARI (Agricultural Technology Application Research Institute). Other R&D Centres and SAUs (State Agriculture Universities) also providing the necessary technology support. NATP rightly recognised the need to go beyond production intervention and incorporate marketing as an important component of the agricultural extension system. The project aims at utilising the services of all the agencies within and outside the government systems for delivery of services.

Not with standing these initiatives, the farmers in India have been for more than a decade facing challenges in realising remunerative prices on their produce. For farmers to sustain their farming activities, they must earn profits, which is possible when they can realise productivity-based higher output, rationalise cost of production and be able to convert their marketable surpluses into optimal value. In contrast to this desired optimal situation, the concerns today vis-à-vis the country's agricultural sector are increasing cost of production, price disequilibrium due to supplies exceeding demand besides fluctuations in prices, and debilitation in production environment mostly linked to extractive technology. The challenge stands further exacerbated by the climate change and its negative influence. This new context calls for a new approach to the system of agriculture and concomitantly the system of agricultural extension. It is necessary, therefore to examine the status of agriculture in India today and take note of the challenges and concerns so as to respond appropriately through the re-oriented agricultural extension system.

### Agriculture in India Today – New Challenges, Concerns and Context for Change

Since 1947 agriculture in India has registered impressive growth in terms of both quantum and diversity. Thanks to diverse agro-climatic and conducive production environment in the country, India's agriculture outputs a range of agri-produce encompassing agronomic (cereals, pulses, oilseeds and commercial crops like sugarcane and cotton etc.); horticultural (fruits, vegetables, flowers, plantation and herbal and medicinal); dairy and livestock; fisheries and aquaculture sub-sectors. The cumulative output of agri-produce in India was 1.3 billion metric tonnes in the year 2020-21. The country has made laudable marks in certain segments like cereals (wheat and rice), commercial (sugarcane and cotton), fruits and vegetables, milk, meat, and fisheries, garnering one of the top three positions at the global level. The year 2020-21 ended with a record output of 309 million tonnes of food grains, 320 million tonnes of horticulture, 195 million tonnes of milk and 14 million tonnes of fish. All this has been possible on account of triple dose of technology, policy and extension working in tandem. However, the sector has come to be subjected to new concerns and challenges, some of which are old and some are new in origin. These are listed and discussed briefly in the following sections.

#### Concerns and Challenges

- i) Challenge to scale of operations due to continuing land division and fragmentation
- ii) Increasing stress on availability and quality of soil and water
- iii) Indiscrete use of agro-chemicals (inorganic fertilizers and pesticides without reference to the actual need) resulting in high cost of production, and lowering of soil fertility and developing of resistance to pesticides
- iv) Decreasing marginal rates of return in case of certain crops like wheat and paddy
- v) Non-availability of labour in time, and high cost in juxtaposition to low level of agricultural mechanisation
- vi) Inadequate access to institutional credit for both production and capital investments
- vii) Increasing risks at pre-production and production stages on account of negative impacts of climate change
- viii) Increasing risk at post-production stage on account of poor market structure and absence of market competitiveness, besides poor financial withholding capacity of the farmers
- ix) Less than desired status of agri-logistics (dry and cold storage, transportation etc) resulting in high degree of food loss and poor connectivity in far-range markets, where there could be demand. One sees surpluses in local area and unmet demand elsewhere
- x) Poor status of rural infrastructure (roads, communication, electricity etc).
- xi) Low level of agro-processing (food and non-food) of the agri-output
- xii) Iniquitous production-basket resulting in simultaneous surpluses of some commodities (cereals) and deficit of some others (pulses and oilseeds)
- xiii) Food sufficiency and simultaneous nutrition deficiency, resulting in high degree of malnourishment in the country
- xiv) Non-egalitarian approach to utilisation of land resources as manifest in overuse of irrigated lands and less than desired attention to rainfed systems resulting in high degree of per ha. yield differences
- xv) Over-dependence on select crop segments (further more on agronomic relative to horticulture within the crop domain) with comparatively lesser attention to other sub-sectors like animal husbandry and fisheries& aquaculture
- xvi) Gender bias as seen from poor ownership of land and other resources, designing of women-centric technologies etc. for women in agriculture, despite growing feminisation

- xvii) Fragmentation of markets across the country resulting in inability of the markets to discover competitive prices on the agri-produce
- xviii) Over regulation of agri-produce in respect to storage and transportation, discouraging private sector trade and investments in agri-logistics
- xix) Weak institutional and sub-system linkages, and poor convergence at national, state and district levels
- xx) Absence of long term and stable duty-regime that is facilitative of import-export environment
- xxi) Consumer-centric inflation management to the disadvantage of the farmer producers

While the above issues have been on the agricultural-scene of the country for long time by now, some new issues that are of recent origin and are coming into visible focus are as follows.

- i) Non-utilisation of agricultural residues relating to crops, dairy and livestock, fisheries & aquaculture that are generated at the production stage as also at processing stage. Simultaneously, unscientific handling of crop residues as seen in burning of paddy straw
- ii) Absence of a professional management of agro-chemical waste leading to pollution of both surface and groundwater
- iii) Loss of bio-diversity due to irrational use of land arising from absence of land use policy and planning
- iv) Unsustainable production system on account of mono-cropping and extractive systems of production technology

#### Manifestations of these challenges

This complex of concerns and challenges has been expressing itself negatively on the agriculture sector, as also the farmers. The composite manifest is unsustainability of agriculture, which is seen in existence of under-

employment and disguised unemployment and a low average annual income for the agricultural households. This is apart from plateauing of yields in case of premier crops like paddy and wheat in the Indo-Gangetic plains, low average productivity in comparison to better performing nations, inter-system (irrigated vs. rainfed) yield variations and partial tapping of the technical yield potential in general. Non-harvesting of the technical yield potential is resulting from the farmers' inability to adopt agronomic practices as recommended by the research system. In order to adopt good production practices, the farmers need access to quality inputs (seeds, planting material etc.), adequate credit, latest information and knowledge, appropriate skills, emerging digital technology and efficient monetisation mechanism. Only, when the farmers supported by the composite-monetisation tool consisting of 'agri logistics-processing-marketing', will they be able to optimise their value capture *vis-à-vis* the agri-produce, and in turn benefit from higher positive returns on the investments made. This will make savings possible savings, that are necessary for re-investment in harmony with recommended package of practices. All that is entailed in consequence, is the importance of an appropriate extension-system.

An efficient and effective extension system is capable of generating aspirations and convert unfelt needs into felt needs in the farmers. Such an extension system is capable of upgrading the associated package of information, knowledge and skill required along the agri-value chain, thereby creating a virtuous cycle for a healthy agricultural system. It essentially will transform agriculture from production-oriented system to agri-business system. An agri-business practised on enterprise lines will operate with profits, employment and income as the key performance indicators of efficiency.

#### Re-imagining and Re-mandating of India's Agriculture

The 21<sup>st</sup> Century has come to challenge the Lewis Model of development which believed in the

ability of the industrial sector to absorb the shifting surplus manpower from the agriculture sector. Arthur Lewis, a development economist put forward his development model called “Economic Development with Unlimited Supplies of Labour”. It envisaged that capital accumulation in the modern industrial sector will continuously draw labour from the subsistence-oriented agriculture sector. This model has been slightly modified by Fei and Ranis subsequently. But, the essence of both the models remains the same. This model which may have been relevant during the early phase of industrial revolution, and even for many decades in the 20<sup>th</sup> century does not seem valid for the 21<sup>st</sup> century. India like most other countries now faces a new paradigm characterised by the following developments.

- i) It is not always easy to find market for the increasing output of goods in the industrial sector and services in the service sector, as countries across the world are building their own domestic capacities. One has to be always competitive to bag a slice of the global market share, and it may not be possible always. In the 18<sup>th</sup> and 19<sup>th</sup> centuries, the newly industrialised and industrialising countries in the west were early birds and also some of them had captive colonial markets for their manufactured goods. It was easy for them, therefore, to expand their territorial markets (including domestic to global markets) and thereby find rationale for expanding their manufacturing base. This enabled the industrial sector to demand and absorb surplus manpower available in the agriculture sector, which was largely subsistent in character.
- ii) The emerging digital technologies of today, comprising artificial intelligence, machine learning, robotics, internet of things, sensors, drones etc. are disruptive and labour-substituting in character. Though the technologies have so far, proved to be disruptive and generators of new nature of jobs, one is not sure of the current set of emerging technologies. Thus, the industry and service sectors may not

be able to generate jobs in proportion to the rate of capital investments and offer gainful jobs to the manpower in agriculture and facilitate a shift therefrom.

This indicates that it will not be easy to shift the huge population now engaged in India's agriculture to non-farm sectors. Agriculture is the predominant livelihood option even now in rural India. The Census 2011 shows, that the total number of agricultural workers were 263 million consisting of 118.7 million cultivators and 144.3 million landless agricultural labour. The Labour Force Participation Rate (LFPR) is also high in India. It is seen from the Agricultural Statistics at a Glance (ASG, 2020) that of the total population, LFPR equivalent to or more than 15 years of age was 499.1 million in the year 2016, which accounted for 52 per cent of the country's total estimated population of 1293.5 million in that year. Employment and income always go together in an economy. When the economy cannot generate adequate employment, or those employed are actually suffering from under-employment or disguised unemployment, the average income is bound to be low. In such a situation, the welfare of the people is catered to by the governments through various welfare centric schemes. In India, a large percentage of its population lives below poverty line. As per Tendulkar Committee methodology, the percentage of population below poverty line in the year 2011-12 was 25.7 per cent in rural India and 13.7 per cent in urban areas (ASG, 2020).

Given this socio-economic structure, it would help to appreciate some key dimensions of the new paradigm in India. These are indicated below.

- I) Those engaged in agriculture sector are neither happy any more nor are satisfied with “subsistence economy”. There is growing aspiration in rural India, particularly among the youth for higher purchasing power of money
- ii) There is growing awareness about inadequacy relating to post harvest management and rising demand for better opportunities to market and monetise their produce

- iii) There is growing awareness about the growth potential of horticulture, dairy and livestock, and fisheries and aquaculture sectors and a general desire for diversification
- iv) There is slow but steady realisation about the need for adopting bio-economy, linked to agro-processing (food and non-food) fed by the biologically generated raw materials on the farms and in the neighbourhood (forest, pasture lands, waterbodies, etc.)
- v) Modern agriculture has scope for increased access to modern technologies and methods of organisation, which can negotiate the challenges of land division and fragmentation as also decentralised and disaggregated agri-produce. The opportunity for this will come from promotion of farmer producer organisations, contract farming, digital trade platforms for both input and output management etc.

These factors are positive in nature and can trigger new approaches to management of agriculture. This suggests the existence of a favourable option for breaking free of the conventional production system limited largely to of food, fodder and fibre and, upgrade it as a contemporary economic activity at par with industry and services. This issue was deliberated in detail by the Inter-Ministerial Committee constituted by Government of India in April, 2016 to recommend strategies for doubling farmers income (DFI). The Committee in its Report (September, 2018) recommends re-mandating of agriculture on the following lines:

- Meet the moral responsibility of ensuring food and nutritional security of the country in consonance with the agro-ecological backdrop
- Generate gainful employment resulting in income gains to make the farmers economically secure
- Generate raw materials that will directly support agro-processing of food and non-food produce to support secondary agriculture

- Support agro-processing industry to produce primary and intermediate goods, which will feed the manufacturing sector

#### Re-orienting Agricultural Extension

Since the purpose of extension is to change the behaviour of the concerned stakeholders with a view to achieving a set of goals, agricultural extension in India needs to be re-oriented to address the complex of concerns and challenges outlined earlier and meet the new mandate as defined above.

Extension systems all over the world are being challenged to improve their relevance and effectiveness in contributing to agricultural and rural livelihood sustainability in an environment of increasing economic, social and ecological risk (Beck 1992; Funtowitz and Ravetz, 1993). The changes required are broadly in relation to sustainability of technology, nutritional security of the consumers, efficiency of marketing, and resilience to climate change.

In India too, the extension system is now required to undergo qualitative change in response to the current and future demands, some of which are discussed below:

- The extension system is needed to promote production system that will offer nutrition security and not just carbohydrate security to the people, keeping in mind that good health is predicated upon balanced diet.
- The extension system is required to advise the farmers to adopt agriculture as an enterprise and therefore practice demand- and price-led production, so that the farmer-producers benefit from remunerative prices.
- The extension system is expected to promote agricultural value chain, so that there is seamless integration of farm-gates with markets resulting in reduced food loss and higher value capture for the farmers.
- The extension system is meant to look beyond the conventional agricultural production and facilitate sustainable production that is science- and evidence-based natural resource

management, more specifically soil nutrient and water management, protection of biodiversity and ecological services.

- With increasing climate change-centric risks to production, the demand on extension system is to focus on both technology and price-risk negotiating tools.
- The extension system is warranted to promote a more broad-based agricultural system by including all sub-sectors including dairy, livestock, fisheries, aquaculture, agro-forestry, herbal and medicinal plants among others.
- Simultaneously, it is incumbent upon the extension system to tap the potential that exists in respect of neglected activities like millets and poorly endowed regions like that of the rainfed areas.
- The extension system would do well to include secondary agriculture besides primary agriculture as its canvas of service delivery.

To be relevant in the present context defined by demand for jobs and incomes, the agricultural extension system will have to be re-imagined treating the new complex of concerns and challenges as a new opportunity to stimulate a paradigm shift to the practice of agriculture. Simultaneously, due emphasis will be needed on ensuring social equity, people's participation and respect for local tradition and customs. This makes it obvious, that the agricultural and extension education institutions revisit their curriculum and pedagogical methods to prepare the extension professionals for the 21<sup>st</sup> century environment.

The DFI Committee deliberated upon these aspects, and stressing the importance of creating opportunities in agriculture for jobs and incomes defines agriculture extension as:

*“A system of empowering farmers with information, knowledge, technology, skill risk and farm management practices, across agricultural sub-sectors and commodity specific agricultural value chain, so as to enable the farmers to realise higher net income from their enterprise on a sustainable basis.”*

Further, the DFI Committee which pivoted its strategy for higher incomes has made comprehensive recommendations based on delineation of the sources of income growth and suggests the corresponding extension strategy to achieve the target of income increase by the year 2022. It would help in understanding the sources of income growth and the approach to management of agriculture, bearing in mind that the spirit of the recommended strategy is linked to generation of jobs, and not welfare-centric money transfers. This is, however, not to deny the role of welfare interventions alongside income-orientation to agriculture.

#### DFI Recommendations – Source of Income Growth

The Inter-Ministerial Committee on Doubling Farmers Income in its 2018 Report has recommended the following seven sources of growth to achieve the targeted income by 2022. These sources will hold good even thereafter as the basis for transforming production-centric agriculture into an income-centric enterprise on a sustainable basis. This approach is also suitable, because it will help in achieving the goals relating to food and nutrition security, eradication of hunger and poverty, and promotion of sustainability as these are agriculture related important goals under India's commitment to Sustainable Development Goals (SDGs), 2030.

1. Improvement in crop productivity
2. Improvement in livestock productivity
3. Resource use efficiency or savings in cost of production
4. Increase in cropping intensity
5. Diversification towards high value crops
6. Improvement in real prices received by farmers
7. Shift from farm to non-farm occupations

As seen above, first six of the seven sources of growth relate directly to agricultural sector. While the seventh source may largely belong to the domains of industrial and service sectors, the



agriculture sector too has an important role to play, if it can facilitate secondary agriculture. Secondary agriculture is based on adoption of food and non-food processing activities. The agro-processing sector which utilises both primary and co-produce generated in the agricultural sector (crops, dairy and livestock, fisheries and aquaculture) can be organised at different levels of processing. These include cottage and village enterprises (mostly for primary processing); small and medium enterprises (mostly for secondary processing) and large and mega enterprises (for high-end processing).

While promoting cottage and village level, as also small enterprises based on locally available agri-produce including residues and wastes, it is the local farmers and landless agricultural labour who can become the proprietor-entrepreneurs. When medium, large and mega enterprises based on agriculturally generated raw materials are promoted, the local farmers and landless labour can find employment opportunities as employees. In either case, the extension system will be called upon to meet the new demand for upgrading the i) entrepreneurial capacities of the farmers and landless labour to become entrepreneurs and ii) skills, knowledge etc. needed to enhance their employability in the secondary agriculture sector. This indicates the need for structural change in the character of extension personnel, which means, that the manpower will need to be not only competent in relation to production, but also be well equipped with post-harvest aspects including aggregation of produce, primary processing, marketing and enterprise promotion etc.

#### Transitioning Agriculture into Agri-business

The extension staff will do well to understand adequately enough to educate and guide the farmers about the key pillars of an income approach to agriculture. This need can be explained as follows.

- Fulcrum Equation
  - o  $[\text{Gross output} \times \text{Remunerative return}] - \text{Cost (Production)} = \text{Net Returns}$

- Primary Pillars (3)
  - o Productivity gains
  - o Cost Efficiency
  - o Monetisation (agri-logistics, processing and marketing)
- Support Pillars (2)
  - o Sustainable technologies and practices
  - o Risk management
- Governance
  - o Efficient Implementation
  - o Maintaining correlation across activities; Ecosystem's approach

#### Response to the New Demands – Expansion of the Extension Perspective

In the context of the new demand on the extension system as outlined above, some select but important dimensions of the new extension, that would need to be taken care of, are discussed below.

- i) Efficiency and effectiveness of extension system

The extension system can be said to be efficient, if it can link the source of information with the receivers by deploying appropriate methods and ensuring adoption of the new practice without any or minimal distortion. Traditionally, the methods followed by the extension system have been (a) individual contact (b) group contact and (c) mass contact.

Confined earlier to analog technology, today digital technology is available with huge potential to facilitate speedy and realtime sharing of data and information with the targeted population. Hence, this digital-based extension method should be considered as valuable and made use of. Depending upon the nature and urgency of the information to be shared, any one or a combination of more than one can be used for efficient extension system.

The sharing of information has not only to be efficient but also effective. Effectiveness refers more to quality, implying the accuracy,

availability, applicability and scope for analysis of the outcome as its parameters. Effectiveness can be ensured, when the extension system understands the entire ecosystem and the actors therein. Further, an optimal blend of the methods impacts the effectiveness.

ii) Cost efficiency in extension

Given that human resource today is not only costly, but also that most states seem to be suffering from manpower-shortage, it is necessary to optimally blend manpower and digital technology as extension tools for both effectiveness in delivery and efficiency of cost. In fact, digital technology is more efficient and effective in transferring repetitive nature of information and achieving real time sharing. In various aspects relating to agriculture, farmers would need the real time data and information for effective application. Such data sets relate to weather, market demand and prices, natural calamities, status of pest and disease etc. Information on availability of inputs along with location is also required by the farmers. ICT can be used extensively for meeting such demands.

However, the importance of manpower in extension cannot be downplayed. Individual and group contacts become inevitable in transferring skills. In case of promoting entrepreneurship and employability, skill upgradation assumes importance. Hence, the manpower component of the extension machinery continues to remain critical. For purpose of effectiveness and efficiency of the manpower, they need to be supported continuously for upgradation of their knowledge and communication in engaging with the targeted population.

iii) Agricultural value chain extension

In order to promote agri-business, agriculture value chain-based system will need to be adopted. Since the entire output value system commences at farm gates and ends in markets,

large number of stakeholders will need to align their activities for efficiency of the agricultural system. These among others include transporters, warehouse keepers, marketers, processors, exporters, etc. These stakeholders together form the output supply chain, wherein, each actor has an individual model to capture value for the roll he plays. The extension system needs to understand as to how the value system can be utilised for the benefit of the farmers. Extension is a support system in respect of both input and output management. The extension system must therefore understand commodity- and location-specific agri-value chains and integrate farmers into these.

iv) Extension for risk management

Agriculture is one of the riskiest of enterprises, vulnerable as it is to nature at production stage, and perishability & price fluctuation at the post-production stage. The extension agencies must be fully aware of various technologies that will help in risk negotiation at the pre- & production stages, as also various instruments available that will help the farmers in minimising their production and income losses. Such tools include promoting climate smart and climate resilient agriculture; helping farmers to utilise the services of forecasting models (include weather forecasting, pest and disease forecasting, price and demand forecasting, etc.), crop and livestock insurance. Both technological and financial approaches to risk management must be promoted vigorously among the farmers by the extension system.

v) Post-harvest extension

As already discussed in the earlier sections, the major challenge in India's agriculture today is not production but post-production management, which refers to linking the farm produce from the farm-gates to the consumption centres. The consumption centres are diverse and include individual

households, bulk purchasers, bio-resource-based agro-industries and so on. The extension system is needed to support the farmers in capturing optimal value on their agri-produce. This is possible when farmers are able to meet the quality standards as per market demand, are able to reach the consumption centres - both in near- and far- range markets without compromise of the quality of produce. The farmers will therefore need to be educated about primary processing, adopting production matrix based on market demands and prices, use of agri-logistics appropriately and finding access to facilities such as eNWR (electronic Negotiable Warehousing Receipt) system to avoid distress sale. The extension machinery will therefore need to capacitate itself with all these new post-harvest management systems, as also related information, so that it can share the same with the farmers effectively.

vi) Extension for promoting enterprise and entrepreneurship

Agriculture as a primary economic activity has so far been confined to primary agriculture. That, the agri-raw material can be processed for creating greater value and thereby capturing greater value for the farmer-producers has not received the attention it deserves. In order to increase the income of the farmers and create greater wealth in the agriculture sector, Agriculture must be recognised as consisting of primary agriculture and secondary agriculture. The secondary agriculture values both primary produce and co-produce (crop residues, waste like bones, viscera, hair, etc.), and utilises these for producing different kinds of food and non-food commodities. New jobs are created and supplementary incomes are generated as a consequence. The extension system would therefore need to be reoriented and trained to enable its engagement with the farmers, in respect of both primary and secondary agriculture.

### Capacity Building of Extension Personnel

The public extension system (PES) is sustained by manpower trained as certificate holders, diploma holders or graduates and post-graduates in various disciplines of agricultural sciences. However, they are called upon to work with the farmers who need pluralistic knowledge related to diverse agricultural sub-sectors, and all along the agricultural value chain consisting of pre-production, production and post-production stages.

An understanding of the definition of the extension highlights that, the extension personnel is expected to be not only technically sound, but also be effective in communicating by understanding the socio-economic context and local traditions of the farming community.

Further, agricultural science like any other discipline is subject to constant change in response to the changing external factors. These triggers may arise from changing climate, changing tastes and preferences, changing purchasing power and so on. The extension staff would therefore need to undergo constant learning and keep itself abreast of the new knowledge and technology.

It is therefore necessary, that the extension system is supported by well-designed initial and mid-course orientation and training programmes from time to time. In today's context where job & income-oriented agriculture demands a new set of interventions in consonance with the sources of income growth listed earlier, the extension machinery will require total re-orientation. Simultaneously, the course content in the agricultural university will also need to be revised appropriately.

An important learning for the extension staff relates to being proficient in use of digital technology, promoting cooperatives and collectives of farmers, engaging with private sector for adopting public-private-partnership (PPP) models and converging the efforts with extension agencies available in non-government sector-private corporates, NGOs etc. It must be appreciated, that

with liberalisation of economy and greater market integration of agriculture, the private sector has been playing an important role in both input and output management. Various inputs like seeds, fertilizers, pesticides, agricultural machinery, credit and insurance are handled by the private sector. On the output management side also, the private sector plays a key role in aggregation, processing, storage, transportation, trading, exporting, besides contract farming and the like. Hence the extension machinery needs to understand the nuances and the underlying principles of these practices. This will help them in engaging with these stakeholders in a meaningful manner, so as to protect the interests of the farmers.

#### Generation of Supplementary Employment in Agriculture and Role of Extension

As has already been brought out, secondary agriculture has huge potential for its promotion in the rural areas and enable the farmers and landless agriculture labour to create new jobs and generate supplementary incomes. So far as agriculture extension system is concerned, it can play meaningful role in that segment of the secondary agriculture which is organised at the level of micro-scale. This includes cottage and village level enterprises, that use simple technology, low order capital and more of labour. The extension machinery can play a useful role in mobilising and motivating the farmers to take to such enterprises. The DFI Committee specifically advocates secondary agriculture of this nature and recommends three types of avenues. These are discussed in brief with examples under each category. Basically, these are suitable to be adopted at farm and village levels in the rural areas, with agricultural hinterlands.

#### Type A: Value addition to primary agriculture production systems

##### Input-centric

The farmers can meet the local demand for various inputs by using their own land or common property resources to raise the same – wasteland, pastureland, waterbodies etc. They can grow seedlings for fruits and vegetables, raise nurseries

for raising forest species and support agro-forestry, forest plantation by the government agencies etc.

There is increasing demand for bio-fertilizers and other bio-nutrients, that offers scope for local production of *Azolla*, *jeevamrut*, *beejamrut* and *panchagavya* by using on-farm and locally available resources.

Other possibilities include plant-based pesticides, extracts from common weeds like *Lantana*; neem seed collection, etc.; concoctions from ingredients of the kitchen like garlic, chilli, asafoetida etc.; making of local jaggery and molasses from sugarcane; feed block using grains, paddy /wheat straw etc.

##### Post-harvest-centric

With training and establishment of small and simple machineries, the farmers and farm-women in particular can practise primary-processing fruits, vegetables and flowers. There exists knowledge, technology and machinery for making of daily-use products like ginger-garlic pastes, chilli/turmeric powder, tamarind seed separation/ pulping, grain milling, pickles, *papad*, juice etc. Tamarind seed separation/pulping, grain milling are other feasible activities. These are micro-enterprises, and when there is adherence to basic quality standards, marketing on physical and online platforms becomes possible.

##### Type B: Alternative enterprises

This involves adopting farm-linked activities, that are supplementary and complementary in nature. These activities help in better utilisation of resources available with the farmers. The illustrations include bee keeping, sheep rearing, goaterly, backyard poultry, duckery, inland fishery, piggery, mushroom cultivation, hydroponics (for production of fodder maize; micro greens), kitchen gardening etc.

There also is scope for another type of alternative enterprise that uses locally available raw material including co-produce for creating value-added products. These encompass making of

broomsticks, table mats, bags, plates etc. The raw materials used include grass, bamboo, cane, coconut and areca nut fronds, leaf sheath, maize husk etc.

The youth in particular with their education and tech-friendliness can be trained and oriented to practise entrepreneurship on organised lines. This implies standardisation of products, adherence to quality parameters, building brands, adopting GI tags, suitable packaging, marketing online etc. With proper hand-holding including linking them to mini-incubation centres, offering institutional credit with concessional rates of interest, the youth can become creators of jobs for themselves and a few others.

Type C: Enterprises that use crop residues and wastes of primary agriculture

The co-produce like straw, stalk, fruit peels, hair etc. are wasted despite their value available to be tapped. Using local raw materials (paddy straw, fronds of coconut and areca nut, vetiver grass etc.) which today are not fully utilised, micro-industries can manufacture particle boards, animal feed block, fuel briquettes, coco peat, leaf sheath plates, etc. at the local level.

In the tribal areas, the people have legal access to non-timber forest produce (NTFPs) like fruits, flowers, leaves, lac, herbal & medicinal plants. These can be processed and sold as value added products instead of disposal as raw produce.

Agri-tourism and Rural-tourism that showcase the country's diverse and rich traditions and culture also provide scope as income generating avenues.

Technology Backstopping to New Extension System

The new system of agriculture centred around jobs and incomes, in addition to nutrition and sustainability would have to be backed by science, technology and innovation. Hence, Public Extension System (PES) as also non-government extension system (NGES) will need to be supported by the National Agricultural Research System

(NARS) of the country. In addition to the ICAR Centres and State Agriculture Universities (SAUs) which form part of the NARS, frontline extension agencies like KVKs, central and state institutions like Govt. of India's MANAGE (National Institute for Agricultural Extension Management), NIPHM (National Institute for Plant Health Management), NIAM (National Institute of Agricultural Marketing) and VAMNICOM (Vaikuntha Mehta National Institute of Cooperative Management) are natural candidates for providing technological support to PES and NGES. There are also central institutes like CSIR-CFTRI (Central Institute of Food Technology and Research Institute), NIFTEM (National Institute of Food Technology Entrepreneurship and Management) etc., that have specialised technology and knowledge relating to agro-processing to offer.

One of the important learnings from the erstwhile T&V system under NAEP is the support it received from NARS and benefitted thereby. The PES staff were trained and oriented at regular and fixed intervals on the technical aspects of production, as relevant for the next fortnight/month. On similar lines, it is necessary to provide tech-backstopping to both, private and public extension systems. In this regard, the panoply of R&D centres belonging to both public and private sectors can own this responsibility and work in concert.

In the context of the new demand for technology and practices that address the whole agri-value chain, various R&D centres that are specialised in related domains will need to play this crucial role of providing tech-backstopping. These Centres, particularly SAUs and KVKs, who are in greater touch with the farming community, can serve as the connecting centres. This implies, that they will shoulder the responsibility to provide a common platform for compilation and collation of relevant technologies available from across the country and screen them for local-needs and train the extension system, who then can take it forward to share with the stakeholders including the farmers. In relation to promoting secondary agriculture-

based rural enterprises, these centres (KVKs and SAUs) will need to develop Technology Business Incubators (TBIs). They also will have to serve as purveyors of enterprise-related information, inclusive of various initiatives of the central and state governments, financial and infrastructural facilities available etc. They also will need to develop customised orientation and training programmes for the extension resources, as also the farmers.

The new paradigm of extension will need to be strengthened so as to enable it to offer the right content. Extension can be effective when the content is relevant and is communicated using the right methods. In this regard, the important support-system that needs to be built is discussed below.

- i. Lab-to-Lab and Lab-to-Land transfer of technology and knowledge. This means the need to build partnership among various R&D labs, so that they can learn from each other/one another and stitch a package of technologies, that is relevant for the extension system. They together can create a digital platform to collate the finally relevant bouquet of technologies and practices with open-source access to all stakeholders including the extension personnel (of both public and non-government agencies). This approach will enable lab-to-lab and lab-to-land flow of content for the extension system
- ii. Land-to-Land and Land-to-Lab communication is important to complete the virtuous loop between laboratories and the farms. Land-to-Land diffusion of information will happen naturally, but can be accelerated by the extension system supporting it. The system can deploy the right method of extension depending upon the nature of information to be shared.

Further, Land-to-Lab transmission of information will enable the R&D centres to identify the field problems more truthfully and work on their solutions. By this, the problem-solving approach will get timely attention.

- iii. Mass media use is integral to agricultural extension, since the farmer-clientele is large in

number and is spread across the nation's vast space. Mass media including tele-vision, radio, print media as also social media are effective in creating awareness about new ideas and interest in available innovations and technologies. Also, mass media is useful in sharing of advance information based on forecasts, relating to pest and disease, price and demand, weather etc.

- iv. Agripreneurship approach, if adopted will invite youth into the agricultural sector. By promoting Agri Start-ups, extension models like Agri-Clinics and Agri-Business Centres (ACBC), new technology and farm practices that will promote jobs and incomes in agriculture will get a fillip.

## CONCLUSION

Since 1947, the year when India gained independence, agriculture has evolved through 5 (five) recognisable phases. These include the periods of i) First decade, when the total food grain production was a low of 50 million tons, and 80 per cent of people depended on agriculture for livelihood; agricultural research outcomes were not disruptive enough to stimulate high output, and the country remained food-deficit. ii) Sixties to mid-eighties, when the country saw breakthrough technology in the crop segment and cooperative-led growth impulses in the dairy sector; the farmers received input support via subsidies on seeds, fertilizers etc. and output support through the system of MSP (Minimum Support price) and MSP-based procurement of agri-produce (mostly paddy and wheat). The green revolution (GR) technology imparted food security to the country, but growth remained confined to irrigated systems and white revolution put India on the global map in milk production, but there was a long way ahead to achieve high per capita milk availability. iii) Mid-eighties and nineties, saw more of land reforms, higher investments in agricultural research and extension, improvements in credit access, inauguration of Agricultural Price Commission and first National Agricultural Policy in the year 2000. This period also the beginnings of agricultural

diversification. iv) Years of 2000 to 2015, when the first seeds of reforms in agricultural sector were initiated, but remained unsteady; diversification into high value agriculture including horticulture, animal husbandry and fisheries began; and the agricultural sector experienced high growth rate. v) Years 2015 to date, the period which manifested visibly the inadequacies of extractive system of production and the need for sustainable approach to agriculture; neglect of post-harvest management as reflected in poor agri-logistics and price fluctuations; and increasing cost of production and farmers' demand for higher MSP. It has also been the period that saw transformative response to the contemporary challenges leading to roll out of new MSP policy, evidence-based soil health management, renewed focus on area expansion under irrigation, high investments for capital formation in agriculture, attention to deficit commodities including pulses, oilseeds and millets; and more importantly restructuring the agricultural strategy into agri-business, that anchors farmers' income as a core concern. This resulted in the government's vision of doubling the farmers' income by 2022 vis-à-vis the benchmark year of 2015-16, and the implementation of a new strategy as recommended by the Inter-Ministerial Committee on Doubling Farmers' Income (DFI).

The nation's agricultural extension system has parallelly evolved over the same period since 1947 in synch with these five phases of agricultural sector in India. As required, the R&D system has led

as well as responded to the changing needs of the nation. An alignment among the three pillars of agricultural transformation is a pre-requisite. These include R&D, Policy and Extension System. It is the policy framework of the nation that influences R&D and Extension System of the country. The inadequacies, that are visible alongside impressive successes in India's agricultural system can be laid at the doorstep of policy framework, if at all some such identification is necessary. Thanks to greater awareness, information revolution, India's commitment to global treaties like SDGs 2030, Paris Agreement on Climate Change among others, and more importantly growing aspirations among the youth in particular, the policy framework has been undergoing paradigm shifts. Rightly, the focus has come to encompass nutritional security for the citizens, income security for the farmers and sustainable approach to production system.

Income security is predicated upon making generation of productive jobs and fair incomes for the farmer-producers. The system of agricultural extension is slowly but steadily undergoing transformation. The most visible component of this transformation is the increasing deployment of digital technology.

The future health of India's agricultural system would for sure depend upon making it economically viable and socially equitable for the farmers, nutritionally dependable for the consumers and technologically sustainable for the ecology of production.

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