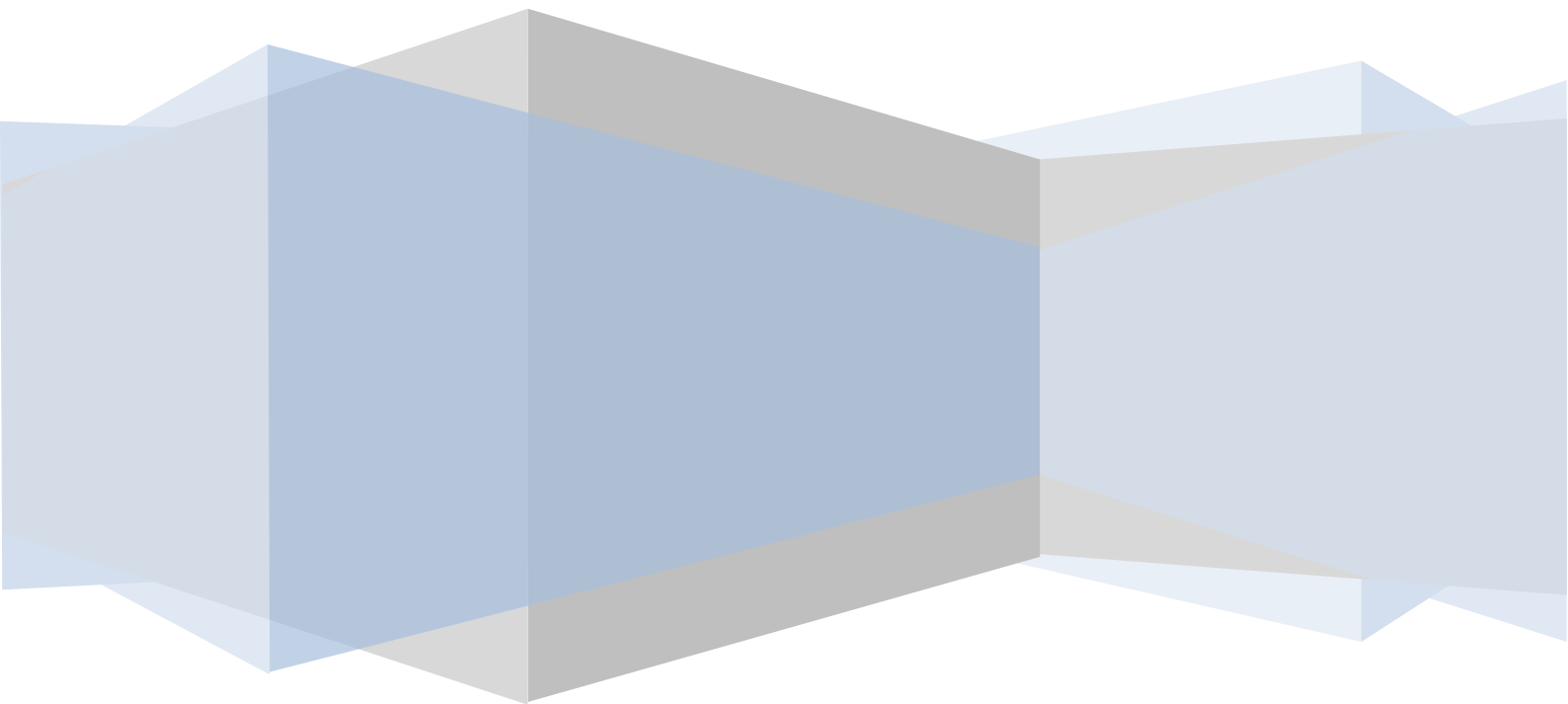


Chapter 6: Good Agriculture Practices

Short Answers

CSM 05: Agriculture

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This chapter contains:

- Good Agricultural Practices
- Secondary Agriculture
- Avenues in Secondary Agriculture
- Agro-processing Industry Development
- Programmes for New Skills and Upskilling
- Operationalising Secondary Agriculture
- Beekeeping
- Lac Cultivation as an Enterprise
- Agro-forestry
- Bamboo as a Component of Secondary Agriculture

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1. Good Agricultural Practices

The Food and Agricultural Organization (FAO) of the United Nations uses Good Agricultural Practice (GAP) as a collection of principles to apply for on-farm production and postproduction processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability. These four 'pillars' of GAP (economic viability, environmental sustainability, social acceptability, and food safety & quality) are included in most private and public sector standards, but the scope which they actually cover varies widely. The concept of Good Agricultural Practices (GAPs) has evolved in recent years in the context of a rapidly changing and globalizing food economy, and as a result of the concerns and commitments of a wide range of stakeholders about food production and security, food safety and quality, and the environmental sustainability of agriculture. A broadly accepted approach using GAP principles, generic indicators and practices will help guide the debate on national policies, actions and preparation of strategies, so as to ensure that all stakeholders benefit from the application of GAP in the food chain. The implementation of GAP should therefore contribute to Sustainable Agriculture and Rural Development (SARD). Its broad objectives are:

- Ensuring safety and quality of produce in the food chain.
- Capturing new market advantages by modifying supply chain governance.
- Improving natural resources use, workers' health and working conditions; creating new market opportunities for farmers and exporters in developing countries.

Key Elements of GAP

Some key elements are as follows:

- Prevention of problems before they occur
- Risk assessment
- Commitment to food safety at all levels
- Communication through the production chain
- Mandatory employee education program at the operational level
- Field and equipment sanitation
- Integrated pest management
- Oversight and enforcement
- Verification through independent, third-party audits

Potential Benefits of GAP

Some identified positive outcomes are listed below:

- Appropriate adoption and monitoring of GAP helps to improve the safety and quality of food and other agricultural products.
- It may help to reduce the risk of non-compliance with national and international regulations, standards and guidelines and the International Plant Protection Convention (IPPC) in relation to permitted pesticides, maximum levels of contaminants in food and non-food agricultural products, as well as other chemical, micro-biological and physical contamination hazards.
- Adoption of GAP helps to promote sustainable agriculture and contribute to meeting national and international environment and social development objectives.

Challenges related to GAP

Some of the challenges are as follows:

- In some cases, GAP implementation and especially record keeping and certification increases production costs. In this respect, lack of harmonization between existing GAP-related schemes and availability of affordable certification systems has often led to increased confusion and certification costs for farmers and exporters.
- There is a high risk that small scale farmers will not be able to seize export market opportunities unless they are adequately informed, technically prepared and organized to meet this new challenge, with governments and public agencies playing a facilitating role.
- Compliance with GAP standards does not always foster all the environmental and social benefits, as claimed.
- Need for creating awareness about 'win-win' practices that will bring about improvements in yield and production efficiencies, as well as environment and health and safety of workers. One such approach is Integrated Production and Pest Management (IPPM).

Good Agricultural Practices for selected Agricultural Components

Soil

- Appropriate soil management aims to maintain and improve soil productivity by improving the availability and plant uptake of water and nutrients through enhancing soil biological activity, replenishing soil organic matter and soil moisture, and minimizing losses of soil, nutrients, and agro-chemicals through erosion, run-off and leaching into surface or ground water.
- Good practices related to soil include maintaining or improving soil organic matter through the use of soil carbon-build up by appropriate crop rotations, manure application, pasture management and other land use practices, rational mechanical and/or conservation tillage practices; maintaining soil cover to provide a conducive habitat for soil biota, minimizing erosion losses by wind and/or water;

and application of organic and mineral fertilizers and other agro-chemicals in amounts and timing and by methods appropriate to agronomic, environmental and human health requirements.

Water

- Agriculture carries a high responsibility for the management of water resources in quantitative and qualitative terms, since it is using more than 80 per cent of the utilisable water in the country. Careful management of water resources and efficient use of water for rainfed crop and pasture production, for irrigation where applicable, and for livestock, are criteria for GAP. Efficient irrigation technologies, as also new generation technologies like sensors and management will minimize waste and will avoid excessive leaching and salinization.
- Good practices related to water will include those that maximize water infiltration and minimize unproductive efflux of surface waters from watersheds; manage ground and soil water by proper use, or avoidance of drainage where required; improve soil structure and increase soil organic matter content; apply production inputs, including waste or recycled products of organic, inorganic and synthetic nature by practices that avoid contamination of water resources; adopt techniques to monitor crop and soil water status, accurately schedule irrigation, and prevent soil salinization by adopting watersaving measures.

Crop and fodder production

- Crop and fodder production involves the selection of annual and perennial crops, their cultivars and varieties, to meet local consumer and market needs according to their suitability to the site and their role within the crop rotation for the management of soil fertility, pests and diseases, and their response to available inputs. Perennial crops are used to provide long-term production options and opportunities for inter-cropping. Annual crops are grown in sequences, including those with pasture, to maximize the biological benefits of interactions between species and to maintain productivity. Harvesting of all crop and animal products removes their nutrient content from the site and must ultimately be replaced to maintain long-term productivity.
- Good practices related to crop and fodder production will include those that select cultivars and varieties on an understanding of their characteristics, including response to sowing or planting time, productivity, quality, market acceptability and nutritional value, disease and stress resistance, edaphic and climatic adaptability, and response to fertilizers and agrochemicals; devise crop sequences to optimize use of labour and equipment and maximize the biological benefits of weed control by competition, mechanical, biological and herbicide options, provision of non-host crops to minimize disease and, where appropriate, inclusion of legumes to provide a biological source of nitrogen; apply fertilizers, organic and inorganic, in a balanced fashion, with appropriate methods and equipment and at adequate intervals to replace nutrients extracted by harvest or lost during production. The safety regulations and established safety standards for the operation of equipment and machinery for crop and fodder production are needed for GAP.

Crop protection

- Maintenance of crop health is essential for successful farming with respect to both yield and quality of produce. This requires long-term strategies to manage risks by the use of disease- and pest-resistant crops, crop and pasture rotations, disease breaks for susceptible crops, and the judicious use of agro-chemicals to control weeds, pests, and diseases following the principles of Integrated Pest Management.
- Good practices related to crop protection will include those that use resistant cultivars and varieties, crop sequences, associations, and cultural practices that maximize biological prevention of pests and diseases; maintain regular and quantitative assessment of the balance status between pests and diseases and beneficial organisms of all crops; adopt organic control practices where and when applicable; apply pest and disease forecasting techniques where available; determine interventions following consideration of all possible methods and their short- and long-term effects on farm productivity and environmental implications in order to minimize the use of agrochemicals, in particular to promote integrated pest management (IPM). It is to ensure that agro-chemicals are only applied by specially trained and knowledgeable persons and accurate records of agrochemical use is maintained.

Animal production

- Livestock require adequate space, feed, and water for their welfare and productivity. Stocking rates must be adjusted and supplements provided as needed to livestock grazing pasture or rangeland. Chemical and biological contaminants in livestock feeds are avoided to maintain animal health and/or to prevent their entry into the food chain.
- Good practices related to animal production will include those that site livestock units appropriately to avoid negative effects on the landscape, environment, and animal welfare; avoid biological, chemical, and physical contamination of pasture, feed, water, and the atmosphere; frequently monitor the condition of stock and adjust stocking rates, The minimum use of the non-therapeutic use of antibiotics; integrate livestock and agriculture to avoid problems of waste removal, nutrient loss, and greenhouse gas emissions by efficient recycling of nutrients are important GAP.

Animal health and welfare

- Successful animal production requires attention to animal health, that is maintained by proper management and housing, by preventive treatments such as vaccination, and by regular inspection, identification, and treatment of ailments, using veterinary advice as required.
- Good practices related to animal health and welfare will include those that minimize risk of infection and disease by good pasture management, safe feeding, appropriate stocking rates and good housing conditions; keep livestock, buildings and feed facilities clean and provide adequate, clean bedding where livestock is housed; ensure staff are properly trained in the handling and treatment of animals; seek appropriate veterinary advice to avoid disease and health problems;

ensure good hygiene standards in housing by proper cleansing and disinfection; treat sick or injured animals promptly in consultation with a veterinarian.

2. Secondary Agriculture

Strictly speaking, the preface “secondary” to any activity, is used to typically imply the next step or higher level of operations – for example, secondary education in school, or secondary processors in computers, or secondary processing in the agro-processing sector, etc. The term secondary agriculture would therefore indicate and refer to an elevated level of agricultural operations, or those linked to agricultural activities. However, it is observed that the term ‘secondary agriculture’ is mainly non-existent around the world, and even then, where it finds limited use, the term is understood differently.

In the United States, the types of operations in “primary” and “secondary” agriculture are categorised: Primary agriculture is cultivation and tilling of soil, and growing and harvesting any agricultural commodity. Secondary agriculture is “performed either by a farmer or on a farm as an incident to or in conjunction with ‘such’ farming operations.” It includes “assembling, ripening, cleaning, grading, sorting, drying, preserving, packing, and storing” fruits and vegetables, but does not include processing of fruits and vegetables from their natural state. This definition excludes all processing activities from being called secondary agriculture. This is similar to how India differentiates between agricultural produce viz an agricultural product for taxation purposes. In the EU, the term secondary agriculture is not used and the EU economic accounts for agriculture (EEAA) include the related service activities as part of the agricultural sector. The United Nations Statistics Divisions, that classifies various economic activities, does not define secondary agriculture.

In India, ‘secondary agriculture’ is spoken of, but is not clearly defined, though it is commonly used to identify the agro-based manufacturing sector. The Planning Commission of India had constituted a Technical Advisory Committee on Secondary Agriculture (TACSA) in 2007. The TACSA submitted its report in October 2008, but did not define the term ‘secondary agriculture’. Instead it states that the term “is very broad as it includes all food and non-food bio-resource-based products for human and industrial use”. The term is seen to be used as an omnibus expression to relate to the product of agro-based processing activities of the secondary sector. Effectively, TACSA detailed the output from the activities to explain the term “secondary agriculture”. In fact, by correlating secondary agriculture to all food and non-food products it seems the term would encompass all types of industries as long as its input is a bioresource – making secondary agriculture another terminology for all kinds of agro-industry.

As agriculture develops as an enterprise, the farmer(s)’ enterprise will constitute an output supply chain and such an entity(ies) can no longer be exclusively seen to belong to the primary activity of cultivation. As farmers’ enterprises develop, we get to see that the agricultural output, is communicated to consumers, while still under ownership of the producer (FPO), utilising secondary or tertiary sector activities, which are managed by the FPO itself.

There is the need to understand and add clarity on the operational framework of the various secondary level activities in agriculture from the perspective of farmers and farming households. This is essential as farmers expand their works beyond cultivation and harvesting.

Operational framework of secondary agriculture

In a scenario wherein the per-capita income of a rural household is less than that of urban household, especially in the age of booming e-commerce, the increasing flow of money from rural to urban areas is a cause for concern. The need is to transform the situation from 'rural people as consumers of industrial goods' to 'rural people as producers of industrial grade output, especially the population related to farming. Secondary Agriculture in such a case is expected to bring about a shift in the direction of flow of money from urban to rural areas, especially through meeting the demand for value addition or pre-conditioning services from the food processing industries in urban areas.

This gap is envisioned to be filled through a fresh emphasis on Secondary Agriculture by complementing the rural household incomes as against efforts of shifting the manpower from farm to non-farm domains, which is not easy to come by.

Defining Secondary Agriculture

The DFI Committee feels that instead of defining Secondary Agriculture² by its possible products, it will be more appropriate to define it by the resources it utilises, the scope of involvement of the agricultural community, the type of technology it deploys, and the scale of the activity. As such, for an activity to be called secondary agriculture, it must be an enterprise that has direct involvement of the agricultural community and must provide growth opportunity to the primary sector. Secondary level activities, linked to agriculture, can include economic activities from the secondary or the tertiary sectors.

It is important to delineate the various productive activities, keeping in perspective the national agenda of doubling farmers' income, promoting farmer(s) owned enterprise, and enhancing rural employment & farm household income. Such economic activities would preferably not be of capital intensive category, be labour intensive, utilise products or by-products from farming and other rural resources, be of operational and technological scale that can be opted for, at village level, and finally enhances wealth creation at rural level.

Special Support to Secondary Agriculture

Secondary agriculture may be considered for special support, such as

- a. Priority sector status for institutional credit.
- b. Low cost skilling and knowledge based exposure.
- c. Specialised extension services for enterprises owned by females.
- d. Priority under rural electrification objectives.
- e. Fast track procedures to avail benefits under ongoing central sector and centrally supported schemes.
- f. Geographical Indicator labels to products from village scale secondary production.

Secondary agriculture would need to be promoted by providing enterprise level support, which can be undertaken by initial setting up of a Division on Secondary Agriculture & Enterprises in all three Departments of the Ministry of Agriculture and Farmers' Welfare, and coordinate their efforts through a structured platform.

3. Avenues in Secondary Agriculture

Prior to the identification of various avenues of Secondary Agriculture in India, there is need to discuss various push and pull factors that prompt the shifts to complement the income generation activity at village level. On one front, the emerging exodus of manpower from agriculture without its matching absorption into the manufacturing and service industries, triggers a need to provide alternative income generation opportunities in rural India calling for immediate focus on Secondary Agriculture (see definition and explanation in Chapter 1). On the other front, the rising per capita income of urban and rural India, changing consumption patterns, competition in international markets, technology enabled linkages between the production centres and the food processing industries and increasing awareness & regulations on food safety standards are prompting changes in the production systems of agriculture and allied sectors. A conscious effort to bridge these two situations would serve the intended purpose of generating additional employment and income within the rural segment, and check avoidable migration, particularly distress migration.

Exodus of manpower from agriculture is widely reported and is considered as an indicator of development. It may not always to be correct to interpret this way, for there can be distress migration even when the alternate sectors of the economy are not prepared for such an absorption. Along with movement of manpower away from agriculture, its decreasing ratio of contribution to GDP is also considered as a parameter of development based on western models of economic growth. As manufacturing and service sectors mature in a traditional economy, the share of primary sector (agriculture) is seen to reduce. However, its contribution in terms of absolute numbers may be growing and it is essential to ensure this . More importantly, there is need to examine how primary and secondary agriculture can be modelled to generate productive employment and income opportunities, and this is critical in the context of India's high population density.

It would also be useful to note, that relative to other comparable poor/emerging economies, India's emphasis on tertiary education, emphasis on capital goods production capability, especially through public-sector involvement, labour laws may have limited India's growth in labour intensive manufacture. In the cases of fast growing states within the country, viz., Tamil Nadu, Karnataka, West Bengal, Delhi, and Maharashtra, the growth path has skipped the pathway of labour-intensive industries to opt for specialisation in skill-intensive industries (within manufacturing). This scenario of missing labour-intensive growth and adoption of higher skill-intensive growth has a significant bearing on the employment of manpower exiting from agriculture sector. It is in this context, that Secondary Agriculture deserves the attention in recognition of its ability to offer in situ gainful employment opportunities. The twin advantages of such an approach are (i) avoidance of distress migration; and (ii) non-farm income avenues adding to farmer's income kitty.

Trends in Agriculture Markets and Emerging Opportunities

Agriculture export as share of total Indian exports has not improved much over the decades since liberalisation. Between 1991-92 and 2010-11, the proportion of Agriculture Exports to Total Exports improved from 1:5 to 1:8 in favour of non-agricultural exports. However, the growth of agriculture exports has not increased substantially given the need to feed the growing population.

Interestingly, the liberalisation and various trade agreements between India and other countries paved the way for greater opening up of the markets. This trend has resulted in the need for stringent adherence to quality standards in terms of grades & standards, inert material, chemicals used in production / protection from diseases and pests, harvesting & storage practices, etc.. Indian production and post-production handling systems are yet to change in response to the global destination markets.

Several initiatives of the Government to improve the market infrastructure and systems are nudging for increased alignment of production for national and international markets. The growing trends of e NAM (electronic National Agricultural Market), trading of agriculture commodities on electronic exchanges, use of expanding warehousing infrastructure is aiding standardisation of agriculture commodities for trading / marketing purposes.

The Avenues

Broadly, the avenues of Secondary Agriculture can be categorised into three types:

- Type A: Value addition to Primary Agriculture Production Systems
- Type B: Alternative Enterprises
- Type C: Enterprises that use crop residues and wastes of Primary Agriculture

Women in Agriculture and Micro-enterprises

Women make substantive contributions to all the agricultural activities encompassing crop production, dairying, animal husbandry and fisheries. Their engagements are visible across the value chain. It must be appreciated, that they do this along with their responsibilities as home makers. The art and science of multi-tasking that women possess is invaluable. Men in comparison are not par the course. Yet, the contributions of women go unheard, untold and unsung. Rendering the situation more sordid, there is so much needed to be done to give them the social status that is rightfully theirs.

Women can become exemplary micro-entrepreneurs, only if their innate talents are made professional through appropriate training to link up with markets and meet the laid down standards. As entrepreneurs, they will come to handle the money directly and claim the rightful position at home and in society.

4. Agro-processing Industry Development

Secondary agriculture as village and cottage enterprise units is discussed, that create employment and help capture value for the actors traditionally employed in the primary sector. However, the entire agro-processing sector sources its raw materials from the primary sector, and except for the aspects of size and technology, the units categorised as secondary agriculture, are essentially a part of the umbrella category defined as the secondary sector economic activity.

In the secondary sector, besides secondary agriculture units, there is also the need to develop large industrial scale units. The key qualifier for such units, would be their large capacity, and their greater reliance on capital intensive and automated technologies. The agenda would not be as much to generate jobs for rural manpower, but to optimise on the harvests and to lead to more sustainable use of resources output, food and non-food, from the varied agricultural production in the country. For example, castor oil extraction units, ethanol and bio-diesel units, enzyme and biological extraction industry, and all other high technology agro or bio-processing industries.

The sheer scale of such industrial units requires that they are designed and planned to receive regular feedstock, which may not necessarily be a locally available resource. These industrial units would not be cottage scale, and essentially may require very highly skilled employees such as chemical engineers, scientists, etc. for their operations. Nevertheless, current day technologies and future developments, will allow such industries to provide human civilization more healthy and sustainable living standards.

Present day Agro-based Industries in India

The agro-based industries probably constitute the oldest industrial development initiatives having arisen alongside agriculture. The earliest examples would be wool and leather based manufacturing, fibres into textiles, pigment extracts, medicinal extracts, beverages, flour milling, etc. In all probability the non-food processing sector developed earlier to the food processing sector.

The raw food was most likely processed individually in family kitchens, before such cooking or food preparation was taken up as an economic activity at enterprise scale. Raw food was also used as a barter to exchange for the other products of industry.

The future of the agro-based industries is bright, even though some agro-based products may have been replaced with industrial materials like plastics and polymers. However, a renewed consciousness to lower the ecological footprint and new technologies have allowed for resurgence of bio-based products, such as biodegradable plastics, bio based fuels and bio-based construction materials.

The potential of many agro-based industries have not been fully explored in India. The country can do well to develop industries that output tertiary and high technology products, using the 1.1 billion tonnes of agricultural produce within the country. All such development should be market linked to avoid post production losses of the manufactured product.

5. Programmes for New Skills and Upskilling

Given that human power, is the major asset that obtains in the agriculture sector, creating a skilled workforce is fundamental to realise manpower productivity. Agriculture domain has witnessed several capacity building/skill building initiatives in the past. With modest agriculture growth, there is a clear need for a shift towards appropriate skill development. The secondary sector, like all other manufacturing industries, relies on a mix of highly skilled and medium skilled work force. Within the secondary sector, the units that are defined as secondary agriculture, would also require certain specialised knowledge and skills in their operations. Though secondary agriculture is being defined as units that are less capital intensive in production and are comparatively more labour intensive, the workforce would require understanding of matters related to the handling of raw material and the transforming or manufacturing operations related thereto, as well as safety and quality aspects as per the needs of each type of unit.

Further, technology involved is no longer static and as new technologies are developed for these activities, regular updating and upgradation of skills can also be an expected demand. The content below discusses various active schemes/ programs, their salient features and various means of enlisting them for promoting secondary agriculture, with a view to impart value to the farmers' slack time with job avenues.

Government Schemes and Promoting Secondary Agriculture

Some of the schemes are discussed below:

Name of Scheme: Pradhan Mantri Fasal Bima Yojna (PMFBY)

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- To provide insurance coverage and financial support to the farmers in the event of failure of any of the notified crop as a result of natural calamities, pests & diseases.
- To stabilize the income of farmers and ensure their continued engagement in farming.
- To incentivize farmers to adopt innovative and modern agricultural practices by derisking them.
- To ensure flow of credit to the agriculture sector by incentivizing the institutional credit system.

Name of Scheme: Market Intervention Scheme (MIS) and Price Support Scheme(PSS)

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- To protect the growers of these horticultural/agricultural commodities from making distress sale in the event of bumper crop during the peak arrival period when prices fall to very low level. Thus it provides remunerative prices to the farmers in case of glut in production and fall in prices.

Name of Scheme: Pradhan Mantri Krishi Sinchai Yojana (PMKSY)

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- To attract investments in irrigation system at field level, develop and expand cultivable land in the country, enhance ranch water use in order to minimize wastage of water, enhance crop per drop by implementing water-saving technologies and precision irrigation.

Name of Scheme: Rashtriya Krishi Vikas Yojna (RKVY)

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- To ensure the preparation of Agriculture Plans for the districts and the states based on agro-climatic conditions, availability of technology and natural resources
- To ensure that the local needs/crops/ priorities are reflected in the agricultural plans of the States.
- To provide backward and forward infrastructure needed to promote production and marketing.

Name of Scheme: National Project on Organic Farming and Paramparagat Krishi Vikas Yojana

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- To promote organic farming practices as an option for sustainable agriculture and to ensure effective utilization of farm resources
- To offer financial and technical support for setting up of organic input production units such as fruits and vegetable market waste compost, bio-fertilizers and bio-pesticides and vermin-culture hatcheries.
- Human resource development and awareness creation and market development for quality control of organic inputs. (Department of Agriculture & Cooperation and Department of Animal Husbandry, Dairying & Fisheries)

Name of Scheme: National Project On Soil Health and Fertility

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- Strengthening of Soil Testing Laboratories (STLs)
- Promoting use of Integrated Nutrient Management
- Balanced use of fertilizers

Name of Schemes: Pandit Deendayal Upadhyay Unnat Krishi Shiksha Scheme

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features: To provide complete knowledge and skill on processing, value addition and marketing of coconut and banana products through capacity building programmes involving research and development organizations.

Name of Scheme: National Project on Agro-forestry

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Objectives:

- Establishment of a National Agro-forestry Mission/Agro-forestry Board to implement the national policy by establishing coordination and synergy among various stakeholders.
- Enhancing farm productivity, incomes and livelihood opportunities of rural households, particularly of the small holder farmers through agroforestry.
- To meet the increasing demand for timber, food, fuel etc.; conservation of natural resources, protection of environment and increasing forest cover etc.
- Special focus on bamboo as agro-forestry intervention for selected areas (north east, eastern states etc.) following the budget pronouncement for a re-structured National Bamboo Mission with an outlay of Rs. 1290 crore to promote bamboo sector in a holistic manner.

Name of Scheme: National Mission on Horticulture

Department: Department of Agriculture, Cooperation and Farmers' Welfare (Ministry of Agriculture & Farmers Welfare)

Salient features:

- To provide holistic growth of the horticulture sector through an area based regionally differentiated strategies

- To enhance horticulture production, improve nutritional security and income support to farm households
- To establish convergence and synergy among multiple on-going and planned programmes for horticulture development
- To promote, develop and disseminate technologies, through a seamless blend of traditional wisdom and modern scientific knowledge
- To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth

Name of Scheme: National Skill Development Mission (NSDM)

Department: Ministry of Skill Development and Entrepreneurship (MSDE)

Salient features:

- To rapidly scale up skill development efforts in India, by creating an end-to-end, outcome-focused implementation framework, which aligns demands of the employers for a well-trained skilled workforce with aspirations of Indian citizens for sustainable livelihoods.

Name of Scheme: National Apprenticeship Promotion Scheme (NAPS)

Department: Ministry of Skill Development and Entrepreneurship (MSDE)

Salient features:

- Sharing of stipend with employers to a maximum limit of Rs. 1,500 per month per apprentice.
- Sharing of Basic Training Cost with Basic Training Providers to a maximum limit of Rs. 7,500 for 500 hours/ 3 months per apprentice.

Name of Scheme: Deendayal Upadhyay Swaniyojan Yojana (DUSY)

Department: Ministry of Rural Development

Salient features:

- To provide skill sets for self-employment to rural masses
- To give incentives to rural poor pursuing self-employment
- To provide financial assistance to self-employed or poor rural entrepreneurs
- To support poor rural people desirous of starting new business or pursuing selfemployment options

6. Operationalising Secondary Agriculture

It would be important to delineate specific avenues and activities, that can be promoted as enterprises under Secondary Agriculture. It can be one of these:

- A. Value addition to primary agriculture production systems.
- B. Alternative enterprises.
- C. Enterprises that thrive on crop residues and wastes of primary agriculture

Level of Enterprises

The primary focus of secondary agriculture in the context of small & marginal farmers in particular, should be one of generating additional jobs and additional sources of income. The emphasis needed is on use of slack / idle resources, namely, land and labour.

An enterprise is a function of:

- Capital
- Organisational structure and management
- Technology
- Associated risks

Enterprises include both industry and service sectors. Based on the level or degree of the above factors deployed, the nature of enterprise can be one of the following:

- (i) Household level enterprise - tiny or cottage industry, for eg. value addition activities like pickle making; or mushroom cultivation using paddy husk; or bee keeping etc. Household level enterprises use very small quantum of capital, low intensity of technology & skill; and organization is simple and is owned & managed directly by the family members. Employs a maximum of 3-4.
- (ii) Village level enterprise – village industry or micro-industry, for eg. oil extraction unit, mini dal mill, compost making unit etc. These enterprises are akin to household level enterprises, except for the level or degree of factors deployed being more intense or sophisticated. Since the scale of operation is higher, the entrepreneur is likely to use resources mobilized from a number of farmers and employ non-family member and manage the unit as an enterprise. Generally, the number of people employed is not more than 10.
- (iii) Small, medium scale industry - These are professionally managed agro-industries, that encompass both food and non-food sectors. The skilled / educated members of a farm family are likely to be absorbed as employees, benefiting from an additional income from non-farm engagement. However, the farm families can relate with such industries, including the large scale industry by supplying their primary product, as also by-products (eg. paddy husk, cotton stalk, etc.) at cost.

Promoting Household and Village Level Enterprises

The emphasis of the Ministries/Departments of Agriculture and allied sectors at central and state levels should be on promoting largely household level enterprises, that would help to add value to the primary products raised on the farm, and utilizing what is left behind as a waste. This in a way takes for agriculture to the next stage, that can be called as secondary agriculture, leading to capture of additional value for the farmer. With deployment of low intensity capital & technology and skill imparted through appropriately designed training programmes, the members of a farm family will be able to utilize their spare / slack time, particularly during non-seasonal times gainfully.

The Ministry has various schemes to support household enterprises. The institutions like those under ICAR or those under DACFW like MANAGE, NIPHM, etc. can provide incubation and training facilities.

In certain limited cases, the Ministry may be able to promote village level enterprises. For example, mini-dal mills, input retail centres. By and large, village level and higher level industrial enterprises need specialized knowledge, and therefore are best managed by the Ministry of SME.

Organisational Support

Within the Ministry / Department at both central and state levels a specially mandated Division would need to be created to promote secondary agriculture. For example, within the Ministry of Agriculture and Farmers' Welfare at central level, all the 3 Departments, namely, DACFW, DAHDF and DARE/ICAR should set up a dedicated Division for this purpose. Further, there should be a common institutional platform for all these 3 Departments to coordinate their activities. Each of them may also identify various institutions / agencies / organizations under them to serve as nodal centres for field level operations. Similarly, there can be replication of this approach at the state levels.

Some of the initiatives needed at the central level are:

- Identification of suitable enterprises and creating implementable project models.
- Designing modules of orientation and training programmes and kit; and coordinating with the concerned like the Ministry of Skill Development and Entrepreneurship.
- Funding for skill development activities; establishment of incubation centres and related infrastructure.
- Identification of institutions to undertake training and hosting of incubation centres.
- Preparing a bouquet of bankable projects; credit linked back ended subsidy based projects can be promoted.
- Designing of suitable Schemes and Guidelines.

- Creating a window for funding. The restructured RKVY-RAFTAR provides for promoting enterprises under secondary agriculture. Credit available under MVDRA, Banks, NABARD etc can also be availed of.
- Developing standards for adherence to quality and harmonization with different standards to enable easy marketability including online trading.
- Facilitating marketing creation at state, national and international levels, so that the local products find space in both near and far-away markets.

It may be useful to create a Special Purpose Vehicle (SPV) on Public Private Partnership (PPP) platform. Private sector led SPV, wherein professionals with domain knowledge are selected from the industry may be a good option. The Government (dedicated Divisions in the Ministry) may play the role of a facilitator and supervisor.

7. Beekeeping

Bees have a symbiotic relationship with plants and one of the most important things they do is pollinate plants. Many of the crops raised and foods produced depend on bees and insects for pollination and completion their reproduction cycle. In case of fruit trees, the size and shape of fruit is also affected by bees. Flowers that are visited frequently by bees will tend to produce larger and more evenly shaped fruit. Beekeeping also helps in enhancing productivity of crops, maintaining bio-diversity and environmental sustainability. Human interface in breeding, rearing and managing of bees is an agro-based activity and is easily undertaken to supplement income of farmers. Requiring very little land, this is amenable to small farmers and as a part of Integrated Farming System (IFS).

Honeybees are best known bees, not only for the honey they produce, but also because they play very important role in pollinating various agricultural and horticultural crops and in increasing their yield and improving the quality of produce. Honeybees ensure pollination in cross-pollinated crops as well as provide honey and a variety of beehive products. Pollination is an essential activity, as it enables plant reproduction and pollinators contribute to the maintenance of bio-diversity, and ensure the survival of plant species including crops that form the basis of agriculture and food security. Both, the diversity of wild plants and the variability of food crops depend on this diversity. Any reduction or loss of bees will stress the agri-value system and stress or damage agricultural production.

Impact of Bees on Yield from Farms

It is being increasingly realized that bees could be less expensive input for promoting sustainable and eco-friendly agriculture and enhancing crop productivity. The potential benefits, due to bee pollination, in the form of increase in yields of various crops including fruits & vegetables, oilseeds, pulses and others varies are observed to greatly enhance. Studies reveal that the income generated through enhancement in crop yield is far higher than the income generated from honey production. Honeybees have a vital role in sustaining the biodiversity of the plants resulting in environmental sustainability.

Till the mid-20th century, honeybees were equated with the production of honey and beeswax. But in the past 3-4 decades, utilizing honeybees to pollinate large number of agricultural and horticultural crops to increase their yield per unit of area, time & input, has become the principle objective of beekeeping in many developed countries. In some countries, many commercial beekeepers prefer to provide honeybee colonies on rental for pollination service over relying on income from honey production. According to the Agricultural Scientists, value of additional yield obtained by pollination service rendered by honeybees alone is about 15- 20 times more than the value of all the hive products put together (Dr. Kaloo, 2004, India). In the European Union (EU), studies estimate that pollination services by honeybees adds 35-50 times the value of additional yield obtained.

Beekeeping and Livelihood Benefits

Beekeeping plays an important role in adding to income of rural population, not only by enhancing the crop productivity, but also by outputting a diversified range of high value beehive products, viz.; bees wax, bee pollen, propolis, royal jelly, comb honey, bee venom, etc. The larger impact is maintaining bio-diversity & environmental quality, ensuring food and nutritional security and more.

Productive beekeeping does not require large capital investment, though certain skills are necessary. Beekeeping has potential to generate employment, and estimates indicate that 10,000 bee colonies require about 3,00,000 man-days in a year. As per economics worked out for beekeeping, the net income from 100 bee colonies varies from Rs. 3,00,000/- to Rs. 5,00,000/- annually, which is directly linked with the prevailing market prices of honey & other beehive products and beekeeping equipment.

Honeybees helps in achieving the goal of food and nutritional security and sustaining the environment. As per an estimate, more than a third of the global food basket is comprised of bee pollinated crops. Nectar and pollen collected by honeybees and converted into nutritive & valuable food, viz.; honey and other beehive products, would otherwise go waste. The pollination also helps in maintaining bio-diversity.

Beekeeping requires no land, minimal inputs, is not strenuous and can be adopted by anyone, encourages forest conservation and has potential for value added products, and has medicinal and cultural values. Bee products are used either as food or in pharmaceutical and cosmetic industries. For this reason, hygienic collection, handling, processing, storage, etc. and maintaining National and International purity standards are of prime importance.

Beekeeping status

World scenario of beekeeping:

Millions of honey bee colonies, mostly, *Apis mellifera*, are maintained all over the world. The world production of honey has been ranging between 15 to 16 lakh tonnes per year. There are 15 countries in the world which account for 90 per cent of the world honey production. In Asia, China is the leading country in production and export of honey, beeswax, bee pollen and royal jelly. China like India has indigenous *A.cerana* bee colonies but has also introduced *A.mellifera* bees, an European species.

Beekeeping in India:

The All India Coordinated Research Project (AICRP) on honey bees and pollinators under ICAR and State Agricultural Universities plays a major role in conducting research work for improving livelihood of Indian beekeepers and farmers. The National Bee Board (NBB), under the Ministry of Agriculture & Farmers Welfare, Government of India and Khadi and Village Industries Commission (KVIC) under the Ministry of MSME supported by Khadi and Village Industries Boards (KVIBs) at the state level are the agencies that promote beekeeping in India.

Major Constraints in Beekeeping

The major constraints confronting the development of beekeeping are summarized as under:

(i) Some major concerns are a lack of

- scientific data on choice of Honeybee species for commercial beekeeping and for promoting cross pollination;
- infrastructure for producing genetically superior queen bee for supply to beekeepers;
- technical knowledge for efficient management of bee colonies for higher honey yield;
- infrastructure at grass root level and national level for promoting beekeeping;
- awareness about yield increase in crops by beekeeping through pollination;
- understanding between farmers & beekeepers.
- laboratories for disease prevention, control and analysis. Eco-friendly control measures for serious problems- Parasitic mites (Varroa, Acarapis etc.), fungi (Nosema, AcoSphaera), bacteria (Paenibacillus, Melissococcus), Viruses (Sacbrood virus), etc. are required.
- indigenous technologies for production of quality honey & other high value products from beekeeping: Bee pollen, Royal jelly, Propolis, Bees wax, Bee venom, Comb honey, etc. including migration/ transpiration technologies for honeybees.
- institutional support for beekeeping in terms of bank loans, etc;
- proper pricing policy for honey and those engaged in packaging, processing and storing honey;
- consumer awareness of honey and its products; and
- convergence of various developmental programmes.

(ii) Poor quality control for production of honey and quality control labs.

(iii) Beekeeping not on the priority list of states. The State Bee Boards/Missions/ Technical Centres/IBCDs (Integrated Beekeeping Development Centres) and the like need to be established.

(iv) Various hindrances in migration, transportation of honeybee colonies.

(v) Forest Laws/Acts, etc.- charging a fee for allowing bee colonies in forest is a disincentive. The laws are also restrictive of the beekeepers/traders/processors of honey.

(vi) Less emphasis for production of other bee products such as beeswax, pollen, propolis, bee venom and royal jelly.

(vii) The behaviour and life cycle of honeybees depend completely on climatic and floristic conditions, which vary from place to place. Flowering of plants and secretion of nectar and production of pollen – sole food of honeybees, influenced by climatic conditions.

(viii) Insufficient database on beekeeping activities.

(ix) Mono-cropping culture in large parts – not good for bee promotion.

(x) Indiscriminate use of insecticides, pesticides, weedicides etc.

(xi) Lack of coordination between/among bee breeders, entomologist & plant breeders, such as to help to evolve scientific beekeeping practices based on good agriculture and management practices, following both crops and honeybees centred approach.

(xii) Heat-waves and & unforeseen changes in climatic conditions.

8. Lac Cultivation as an Enterprise

Lac cultivation provides sustained & high economic returns, generates employment opportunities and supports lac based rural cottage industries. Out of 25 crore households in India, about one million farm families are engaged in lac cultivation across the country, especially in the eastern and central parts of India. In major lac growing states namely, Chhattisgarh, Jharkhand, Odisha and West Bengal 25-32 per cent of a family's total farm income comes from cultivation of lac and about one million man-days are generated in the existing lac processing factories alone. Being an export oriented commodity, it contributes towards foreign exchange earning of the country. Globally, India is the leading exporter of lac. Cultivation of lac not only provides livelihood to lac growers, but also helps in conserving the green cover of earth, lac insects and associated biota. India is world leader in production with a production of around 17,000 tons of lac per annum (average of 2010-11 to 2014-15). Lac production is confined presently to Eastern India i.e. Jharkhand (51%), Madhya Pradesh (15%), Chhattisgarh (44%), and Odisha (4%). Though, classified as minor forest produce on certain considerations, lac ranks as a potential source of revenue for farmers. Growing host-trees for timber and fuel yields revenue in cycles of long years, whereas cultivation of lac on these trees gives a return almost every year, and is therefore preferred by lac growers.

Lac cultivation requires plants called lac-hosts. More than 400 plants have been reported as lac-hosts all over the world. Kusum (*Schleichera oleosa*), Palas (*Butea monosperma*), Ber (*Zizyphus mauritiana*) and *Ficus* spp. account for about 90 per cent of total lac production in the country as host plants. Besides these lac cultivation can be commercially carried on about 30 other host-plants. Recently, *Flemingia semialata* – a bushy lac-host has been showing the promise for intensive lac cultivation

Role of Lac Cultivation in Disadvantaged Areas of India

There exists 80,000 square km of area under lac cultivation comprising 200-250 millions of host trees across the country, but not all of these trees are utilized for lac cultivation. Employment generation in lac cultivation is about 80-90 million person days per annum, and about one million farm families are supported.

The lac growing regions are characterized by high proportion of tribal population, families living below poverty line and low literacy percentage. The tribal population mainly depends on rainfed agriculture and forest produce for its livelihood, and lac is an important source of cash flow. One of the merits of lac cultivation is that it does not require irrigation or watering when done on tree species. Front Line Demonstration programme executed in various states like Jharkhand, Chattisgarh, West Bengal, Odisha etc. confirm the success of lac farming under rainfed condition.

The NITI Aayog has identified 150 districts as most backward in the country. Many of the promising technologies and research findings have not reached the farmers of these districts mainly due to deficiencies of delivery systems and lack of economic incentives. Among these, lac cultivation is an important vocation for inhabitants of 45 backward districts. Another 30 districts have potential for introducing lac cultivation in their farming system. Jharkhand, Chhattisgarh, Madhya Pradesh,

Maharashtra and West Bengal contribute about 95 per cent of the total lac produced in the country. About 200 processing units including button lac, seedlac, shellac, bleached and aleuritic acid units operate in West Bengal, Chhattisgarh and Jharkhand.

Lac Culture as a Profitable Venture

Lac can also be suitably grown on marginal and degraded lands and requires negligible inputs like pesticides, fertilizers and water etc. It gives no competition to other agricultural / horticultural crops. Lac culture acts like an insurance crop particularly during drought years and is a good source of livelihood especially for farmers inhabiting forests and sub-hilly tracts.

The following strategies are employed for sustainable production of lac in the region:

- (i) traditional lac cultivation on tree species in forest / sub-forest areas;
- (ii) intensive lac cultivation on bushy host plants;
- (iii) integration of lac culture with agriculture;
- (iv) extension of lac cultivation to potential non lac growing areas; and
- (v) training of traditional lac growers in scientific methods of lac cultivation

Lac based rural enterprises

Lac resin is such a versatile product that it makes its presence felt in most of the sectors like varnish, paints, inks, adhesive, food, cosmetics, leather, electrical, pharmaceuticals industry, besides some miscellaneous uses. The wax obtained from lac insect also finds its uses in shoe, automobile and floor polish, bottle sealer, tailor's chalk, crayons, lipsticks and fruit coatings. The scale of operations can vary from a very small-scale cottage unit consisting of 3-5 persons to a very large lac based unit of more than 100 persons. A few small lac based units suitable are as follows:

- (i) Lac Processing: The lac produced at farm level is processed in factories for refining. It involves two steps (a) the conversion of stick lac into seed lac (granulated form) and (b) conversion of seedlac into shellac (flake form).

Strategies for Increasing Lac Production and Income

Developmental agencies in different lac growing states have to come forward for promoting adoption of proven technologies of lac cultivation on farmer's field. Similarly, lac industries need to provide feedback regularly and care for farmers cause. The following issues need to be addressed to meet the objective:

- i. Speedy decision making on formation of National Lac Development Board to monitor, coordinate, liaise the developmental issues, problems and take policy decisions on: declaring lac as an agricultural commodity, promotion of lac at state level, maintaining buffer stock of lac, price stabilization, implementation of Minimum Support Price, and regularizing export / import of lac. The responsibility of lac development needs be assigned clearly to one of the relevant state departments.
- ii. Employment Generation Schemes like MGNREGA need to be linked to lac promotional activities like raising large scale plantations of lac-host trees. Traditional lac host trees i.e. palas, ber and kusum can be planted in waste land, bunds of agricultural field and

- backyard of farmers' houses and utilized for lac cultivation without costly inputs like fertilizers, pesticides etc.
- iii. Credit and insurance to lac growers: Lac is a high value crop with high risk factors. Most of the lac growers being poor and illiterate do not have capacity to procure inputs and their risk bearing capacity is also very low. There is need to have a mechanism to declare large scale crop mortality over larger area as natural calamity, so that farmers could be compensated and supported to sustain their interest in lac cultivation. Subsidized loans from banking institutions should also be available to enterprising farmers for lac cultivation.
 - iv. Enhancing exploitation of unexploited host plants: Plenty of lac host trees are available in/on farmers' house backyard, agricultural field and forest area. Survey made in Ranchi and West Singhbhum district of Jharkhand shows that host utilization for lac cultivation was very low and it was 28.7 per cent for palas, 53.8 per cent for ber, 17.2 per cent for kusum and 7.4 per cent for other host trees. This indicates a greater scope for increasing lac production by utilizing more of the hosts for lac cultivation. Target atleast 2 per cent increase in lac host utilization every year to reach 50 per cent from the present average of 28 per cent.
 - v. Revival of lac in traditional production catchments: Some of the districts have potential to cultivate lac. Most of the lac growing districts and the districts which have potential to cultivate lac fall under the category of disadvantaged districts as identified by the Planning Commission/NITI Aayog of India. Efforts need to be made to reintroduce lac cultivation in these districts.
 - vi. Quality and timeliness of availability of brood lac is the most important in expansion / revival of lac cultivation. The lac growing states should develop brood lac farms in high production catchments (at least one in each district). These could be managed through JFM with technical guidance of IINRG.
 - vii. Promote ber for kusmi lac as it is highly productive and better in quality. Moreover, it is less prone to large scale mortality that has been witnessed recently in rangeeni strain of lac insect affecting lac production and interest of lac growers.
 - viii. *Flemingia semialata* and some other fast growing, short statured and perennial shrubs can be used for lac cultivation on plantation basis in both irrigated and rainfed conditions. These hosts are suitable for lac production during winter / rainy season, with the weekly irrigation also used for production of summer season crop. Lac cultivation can be initiated on these hosts within two years of planting. These are particularly beneficial for those farmers who do not have traditional host-plants but, are interested in starting lac cultivation.
 - ix. Training in scientific methods of lac cultivation: Survey data collected by IINRG shows that even untrained lac growers earn Rs. 7,200 per family from cultivation of lac and this income was more than double in case of trained lac growers. This demonstrates the scope that exists for increasing income through scientific method of lac cultivation. Income from lac cultivation was found to contribute towards 24.0 and 32.0 per cent of total income and farm income respectively for trained lac growers. Trained lac growers give more emphasis on brood lac production over stick lac production. Higher level of brood lac production resulted in self sufficiency in brood lac and more utilization of host trees for lac cultivation.

9. Agro-forestry

Status and Scope for Promotion of Agro-forestry

Agriculture and forestry can no longer be treated in isolation and linking these two is imperative for socio-economic development in the twenty-first century (FAO, 2016). Prior to the 'Green Revolution', the majority of subsistence farming anywhere in the world involved growing of mixed species, usually including trees (Mark and Mbow, 2014). Agro-forestry is a land use system, which integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability.

Agro-forestry provides both climate change mitigation and adaptation benefits to farmers. In addition to income from sale of agro-forestry products, trees on farms are a critical component of climate-smart agriculture in many systems. Trees regulate moisture, moderating drought or heavy precipitation, and soil temperature. Trees contribute to soil fertility by adding nutrients in the case of nitrogen-fixing species, and they contribute to increasing soil organic matter. Increasing bio-mass carbon on agricultural lands through agro-forestry may also improve biodiversity, water quality, and, in some cases, hydrological cycles (CGIAR, 2017). This is a traditional way of sustainable land management practised in India and its contribution to food, fuel, fodder, fibre and timber is well recognized.

Extent of activities and potential for employment generation

At present agro-forestry meets almost half of the demand of fuel wood, two-third of the small timber, 70-80 per cent wood for plywood, 60 per cent of raw material for paper pulp, and 9-11 per cent of the green fodder requirement of livestock, besides meeting the subsistence needs of households for food, fruit, fibre, medicine, timber etc. (ICAR-CAFRI, 2015). Agro-forestry not only provides environmental services, but also economic gains, as about 65 per cent of the country's timber requirement is met from the trees grown outside forests (SMAF, 2016)

Wood-based products such as paper, pulp and furniture offer vast potential for enhanced income for farmers (NITI, 2017). Employment growth with rising productivity is the most effective mechanism to alleviate poverty to the poor with equity. Dhyan et al. (2003) reported that agro-forestry provides employment with relatively lower investment and that too for the unskilled rural sector. The role of agro-forestry in employment generation through various activities involved in production and processing is well documented. For example, Poplar is a prominent industrial species, which covers less than 2 per cent area under agro-forestry with four to five lakh ha but generates about 90 to 100 million man-days of employment per year. This includes 20 million man-days crop cultivation; 20 million man-days in felling trees and their conversion into logs, grading, loading, unloading, stacking and handling timber; and approximately 50 million man-days in wood based industry involved in converting poplar wood into wood based products in India (Dhiman, 2008 and ICFRE, 2016).

Expected Cost of Cultivation and Financial Viability

There are several studies available on financial analysis of agro-forestry systems in country. Jain and Singh (2000) conducted a study on performance of Poplar-based agro-forestry in terms of income, employment and environmental impact in Shahjahanpur district of western Uttar Pradesh. They reported that Poplar-based agro-forestry is economically viable and more profitable than many of crop rotations followed in the study area. This land use system is also capable for providing employment opportunities Chahal et al. (2012). It recorded highest net income in case of poplar + sugarcane (Rs. 64,355/ha/year), followed by poplar + turmeric (Rs. 59,543/ha/year) and lowest by poplar + rainfed wheat (Rs. 18,719 /ha/year). Poplar alone gave a net income of Rs. 20,188/ha/year. The traditional rice-wheat crop rotation provided Rs. 22,970/ha/year as net income. Deswal et al. (2014) reported that an average farmer earned 46 per cent higher income from poplar-based agro-forestry compared to rice-wheat crop rotation.

There is dearth of valuation of ecosystem services of agro-forestry in country. The estimated value of provisioning services usually found lesser than other ecosystem services such as regulatory, supporting and cultural services generated from agro-forestry. Alam et al. (2014) conducted a study on valuation of ecosystem services of tree-based intercropping in Canada and reported that only one-third value contributed by provisioning services in total economic value of the system. They suggested that farmers only benefitted by provisioning service, hence government incentives are needed to encourage farmers to adopt practices that benefit society as a whole.

The financial analysis of prominent agro-forestry systems prevalent in various agro-climatic zones in India was conducted based on the data from 'Report of the Task Force on Greening India for Livelihood Security and Sustainable Development' of the Planning Commission.

Agro-forestry Support and Interventions Needed

Two new sub-missions under NMSA along with reforms imparted to the relevant Acts/Rules offer a new policy and programme support to promoting agro-forestry. These are:

- National Mission on Agro-forestry
- Restructured National Bamboo Mission

The Government of India's reform initiatives include issue of guidelines entitled "Wood-Based Industries (Establishment and Regulations), 2016" in compliance of the directions contained in the Order dated 5-Oct-2015 of the Supreme Court of India, in respect of rule and regulations for wood-based industries. The proper implementation of these guidelines by state governments would help in correcting the distortions in wood market and will be beneficial to all stakeholders, especially the agro-forestry farmers in the country. Various policy issues related to regulations, which affected the cultivation of trees on private land, harvesting, marketing, transportation, utilization and trading. All these brought out in the National Agroforestry Policy (2014) have been addressed through implementation of Sub-Mission on Agroforestry (SMAF), 2016.

Government of India has been giving a special grant to Punjab, Haryana and western Uttar Pradesh under crop diversification programme (CDP) since 2013-14. The objective has been to diversify rice-wheat system through agro-forestry. Poplar and Eucalypts are among the few tree species promoted

under this diversification plan. However, particularly in the state of Punjab, Eucalyptus plantation is encouraged in water-logged areas only.

Agro-forestry model should be specific to size of the farm holdings, soil type and slope of field, capital and labour availability, status of supply chain and market demand of a particular species and over- all marketing infrastructure in a given agro-climatic zone in country. Agro-forestry extension should be equipped with modern technique that can enable to bridge the knowledge gap between research institutions and farmers' fields.

The collection and dissemination of species-wise wood price in various markets also necessary for evidence-based research, forecasting of wood price and economic analysis of agro-forestry systems in country.

Normally, market information for inputs and outputs is not available as in case of other agricultural commodities. Even now market-wise time series data for wood is not available on the AGMARKNET portal, which is necessary for any analysis for market research. In fact, market research is a 'black box' in case of agro-forestry enterprises, because of longer gestation period of tree component.

10. Bamboo as a Component of Secondary Agriculture

Bamboos are the fastest growing perennial, tall, wide spread and versatile species with ability to produce culms every year. It belongs to the grass family (i.e., Poaceae) and constitutes a single sub-family Bambusoideae. Bamboos have multiple utility (about 1500), that include food, fibre, fuel, construction & engineering materials, panel products, charcoal, medicinal products, paper, flooring, screens etc. Bamboo is also a source of active minerals such as vitamins, amino acids, flavine, phenolic acid, polysaccharide, trace elements, etc. All these traits qualify it to be an asset that fulfils the basic needs of human survival, i.e food, clothing and shelter. Many nutra-ceuticals can be extracted from bamboo culm, shoot and leaf which have anti-oxidation, anti-aging, anti-bacterial and anti-viral properties. It is an alternate form of timber, that is more easily accessible to the poor. Hence, it is a popularly referred to as 'green gold'. In sum, it plays a substantial role in the economy of India and provides livelihood support to millions of people.

Just three countries, namely, China, India and Myanmar account for 80 per cent of the total bamboo area in the world. It is estimated that India is the second largest country in world with 37.8 per cent of the total bamboo forest area after the China (FSI 2011). Bamboo is found in all most all parts of the country except Jammu and Kashmir where it does not occur naturally.

Importance of bamboo

The importance of bamboo comes from its eco-friendliness and large bio-mass production, being a substitute for timber, soil erosion control ability, besides usefulness in maintenance of soil health and amelioration of micro-climate. It is amenable to multiple uses, and is therefore, well suited to value addition activities, generating thereby number of employment opportunities in the rural sector.

Potential of Bamboo in Employment Generation

Bamboo has rural, domestic and industrial uses enabling it to play a vital role in the economy and manpower utilization. The manpower is used in raising bamboo, its maintenance, harvest, transport, storage and end uses. These aspects have been studied and quantified. Every hectare of bamboo plantation generates about 160 workdays. An average of 8-10 workdays is needed to harvest one tonne of bamboo. Five workdays per tonne are generated by transportation and handling of bamboo. As many as 80 workdays are required for processing one tonne of bamboo and its weaving into usable products. In cottage industries, about 600 workdays are required per tonne of bamboo in primary processing

Consortia related to Bamboo

INBAR, Delhi: The International Network on Bamboo and Rattan has its headquarters at Beijing, China with an office at Delhi. It is a premier organization that has networked various institutions, industries, producers and service providers working on Bamboo by bringing all on to a common platform. It is involved in development of technology and extension in all aspects dealing with Bamboo.

NMBA, Delhi: The National Mission on Bamboo Applications with its office at Delhi is a Government India's initiative to give fillip to bamboo based activities in India from all angles including policy development, widening and enhancing production base, value addition, enterprise development, marketing etc. This Mission provides financial and technical support in all these aspects. Now the Restructured National Bamboo Mission has been provided adequate budgetary support (Rs.1290 crore for the year 2018-19).

IWST, Bangalore: The Institute of Wood Sciences and Technology located at Bengaluru is an institute of the Indian Council for Forestry Research and Education (ICFRE) involved in development and dissemination of wood technology. They have developed expertise in preservation and processing of timber including bamboo for enhancing longevity and shelf life of the products and thereby reduce pressure on forests.

NID Ahmedabad: The National Institute of Designs at Ahmedabad, Gujarat is a premier institute in development of designs. This institute has designed high quality bamboo furniture that has export potential. Most of this furniture is based on bamboo poles and is eco-friendly and fully recyclable. This institute has trained a number of craftsmen who can impart training to selected VSS (Village Service Society) members in furniture craft. Training facilities available in this institute are used in training master craftsmen from among VSS members. The growth centre at Asifabad/Kagaznagar can serve as Centre for this activity.

Bamboo as Secondary Agriculture

Since it is a versatile crop and is well suited to less endowed areas, besides being amenable to agro-forestry, the farmers will be able to take advantage of the recently amended provision to the Indian Forest Act, 1927, whereby bamboo stands exempted from felling and transit permit, and incentivising them to grow it on their farms. In sequel, the farm families will be able to adopt bamboo based household level cottage industry for using their inter-seasonal free time more gainfully. They will need training, financial support and market facilitation to do so.

Bamboo is amenable to large number of usages, using which potential small and medium scale industries can be built up, preferably in close proximity to bamboo hinterlands. The farmers can be enabled to tie up with such industries. There also exists scope for educated youth to build aggregation enterprises as gainful employment. Hence, bamboo cultivation holds immense potential to generate household level and village level enterprises.
