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Ministry of Agriculture &
Farmers Welfare

Report of the Committee on Doubling Farmers' Income

Volume IX

**“Farm linked Activities and
Secondary Agriculture”**

**“Adding Value to Primary Produce and Building
Agricultural Enterprises in the Rural India”**

Document prepared by the Committee on Doubling Farmers' Income,
Department of Agriculture, Cooperation and Farmers' Welfare,
Ministry of Agriculture & Farmers' Welfare.

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Foreword

The country has witnessed a series of concerted discussions dealing with the subject of agriculture. In 1926, the Royal Commission of Agriculture was set up to examine and report the status of India's agricultural and rural economy. The Commission made comprehensive recommendations, in its report submitted in 1928, for the improvement of agrarian economy as the basis for the welfare and prosperity of India's rural population. The urban population was about 11 per cent of the whole, and demand from towns was small in comparison. The Commission notes, that communication and physical connectivity were sparse and most villages functioned as self-contained units. The Commission encompassed review of agriculture in areas which are now part of Pakistan, Bangladesh and Myanmar. The net sown area in erstwhile British India was reported as 91.85 million hectares and cattle including buffaloes numbered 151 million. Almost 75 per cent of the cultivated area was under cereals and pulses, with rice and wheat occupying 46 per cent of the net sown area. The area under fruits and vegetables was about 2.5 per cent and that under oilseeds and non-food crops was about 20 per cent. In the ensuing years, as well known, the country underwent vast changes in its political, economic and social spheres.

Almost 40 years later, free India appointed the National Commission on Agriculture in 1970, to review the progress of agriculture in the country and make recommendations for its improvement and modernisation. This Commission released its final report in 1976. It refers to agriculture as a comprehensive term, which includes crop production together with land and water management, animal husbandry, fishery and forestry. Agriculture, in 1970 provided employment to nearly 70 per cent of the working population. The role of agriculture in the country's economic development and the principle of growth with social justice, were core to the discussions. The country was then facing a high population growth rate. After impressive increase in agricultural production in the first two Five Year Plans, a period of stagnancy set in and the country suffered a food crisis in the mid-1960s. The report in fifteen parts, suggested ample focus on increased application of science and technology to enhance production.

Thirty years hence, the National Commission for Farmers was constituted in 2004 to suggest methods for faster and more inclusive growth for farmers. The Commission made comprehensive recommendations covering land reforms, soil testing, augmenting water availability, agriculture productivity, credit and insurance, food security and farmers competitiveness. In its final report of October 2006, the Commission noted upon ten major goals which included a minimum net income to farmers, mainstreaming the human and gender dimension, attention to sustainable livelihoods, fostering youth participation in farming and post-harvest activities, and brought focus on livelihood security of farmers. The need for a single market in India to promote farmer-friendly home markets was also emphasised.

The now constituted DFI (Doubling Farmers' Income) Committee besides all these broad sectoral aspects, invites farmers' income into the core of its deliberations and incorporates it as the fulcrum of its strategy. Agriculture in India today is described by a net sown area of 141 million hectares, with field crops continuing to dominate, as exemplified by 55 per cent of the area under cereals. However, agriculture has been diversifying over the decades. Horticulture now accounts for 16 per cent of net sown area. The nation's livestock population counts at more than 512 million. However, economic indicators do not show equitable and egalitarian growth in income of the farmers. The human factor behind agriculture, the farmers, remain in

frequent distress, despite higher productivity and production. The demand for income growth from farming activity, has also translated into demand for government to procure and provide suitable returns. In a reorientation of the approach, this Committee suggests self-sustainable models empowered with improved market linkage as the basis for income growth of farmers.

India today is not only self-sufficient in respect of demand for food, but is also a net exporter of agri-products occupying seventh position globally. It is one of the top producers of cereals (wheat & rice), pulses, fruits, vegetables, milk, meat and marine fish. However, there remain some chinks in the production armoury, when evaluated against nutritional security that is so important from the perspective of harvesting the demographic dividend of the country. The country faces deficit of pulses & oilseeds. The availability of fruits & vegetables and milk & meat & fish has increased, thanks to production gains over the decades, but affordability to a vast majority, including large number of farmers too, remains a question mark.

The impressive agricultural growth and gains since 1947 stand as a tribute to the farmers' resilience to multiple challenges and to their grit & determination to serve and secure the nation's demand for food and raw material for its agro-industries.

It is an irony, that the very same farmer is now caught in the vortex of more serious challenges. The average income of an agricultural household during July 2012 to June 2013 was as low as Rs.6,426, as against its average monthly consumption expenditure of Rs.6,223. As many as 22.50 per cent of the farmers live below official poverty line. Large tracts of arable land have turned problem soils, becoming acidic, alkaline & saline physico-chemically. Another primary factor of production, namely, water is also under stress. Climate change is beginning to challenge the farmer's ability to adopt coping and adaptation measures that are warranted. Technology fatigue is manifesting in the form of yield plateaus. India's yield averages for most crops at global level do not compare favourably. The costs of cultivation are rising. The magnitude of food loss and food waste is alarming. The markets do not assure the farmer of remunerative returns on his produce. In short, sustainability of agricultural growth faces serious doubt, and agrarian challenge even in the midst of surpluses has emerged as a core concern.

Farmers own land. Land is a powerful asset. And, that such an asset owning class of citizens has remained poor is a paradox. They face the twin vulnerabilities of risks & uncertainties of production environment and unpredictability of market forces. Low and fluctuating incomes are a natural corollary of a farmer under such debilitating circumstances. While cultivation is boundarised by the land, market need not have such bounds.

Agriculture is the largest enterprise in the country. An enterprise can survive only if it can grow consistently. And, growth is incumbent upon savings & investment, both of which are a function of positive net returns from the enterprise. The net returns determine the level of income of an entrepreneur, farmer in this case.

This explains the rationale behind adopting income enhancement approach to farmers' welfare. It is hoped, that the answer to agrarian challenges and realization of the aim of farmers' welfare lies in higher and steady incomes. It is in this context, that the Hon'ble Prime Minister shared the vision of doubling farmers' income with the nation at his Bareilly address on 28th February, 2016. Further, recognising the urgent need for a quick and time-bound transformation of the

vision into reality, a time frame of six years (2016-17 to 2022-23) was delineated as the period for implementation of a new strategy.

At the basic level, agriculture when defined as an enterprise comprises two segments – production and post-production. The success of production as of now amounts to half success, and is therefore not sustainable. Recent agitations of farmers (June-July 2017) in certain parts of the country demanding higher prices on their produce following record output or scenes of farmers dumping tractor loads of tomatoes & onions onto the roads or emptying canisters of milk into drains exemplify neglect of other half segment of agriculture.

No nation can afford to compromise with its farming and farmers. And much less India, wherein the absolute number of households engaged in agriculture in 2011 (119 million) outpaced those in 1951 (70 million). Then, there are the landless agricultural labour who numbered 144.30 million in 2011 as against 27.30 million in 1951. The welfare of this elephantine size of India's population is predicated upon a robust agricultural growth strategy, that is guided by an income enhancement approach.

This Committee on Doubling Farmers' Income (DFI) draws its official members from various Ministries / Departments of Government of India, representing the panoply of the complexities that impact the agricultural system. Members drawn from the civil society with interest in agriculture and concern for the farmers were appointed by the Government as non-official members. The DFI Committee has co-opted more than 100 resource persons from across the country to help it in drafting the Report. These members hail from the world of research, academics, non-government organisations, farmers' organisations, professional associations, trade, industry, commerce, consultancy bodies, policy makers at central & state levels and many more of various domain strengths. Such a vast canvas as expected has brought in a kaleidoscope of knowledge, information, wisdom, experience, analysis and unconventionality to the treatment of the subject. The Committee over the last more than a year since its constitution vide Government O.M. No. 15-3/2016-FW dated 13th April, 2016 has held countless number of internal meetings, multiple stakeholder meetings, several conferences & workshops across the country and benefitted from many such deliberations organised by others, as also field visits. The call of the Hon'ble Prime Minister to double farmers' income has generated so much of positive buzz around the subject, that no day goes without someone calling on to make a presentation and share views on income doubling strategy. The Committee has been, therefore, lucky to be fed pro-bono service and advice. To help collate, analyse and interpret such a cornucopia of inputs, the Committee has adopted three institutes, namely, NIAP, NCAER and NCCD. The Committee recognizes the services of all these individuals, institutions & organisations and places on record their service.

Following the declaration of his vision, the Hon'ble Prime Minister also shaped it by articulating 'Seven Point Agenda', and these have offered the much needed hand holding to the DFI Committee.

The Committee has adopted a basic equation of Economics to draw up its strategy, which says that net return is a function of gross return minus the cost of production. This throws up three (3) variables, namely, productivity gains, reduction in cost of cultivation and remunerative price, on which the Committee has worked its strategy. In doing so, it has drawn lessons from the past and been influenced by the challenges of the present & the future.

In consequence, the strategy platform is built by the following four (4) concerns:

- Sustainability of production
- Monetisation of farmers' produce
- Re-strengthening of extension services
- Recognising agriculture as an enterprise and enabling it to operate as such, by addressing various structural weaknesses.

Notwithstanding the many faces of challenges, India's agriculture has demonstrated remarkable progress. It has been principally a contribution of the biological scientists, supplemented by an incentivising policy framework. This Committee recognizes their valuable service in the cause of the farmers. It is now time, and brooks no further delay, for the new breed of researchers & policy makers with expertise in post-production technology, organisation and management to take over the baton from the biological scientists, and let the pressure off them. This will free the resources, as also time for the biological scientists to focus on new science and technology, that will shift production onto a higher trajectory - one that is defined by benchmark productivities & sustainability. However, henceforth both production & marketing shall march together hand in hand, unlike in the past when their role was thought to be sequential.

This Report is structured through 14 volumes and the layout, as the readers will appreciate, is a break from the past. It prioritizes post-production interventions inclusive of agri-logistics (Vol. III) and agricultural marketing (Vol-IV), as also sustainability issues (Vol-V & VI) over production strategy (Vol. VIII). The readers will, for sure value the layout format as they study the Report with keenness and diligence. And all other volumes including the one on Extension and ICT (Vol. XI), that connect the source and sink of technology and knowledge have been positioned along a particular logic.

The Committee benefited immensely from the DFI Strategy Report of NITI Aayog. Prof. Ramesh Chand identified seven sources of growth and estimated the desired rates of growth to achieve the target by 2022-23. The DFI Committee has relied upon these recommendations in its Report.

There is so much to explain, that not even the license of prose can capture adequately, all that needs to be said about the complexity & challenges of agriculture and the nuances of an appropriate strategy for realising the vision of doubling farmers' income by the year of India's 75th Independence Day celebrations.

The Committee remains grateful to the Government for trusting it with such an onerous responsibility. The Committee has been working as per the sound advice and counsel of the Hon'ble Minister for Agriculture and Farmers' Welfare, Shri Radha Mohan Singh and Dr. S.K. Pattanayak, IAS, Secretary of the Department of Agriculture, Cooperation and Farmers' Welfare. It also hopes, that the Report will serve the purpose for which it was constituted.

12th August, 2017

Ashok Dalwai
Chairman, Committee on
Doubling Farmers' Income

About Volume IX

The ninth volume of the Report of the Committee on Doubling Farmers' Income (DFI) examines the need and the scope to develop additional economic activities in the agrarian rural economy. These farm-linked activities, when developed at farm and village levels, benefit the farming communities by way of gainful employment and additional incomes.

As already discussed in earlier volumes, the average monthly farm income is low and not adequate to fulfil the welfare requirements of the farmer. Simultaneously, the farm families suffer from underemployment and disguised unemployment. The irony is, that the two basic assets that the farm families own, namely, land and manpower, are not fully utilised. It is estimated that the average number of days in a year that a farmer is engaged, leaves him a lag period. With the cropping intensity being low, the land obviously also suffers a lag in its gainful use. Additionally, the system has been unfair in attaching value, by and large, to the primary produce like grain or fruit, treating other by-products like straw, stalk, etc. as agricultural waste.

This Volume, draws attention to the intrinsic value contained in every biological output, and it is considered a waste today only because the system is wasting the opportunity by not recognising its value. Suggestions on ways to optimally use all the biological generated produce from the farm and in the neighbourhood, as useful raw materials that will fill the lag periods that farm families suffer from today are discussed.

Value addition has two connotations, one where the value is added to the primary produce and the other where value is added to the producer. In the first, the primary output from on-farm activities is transformed into a value added product - as food, fodder or feed for the industry. The other is, where the primary produce is preconditioned to connect with distant and more efficient markets, without compromise in quality, thereby enabling the farmer-producer to maximise value capture for himself. By monetising every crop, drop and ounce produced, the farmer can rightfully optimise on the productive use of all production from farming activities.

In the above context, emphasis is laid on the concept of Secondary Agriculture and it has been defined. It is placed as a companion to farming, which is a well known primary activity, and the two together will constitute the primary economic sector. Volume-X that follows, will deliberate on the various risks that beset the agricultural sector.

Ashok Dalwai

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Doubling Farmers' Income

Volume IX

“Farm linked Activities and Secondary Agriculture”

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Chapter 1

Setting the Context

Agriculture is the core activity in rural areas of the country. While it is a primary sector, the material output from agriculture provides sustenance to multiple secondary sector manufacturing activities, which thereafter outputs products for end-consumers. The primary output that is directly consumable also requires to undergo activities that allow farmers to capture greater value from the markets.

1.1. Background

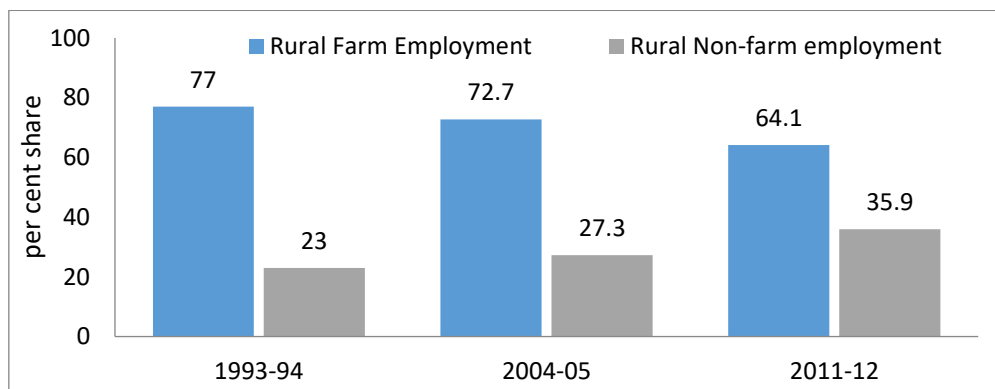
The per capita income of the rural households is significantly less than that of urban households in India and the share of agriculture in rural income has witnessed a downwards trend. There are various interventions recommended by this DFI Committee to strengthen and grow the contribution of agriculture to the economy. There remain other opportunities to advance agriculture and allied economic activities and also provide gainful employment for the farm households, including the rural youth in particular. The provision of alternative means of livelihoods in rural areas, especially when these are directly linked to the core activity of agriculture, will not only supplement the existing income levels of farming households, but also abet and enhance the value captured from agriculture itself.

In the backdrop of emerging need for additional sources of income and to capture more value from the output of agriculture, there is a need to revisit the existing understanding of Secondary Sector activities and the term 'Secondary Agriculture' and develop an inclusive understanding on the concept. This volume discusses agriculture linked activities and secondary agriculture and suggests a framework, that includes various near-farm and village level activities.

1.2. Farm and Non-Farm Contributions to Farmers' Income

Rural non-farm sector employment is defined as any form of employment other than farm employment in the type of wage, self, or unpaid family labour. With rapid urbanization and infusion of modern technologies, India has been witnessing a transformation in employment and income from agro based rural economy to industry based urban economy which is associated with a vibrant Rural Non-Farm Sector (RNFS).

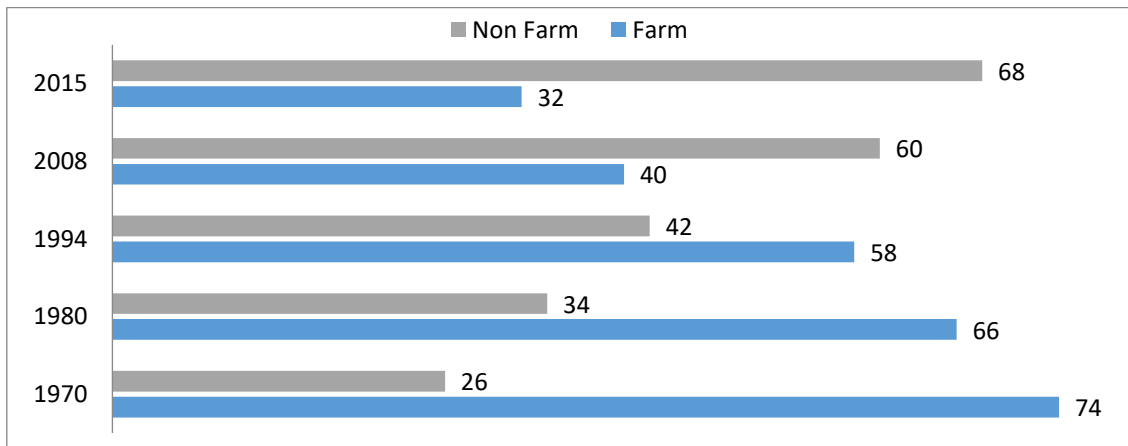
Figure 1.1 Rural farm and non-farm employment over the years



Source: NSSO

The figure 1.1 depicts a decline in rural farm employment, post liberalisation period, and a progressive increase in non-farm jobs. The corollary is a decline in farm income and rise in non-farm income in the economy as depicted in figure 1.2 below:

Figure 1.2 Share of farm and non-farm incomes over the years (%)



Source: National council of Applied Economic Research, Elara securities Research

Though the output in rural India between the years of 1970-71 and 2011-12 increased seven times, employment did not even double during the corresponding period. This is attributed to the fact, that while a substantial chunk of rural workforce withdrew from agricultural sector, the majority did not join the non-farm sectors. It calls for a closer delineation of the multiple sources of rural incomes and evolving dynamics of rural income generating activities. In addition to the agricultural output, the rural areas have been found to be contributing “*about half of the manufacturing and construction sectors output and one quarter of the services sectors output in the country*” (Ramesh Chand, S. K Srivastava and Jaspal Singh, 2017).

1.2.1. Multiple incomes of rural households – risk mitigation

Various studies have revealed that rural economy in India is undergoing a rapid structural transformation, wherein rural non-farm employment and income are gaining share and playing an important role. Non-farm employment in India has been markedly increased in the share of rural post-reform 1993-94. There has especially been a boom in infrastructure and construction with improvement in transportation and communication and wage rates. Increase in rural literacy and increased thrust of Government in social development programs in rural areas have become the drivers of change. However, the non-farm sector still has a long way to go to reap its full potential benefits by addressing the inadequacies relating to several factors like rural infrastructure (particularly roads, electricity and communication facilities), lack of sufficient skilled labour and adequate access to credit and information.

Other studies have revealed that the contributors of rural income are becoming “more urban” in nature. However, this raises debate on how the term rural is delineated, by geography, economy, activity, habits, etc. Nevertheless, the indications are that infusion of industrial technologies, services, communication and enterprise models at village level provide new non-farm and near-farm livelihood opportunities to the rural populace.

It is interesting to note, that 44 per cent of rural households found employment in non-farm and casual labour work, while about 26 per cent of the rural households are purely dependent on farming for their livelihoods. Almost 25 per cent rely on non-farm sources for their living. This is beckoning at the multiplicity of non-farm job opportunities for the rural workforce.

Table 1.1 Sources of income and proportion of rural households

Household type and level of earnings			
Rural household type - based on major source of Income	Rural households (million, 2014)	Share of households (%)	Share of Income (%)
Pure farm households	46.2	26	25
Farm and non-farm income	39.2	22	25
Agricultural labour only	17.8	10	6
Non-farm including casual labour	76.2	42	44
Total Rural Households	179.4	100	100

Source: ICE 360° Survey (October 2014) from People Research on India's Consumer Energy

This Committee primarily focuses on growth of farmers' income and on enhancing the share of farm income in their total income. However, it takes cognisance of the fact that the rural workforce and rural households, which may not typically be categorised as farmers, will also benefit from agriculture linked interventions. Agricultural enterprises and modernisation can be modelled in such a way as to form the key to link on-farm and off-farm activities, and for generating non-farm employment and incomes. Bringing organised industry to rural regions can boost the non-farm rural economy, and a few such examples are village based production of nutrients, bio-pesticides, bio-fertilizers, seed production and agro-processing. The agri-business opportunities in hydroponics and medicinal plants can also add to this growth.

A typical farming household manages expenses with unsteady, unpredictable and irregular income streams, owing to the seasonal nature of agricultural output which is further subject to other externalities. This also reflects in the income stream of many rural households, even if they may not solely rely on farm income. Recent evolution of credit availability from community savings group and micro-finance institutions has enhanced access to short-term borrowings, for both consumption and income generation purposes at a decentralised level. Human capital essentially constitutes the principal asset available to most rural households, as the valuation of other material assets viz. land, livestock, buildings, shops, etc., often falls short to attract sufficient income for the entire household, particularly in case of smallholders.

The availability of human capital is subject to periodic stresses and mishaps like floods, and seasonal drift of manpower from villages into cities for livelihood. Such manpower movement, was more evident in the previous decade, when the rural workforce would return to villages during harvesting seasons. A multiplicity of income sources was sought by a large section of the rural manpower. The multiple income sources helped to mitigate some of the risks associated with agriculture and allowed for shared income sources in a household.

It is also known, that households that can sustain themselves on farm income, especially those with large land holdings, outsource the farming work and take up additional activities that are in synergy. For example, a tractor owner could lease out the option to others, or in a farmer group would jointly source farm inputs for group members and also as a service to other farmers. Such income opportunities have also been scaled up into custom hiring centres and large farmer producer organisations. The opportunity to undertake secondary agricultural activities in an organised manner is also appreciated as cottage level industry in case of weaving, dairy processing, primary processing, leather preparation activities and others. Many such activities, that capture value at village level, require increased attention to give such development more impetus, from the perspective of doubling farmers' income. Large scale agro-industry including food processing was expected to provide such income opportunities to farming communities, both from creation of a consumption point for the primary produce and by providing employment. However, frequently the raw material is sourced from elsewhere and employment growth is minimal.

1.3. Rural Growth and Economic Sectors

Agricultural production is not the sole output from the rural economy. Agriculture in turn, sets off other near-farm and non-farm economic activities in the rural landscape. The overall well-being of the rural population therefore depends on agriculture as a primary sector, and various associated secondary and tertiary sector activities that either support agriculture or are supported by agriculture. A village is, in fact, a microcosm of the wider human civilization, which itself found cause, birth and sustenance from agriculture.

Besides producing nearly all the agricultural produce, the rural areas of the national economy contribute about one third of non-farm output and 48.7 per cent of non-farm employment in the country¹.

Table 1.2 Share of rural areas in total NDP & employment across different sectors (%)

Year	Agriculture		Non-agri.		Manufacturing		Construction		Services	
	NDP	Emp.	NDP	Emp.	NDP	Emp.	NDP	Emp.	NDP	Emp.
1970-71	96.2	96.8	32.4	47.3	25.8	51.5	43.2	64.6	32.8	42.1
1980-81	94.9	95.9	35.0	44.9	31.8	48.1	45.6	58.8	34.0	41.7
1993-94	93.9	95.8	34.8	46.6	29.8	51.3	45.1	57.2	33.6	42.3
1999-00	93.2	96.6	31.8	45.8	41.6	51.5	43.3	57.6	27.1	40.7
2004-05	94.1	96.1	36.7	47.2	42.5	49.6	45.5	64.4	32.7	41.9
2011-12	95.1	95.9	35.3	48.7	51.3	47.4	48.7	74.6	25.9	39.6

Note: Emp.: Employment, Non-agri. Includes manufacturing, construction, services and other sectors

The share of rural areas in manufacturing output has doubled in sixty years, without an associated increase in share in the workforce. This is also a sign of the fact that manufacturing technologies are no longer manpower intensive. In the future too, it is unlikely that

¹ Changing Structure of Rural Economy of India Implications for Employment and Growth – Discussion paper Nov, 2017 Ramesh Chand, S. K Srivastava and Jaspal Singh

manufacturing and services will be able to absorb large scale manpower, through construction has continued to be an employment generator.

Table 1.3 Sectoral share of workforce in Rural Areas

Year	Agriculture	Manufacturing	Construction	Services
1972-73	85.5	5.3	1.4	7.3
1983	83.6	6.2	1.3	8.8
1993-94	78.4	7.0	2.4	11.4
1999-00	76.3	7.4	3.3	12.5
2004-05	72.6	8.1	4.9	13.9
2011-12	64.1	8.6	10.7	15.5

Note: Shares do not sum upto 100 due to exclusion of some minor sectors.

Source: See footnote 1

An analysis of the sectoral share in the total rural workforce shows, that since the start of 1970s, the construction sector has absorbed the largest shift out of agriculture, along with services, while the share of agriculture reduced about 20 per cent. Of this, a nearly 8.5 per cent drop in the share of agriculture in the rural workforce occurred in the period 2004-05 to 2011-12, of which the construction captured the largest shift in workforce. The drop in agricultural employment since 2004 is also a result of on-farm tools and farm-mechanisation which eased the drudgery in farming, and freed the workforce for other sectors.

It is often projected that the previously recorded trends in Western Europe, Japan and China will be repeated in India. The past trends in these regions saw the constant shift of workforce out of agriculture into manufacturing or other sectors, and a consolidation of farming or the outsourcing of farming into less developed countries. It is worth considering, that these trends are of the past, rooted in a time when the industrial sectors were growing with simpler technologies, and requiring large scale manpower.

On the contrary, the modern day and future scenario is seeing drastic changes in their manpower requirements. The technologies in use now include computers, robotics and artificial intelligence, not only reducing the manpower needs of various industries and services, but also requiring a different level of capacity and skills. The agricultural workforce class cannot always be readily transplanted into other sectors.

1.3.1. Recent period in rural non-agri sectors

It is worth examining studies that have assessed how the non-agri sectors (manufacturing, services, construction, etc.) have behaved in the recent period, in terms of providing employment in rural areas.

There has been significant growth of manufacturing in rural areas, contributing to its higher share in Net Domestic Product (NDP). However, in the recent period after 2004-05, the growth is seen to be with no substantive or negligible growth in employment share of manufacturing sector in the rural workforce. It can be inferred that capital is increasingly deployed for manufacturing technologies that are less labour intensive.

Table 1.4 Sub-sector changes in employment (usual status) in manufacturing and services sectors

Sub-sectors	Employment: usual status (million)		Compound growth rate (%)	Share in total employment (%)	
	2004-05	2011-12		2004-05	2011-12
Wearing apparel	3.4	4.2	2.9	12.3	14.5
Tobacco products	3.4	3.6	0.8	12.3	12.5
Textile	4.5	3.6	-3.2	16.0	12.3
Non-metallic mineral products	3.4	3.6	0.8	12.3	12.5
Food products and Beverages	3.4	3.4	0.0	12.3	11.8
Machinery, metal products and transport equipment	2.1	3.0	5.7	7.4	10.4
Wood and wood products	4.1	2.8	-5.4	14.8	9.6
Furniture	1.7	1.5	-2.1	6.2	5.1
Chemical products	0.7	0.6	-2.6	2.5	2.0
Rubber and plastic products	0.3	0.4	1.1	1.2	1.3
Paper and printing, etc.	0.3	0.3	-0.3	1.2	1.2
Leather and related products	0.3	0.3	-1.8	1.2	1.0
Others	0.0	1.7	-	0.0	5.8
Manufacturing sector- Sub total	27.6	29.0	0.67	100	100
Wholesale & retail trade; repair of motor vehicles	18.5	18.8	0.3	38.9	36.0
Transport, storage & communication	8.6	10.0	2.3	18.0	19.2
Education	5.5	7.0	3.4	11.5	13.3
Hotel and restaurants	2.4	2.9	2.9	5.0	5.6
Public administration, defence and compulsory social security	2.7	2.7	-0.5	5.8	5.1
Health and social work	1.4	1.6	2.0	2.9	3.0
Financial intermediation	0.7	1.1	7.1	1.4	2.1
Others	7.8	8.2	0.7	16.4	15.7
Services sector: Sub-total	47.6	52.3	1.4	100.0	100.0

Source: See footnote 1

This, more recent development of capital intensive growth, can be expected to be the future trend where machine and energy productivity will be a priority in the manufacturing sectors.

In case of the services sector in rural areas, the changes in its share in NDP, have not been at the cost of its share in the rural workforce. In the period 2004-05 to 2011-12, the bulk of employment growth in services sector is observed in its sub-sectors of logistics, education, hospitality and financial intermediation. In all, the services sector added almost 5 million to their workforce, compared to 1.4 million added by the manufacturing sector.

The construction sector, requiring less skills compared to manufacturing and services, has absorbed the bulk of the rural workforce, besides agriculture itself. However, any inference that skilling of the rural workforce would alone enable the manufacturing and services sector to absorb more manpower may not be an entirely accurate assessment. It is not to say however, that skilling is not important. On the contrary, more of skilling the rural workforce is essential.

1.3.2. Manpower – the ignored production factor

As new manufacturing sector develops in rural areas (and with the modernisation of old industry), the industrialist prefers to rely more on technologies that will automate or optimise operations and minimises the need for manpower or labour. This will, therefore, not satisfactorily address the goal of employment generation for the rural labour-force. Not all industrial development has resulted in equally developing the desired employment. There is the need to strategically promote the right kind of development in manufacturing and services sectors, that will generate employment, and which can be filled with both the skilled and non-skilled rural workforce.

Such opportunity arises in the form of labour intensive, small and micro (MSME) enterprises. These, when as small cottage industry, at village level, will require to be connected and communicated to markets, which also gives a boost to the associated service sector in rural areas. **Wherever, cottage scale industry utilises the agricultural output and resources that abound at village level, they help set off greater demand and help create a virtuous cycle of growth in the rural economy.** Such a set of organised economic activities, near-farm or off-farm, closely dependent on the resources available at village level including the manpower, create opportunities that pave the way for empowerment through self-employment and entrepreneurship.

It is widely known, that the development of any country depends upon the equality of human capital and human development activities undertaken. Human capital in Indian rural economy is the principal asset owned by the rural households, more important than other common assets viz. land and livestock. The pace of developing village level enterprises can be accelerated to meet the demands for more productive jobs and incomes.

With economic innovation and development, the rural manpower is expected to acquire higher degree of professional skills to measure up to the new requirements. It is therefore, necessary to enhance techno-managerial and marketing skills of the rural workforce by establishing required institutional linkages and associations. While educational and training institutions are playing their role in the knowledge and skill transfer domain to the rural manpower, the large industries need to build their own resources and networks to keep upgrading the skill ecosystem as per technological and market dynamics. Rural India has remained in want of adequate investment for resource development.

Through this lens, one can see slack periods when the rural workforce seeks gainful occupation and many blind spots in utilisation of the available manpower resources. These have either been overlooked or underutilized for want of knowledge, skills and support from industry.

1.4. Economic Activities as Sectors of the Economy

Economic activities are those productive activities by humans that generate income. These are universally divided into three broad groups or sectors – **Primary, Secondary and Tertiary**. A review of these universal categories is mentioned before explaining secondary agriculture.

(i) **Primary Sector (Mining or Agricultural sectors).** It includes the economic activities which are connected with extraction and production of natural resources, e.g., cultivation, fishing, mining, etc. The activities of the primary sector are directly dependent on earth's resources and the environment such as land, water, minerals. The activities include hunting, fishing, gathering, pastoral, forestry, cultivation, mining and quarrying (red collar work). The output can be consumed directly by society, or can undergo additional or additive processes to be made usable by consumers.

(ii) **Secondary Sector (or Industrial sector).** It includes all activities which are concerned with processing of materials which have already been extracted at the primary stage, e.g., the mining of iron ore is primary industry, but manufacture of steel using it is secondary industry. Similarly, cotton processed into clothing or industrial processing of wheat grain into bread. The sector is dependent on inputs from the primary sector, where the raw material is transformed into a more valuable product, through activities concerned with manufacturing, construction, processing (blue collar work).

(iii) **Tertiary Sector (or Service sector).** It includes the support services to primary and secondary sector such as transport, banking, exchange, insurance, warehousing, communication, advertising, etc., to facilitate the flow of goods (from primary or secondary sector) and production of services in the economy (white collar work). Many of these activities can be outsourced as these are not localised to resources affected by the environment.

Certain higher services under the tertiary sector are categorised as Quaternary and Quinary activities. Quaternary relates to specialised activities in knowledge and information management. Quinary relates to ideation - evaluation, re-arrangement of existing concepts, creation of new ideas, policy making, etc. that impact on other economic sectors.

1.4.1. Agriculture as an economic activity

India is undergoing a process of urbanisation, the major share of growth in urban population is due to rural-urban migration and due to reclassification of rural settlements into urban. However, projections indicate that until 2050, more than 50 per cent of the country's population will still be rural. Thereafter, if the trends continue, the urban population may start to overtake rural population. Nevertheless, agriculture and allied activities will remain a focus area of the economy, not only from the perspective of employment to half the population, but also for nutritional and food security concerns of the other 50 per cent.

Agricultural activities, are traditionally interpreted as a primary sector. This interpretation also infers and limits the agricultural workers to biological production and linked actions such as sowing, rearing, cultivation and harvesting. Uniquely, unlike from mining, the bulk of the output from agricultural activities, can be directly used by end-consumers (as in case of many food items), or feed the manufacturing sector (as in case of fibre, construction, etc.).

The economic value that is captured from the output of agricultural activities is, intrinsically

linked to the other economic sectors. The output from a farm has notional material value only, except if consumed by farmer, until it connects with other consumers. To capture value, the agricultural output requires marketing services if monetised in its primary format as produce, or needs to integrate as feedstock with the manufacturing sector where it gets converted into a consumable product. For example, the produce needs for transport and warehousing (tertiary sector activities) to communicate the fresh onion or tomato to consumers, and there has to be demand from a textile factory (secondary sector activity) for cotton cultivators to progress.

1.4.2. Philosophy behind farm linked activities and secondary agriculture

There is need to focus on the additional means of generating employment and income for farming household, apart from the conventional modes of primary production in agriculture and allied sectors. The promotion of capital intensive industries, to the exclusion of labour intensive small scale enterprises, is not beneficial in light of high availability of the rural workforce. It is imperative that the resources available at the disposal of rural people including the farmers' time are used more efficiently.

Income of farmers, need not merely be a function of physical yield of grain or fruit. The amenability of the produce as raw material to manufacturing sector also deserves to be considered as a discernible factor in incomes. Future agricultural research has to look at both these aspects, as the nature of physical yield and whether it suits its end-use is more important in today's stage of agricultural development, and societal demands.

As an illustration to impart perspicacity to the discussion, take the case of sugarcane farming. Up and until, sugarcane is considered as a crop for producing jaggery or sugar, and efficiency of its cultivation is measured by sugar recovery. If the prefix 'sugar' is delinked, then the remaining part 'cane' enables an understanding that it can be used for other purposes too, and efficiency of cultivation measured accordingly. Unlike now, sugarcane can be cultivated as a plantation, and diversified as 'sugarcane plantation' for sugar; 'energy plantation' for ethanol; and 'bio-farm plantation' for industrial grade chemicals. Today the demand in the society is not only for sugar, but other products too.

The traditional understanding of farm productivity is not enough and farmer or farm-household productivity should be evaluated. A farmer's yield need not be merely a measure of output per area, but as income returns per man-day. For this, the primary activities may not remain sufficient, but utilising the resources at next level or secondary stage activities becomes an important contributing factor. The number of productive jobs that an asset or activity can create is more important than the yield per se.

Since a large section of manufacturing activity relies on agriculture as a resource base, the near-farm activities to feed such industry can be developed in the hands of farmers to add to their ability to capture greater value as suppliers to such industry. The various ancillary activities, directly linked to the resources available at village level including manpower, that also support the growth of farm income, be understood as agriculture linked economic activities and be

accorded special development support.

This Committee brings focus on such farm-linked activities in the backdrop of income generation in the rural areas, especially activities that are farm-related and the various options that are available to increase the efficiency of factors of production (land, labour and capital) that are currently deployed in Indian Agriculture.

1.5. What is “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 bio-resource – making secondary agriculture another terminology for all kinds of agro-industry.

The TACSA report focuses on products of the bio-processing industries, including the secondary and advanced level of manufactured products of the industry, such as extracting

ethanol, chemicals, enzymes, biologicals, bio-polymers, etc. Implicit in the TACSA report is that secondary agriculture means a high level technological capacity used at industrial level scales. Consequently, secondary agriculture, as referred by TACSA would belong to the domain of large high-tech industrial sectors. These industrial activities actually go beyond the immediate capacity of the farmers and have specialised manpower needs.

Even in the case of direct supply from farm-to-fork, the agricultural enterprise of a farmer or a group of farmers, will involve multiple activities. These activities will cut across all economic sectors (as in section 1.4) which have to integrate into a supply chain. The primary sector activity (farming), would leverage the service sector to capture value across time and space, and further maximise on its outputs by using the manufacturing sector to change the form of the output. The collaboration among the primary, secondary and tertiary sectors would help capture value out of every grain, ounce and drop of agricultural produce.

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.

1.5.1. 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.

Though Secondary Agriculture constitutes various segments of primary agriculture production processes, as explained in the previous section, certain tenets are hereby laid out to identify and categorise a given activity as such.

i. Uses slack / idle resources viz., land and labour (manpower time)

Secondary Agriculture activities complement various primary agricultural production systems and do not just supplement them. In other words, Secondary Agriculture increases the vertical elasticity of farm resources as against horizontal elasticity. Land for example is considered inelastic, but can be made vertically elastic. Given the seasonal production characteristics of agriculture in India (owing to the south west and north east monsoons), wherein rainfed agriculture occupies 54 per cent of net sown area, contributing 44 per cent of foodgrains and supporting 40 per cent of the population, the resources (land and manpower) are recognised to be lying idle for significant proportion of the year. This excludes the prolonged and frequent occurrences of drought across the years / 'no rainfall spells' within a year, leading to abandoning of crop cultivation by farmers. On an average, a farm family is gainfully employed on farm for about 180 days in a year.

Secondary Agriculture is expected to bring this idle resource into productive purposes thus generating income. For example, any farm related activity that uses the land or labour beyond the Kharif, Rabi and Zaid seasons would qualify for a Secondary Agriculture activity. Income generation activities that use the crop residues viz., paddy straw fodder blocks, crop residue briquettes, crop produce pre-conditioning for markets (cleaning, sorting and grading of crop produce), honey bee keeping, mushroom cultivation, backyard poultry etc that do not compete with the time that is required for various inter-cultivation activities of primary agriculture production, qualify to be defined as a secondary agriculture.

Various income generating activities of animal husbandry that do not compete with the primary agriculture activities for their resources (land and labour) also qualify for the secondary agriculture. For example, dairy, poultry, sheep rearing that utilise the idle time of the family labour constitute Secondary Agriculture. However, distinction has to be made between dairy (or any similar activity) taken up as primary agriculture activity and that practised as a secondary agriculture activity. In most of the cases, the scale of the activity, given the resources it commands for production purposes, determines whether it is secondary or primary nature of the agriculture activity.

ii. Contributes to primary agriculture production system

Secondary Agriculture is expected to contribute to the efficiency of resource use in Primary Agriculture, without ignoring the complementary nature of resource use. Typically, a large proportion of the prevailing agriculture production system depends on the inputs manufactured in urban areas, thus resulting in the movement of goods from urban to rural areas, while the money moves in reverse direction from rural to urban areas.

Secondary Agriculture is envisioned to contribute to rural industrialisation in the form of especially various Cottage and Village Industries that not only provide inputs that feed into primary agriculture (eg., compost) but also offer various pre-conditioning services to the commodities produced through primary agriculture that find their way into the food processing industries established in the urban areas.

Three principal segments of a typical production cycle in primary agriculture domain viz., inputs, production processes and the harvest/post-harvest handling of the output, offer a fertile ground for building local enterprises producing agriculture inputs and preparing the primary agriculture produce for the markets or the agro-processing industry.

Some of the potential avenues of Secondary Agriculture include enterprises in seed production domain viz., nurseries for field crop planting material, horticulture crops, agro-forestry species, floriculture etc; production and supply of plant nutrient viz., vermicompost, anaerobic digestion, bio-fertilisers (azospirillum, azatobactor etc.), bio-pesticides (plant extracts, pheromone traps and other conctions); nutrient advisory and management; making of pickles, papads, sweet-meats, assorted chutney powders etc. In the area of post-harvest handling of the production, the pre-conditioning of the crop produce is widely recognised as a potential avenue to generate additional income as well as to capture more value from the production.

Produce from various field crops, vegetable crops, flowers, spices, herbs, animal husbandry, dairy & fishery sector, as also from the common property resources (CPRs) that include water bodies & forests, mangroves, etc. provide scope & space for creating platforms for converting the farmers' idle time into productive time.

iii. Secondary Agriculture activities essentially should generate income

As against the incremental benefits an activity can accrue, activities of Secondary Agriculture are expected to generate income by ascribing the specific status of Job Role for each activity. It is specially recommended that a list of such activities is prepared with a distinctive Job Name and notified by the Sector Skill Councils for unambiguous adoption of such activities in the ongoing Government Schemes related to Skill Development, Entrepreneurship Development and Income Generation.

Further, it is clarified that such income generating activities constitute specific and recognised skill sets and should be able to sustain an individual. In other words, the income thus generated should hold the potential to keep the enterprise viable and financially sustainable.

The resource use efficiencies achieved through various improved practices in primary agriculture activities do have merit, and are covered in other volumes of the DFI report. This volume stresses the need to look at those activities that have the independent potential to generate employment and income for farmers, other than from the incremental yield or price of produce from primary agriculture.

1.6. 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 its 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

² The word 'Agriculture' in the context is used in broader sense that includes allied sectors too.

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.

Therefore, secondary agriculture is defined as a productive activity at enterprise level that,

- i. utilises as raw material the primary product and by-products of agriculture and other biological resources available locally in its rural agrarian neighbourhood; and/or
- ii. deploys locally available skills or a high level of rural manpower, to operate/manage/maintain the production of goods and services; and
- iii. can be categorised appropriately under the Micro, Small or Medium Enterprises Development (MSMED) Act 2006;

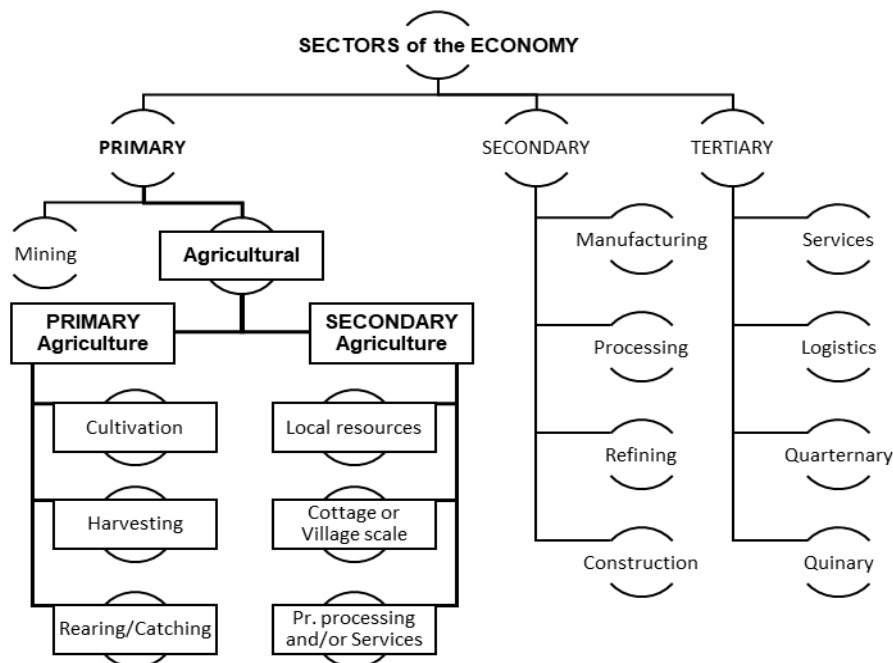
To explain inclusions and exclusions some examples are rendered below:

- a. A cotton ginning unit, to separate lint and seed from locally grown cotton, using local human resources and within norms for capital investment under MSME rules would be qualified as secondary agriculture. However, a cotton textile factory, sourcing its raw material across borders and with high capital investment may not be qualified as secondary agriculture.
- b. A jaggery making unit, in the sugarcane growing area would be secondary agriculture, but not a processing unit that procures cane molasses from other regions.
- c. A cottage scale unit employing local labour at a village, to create jams, pickles, chips, khadi products, etc., would be secondary agriculture, but not an automated aseptic pulping and juicing factory that sources tomato puree from other countries, or other locations within the country.
- d. A cashew processing unit that shells, salts and packages cashew from its neighbourhood growers, but not a similar unit if raw cashew is sourced from foreign growers.
- e. A milk pooling and chilling unit in a village would be secondary agriculture, but not a milk processing factory that sourced from thousands of such pooling units operated by a dairy cooperative.
- f. A cottage scale naturopathy or ayurvedic unit would be secondary agriculture, but not if it is of industrial scale producing ayurvedic products using automatic lines.

In the opinion of the DFI Committee, secondary agriculture should be described, first as an activity that can be considered as a cottage industry at a scale that contributes to the economic

well-being at the village scale, and secondly as an activity that is integrated into its neighbourhood in terms of input resources, either for its raw material or for its manpower. Small scale activities such as beekeeping, vermin-compost units, organic colour or dye making, mushroom spawning, silk worm breeding, nurseries, etc. would also be good examples of secondary agriculture where rural manpower, skills and locally available inputs are utilised.

It is equally obvious that breeding of racehorses, kennels, wildlife reserves, R&D centres, large pharmaceutical and agro-chemical industries, etc. would not be secondary agriculture. Large industries, are not secondary agriculture but are a particular opportunity to farmers, as consumers of their raw material. However, if the locally produced raw material undergoes primary processing at village level, and such value added primary output is supplied to the industry, it is considered as secondary agriculture. Where the village level enterprise, uses local resources to create a value added product, it would be considered secondary agriculture.



If an economic activity utilises the resources available locally at rural level, including the output from farms, and can be undertaken by farming households, then a special status may be accorded to such activity, as secondary agriculture. This will help promote the necessary industrialisation of rural India, and will also provide scope for growth in income from non-farm and near-farm activities.

1.6.1. Why define secondary agriculture?

Section 1.3 touches upon the recent trends in the rural economy, especially in terms of employment and income generation. It also explains that the manufacturing sector has not generated the anticipated number of jobs, due to a preference for capital and technology intensive production by large industries. Various government schemes also promote industrial development that deploys emerging innovations like automation, artificial intelligence,

robotics etc. which may not be relevant in case of employment generating enterprises that need to come up at village level.

The referenced discussion paper on the changing structure of rural economy by Chand *et al* 2017, had concluded that there is a need for a rethink, on pursuing the traditional development approach of shifting workforce from agriculture to manufacturing and services. India should instead, explore possibilities of creating blue collar jobs in and around agriculture. These can be harnessed by developing and promoting enterprises at or near farms, which are based on the output from agriculture and manage the post-harvest on-farm value addition as goods or market linking services.

Secondary agriculture as defined, if supported appropriately can help drive the growth of primary agriculture, visualised as under:

- (i) Encourage the right and optimal kind of rural industrialisation that generates employment and helps capture more value from the produce of primary agriculture.
- (ii) Build a strong demand for primary produce through near-farm or on-farm activities that create new products or value-added raw inputs for industrial scale manufacturing sector.
- (iii) Establish the appropriate linkages between the secondary and tertiary sectors on the one hand, and primary sector on the other hand, both in terms of manpower, skills and bio-resources.
- (iv) Develop human and capital resources to promote enterprises at rural level – to replicate Start-up India at village level.

1.7. 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.

1.8. Annotation

Rural development is vital and more than 50 per cent of India's population will continue to reside in rural areas until 2050. The productive output from agricultural activities realises economic value with support of various ancillary activities such as the services of markets, transport, storage, etc. In many cases, the principal output is also made valuable because of demand from the agro-processing (food and non-food) industry, which in turn outputs a secondary product. The growth of the agricultural sector is also conditional on inputs such as technological advancements, policy support, extension support, and more, which fall under tertiary sector activities.

Indian Agriculture has undergone a transformation, wherein the subsistence agriculture has evolved into commercial agriculture, towards meeting higher income necessities and daily nutrient requirements during the times of current market economies. However, the problem of production is not solved, as instead, the output requires greater focus to bring it to gainful uses and to make it sustainable in all aspects. Production itself is not adequate to meet all requirements of the farmer.

Due to composite set of factors, the commercial agriculture (can be read as production for markets as against production for personal consumption) is not sufficient to meet the income / nutritional needs of the family. A substantial 22 per cent of rural households are complementing their farm incomes with non-farm incomes, and only 26 per cent of the households have remained 'pure farm households'. Further, the manufacturing and service sectors of the economy have assumed disproportionate value addition to employment proportions and render low employment options in these sectors.

The growth in manufacturing industry is attributed to the technology and capital intensive systems as against the labour intensive economic activity essential to meet the employment needs of the manpower exiting the agriculture sector (about 16 per cent from 65 per cent in 1993-94 to 49 per cent in 2011-12). In case of service sector, while the share of value addition increased from 43.5 per cent to 60.0 per cent (addition of about 17 per cent), the share of employment increased by only 6 per cent (from 20 per cent to 26 per cent). During the period 1970-71 to 2011-12, while the rural output increased by seven times, the share of agriculture in rural income reduced to 39 per cent. This picture calls for special focus on enhancing the farm incomes through creating more employment.

Oft spoken 'waste to wealth', infers that there is some waste produced from various agricultural activities. However, this concept of waste is a falsity, as all output from farming is an item of value. Waste to wealth is an artificial construct - the waste is only in the eye of the beholder that imagines waste - when actually the all farming output has inherent value. There is a need to end the perception of waste from farms and instead to view every unit of output as an opportunity to generate value.

Manpower stands as the principal asset of rural households, while other assets are falling short of providing sufficient income to the household. In the context, the techno-managerial and market skills of rural workforce need to be enhanced.

Rural development will include rural industrialisation and such industrialisation will include economic activities that are directly linked to agriculture. Traditional development of manufacturing sectors promotes capital intensive production and do not generate jobs in sufficient numbers. The manufacturing and services sector (secondary and tertiary sectors) need to be developed at village level and linked to the primary sector, such that it can provide additional employment opportunity to the rural labour force.

Farm-linked economic activities, at near-farm locations need to be promoted, especially those that are simple to deploy, easy to replicate, and readily serviceable. The concept of “simple, replicable and serviceable” systems should be kept foremost, when developing industries or services at village level. This will also help in ensuring that non-farm income growth is intrinsically linked, complements and supports the community’s on-farm incomes.

Developing the secondary and tertiary sectors at cottage industry scale, will bring income opportunity and growth to the rural economy. Such activities from the secondary and tertiary economic sectors, if generating local employment while using co-located bio-resources may be labelled as secondary agriculture and given special status in the rural economy.

Through Secondary Agriculture, DFI Committee calls for enhancement of resource use efficiency in factors of production, in addition to value addition; and focus on all value chain models in the larger agricultural value system.

Key Extracts

- Promote secondary and tertiary sector activities as secondary agriculture, to use primary produce from the neighbourhood and provide employment to local population.
- Secondary Agriculture utilises the slack resources (land and time) available in farming areas and essentially generates income. Focus needs to be accorded to multiplicity of incomes that can prop up the current incomes of farming households.
- Secondary agriculture enterprises can output both value added goods or services that help the primary sector capture more value from its primary products or by-products.
- All output from farming has an inherent value and nothing needs be considered as waste. The waste only arises when the output or the by-product is not brought to gainful end-use.
- Secondary Agriculture is an independent and important field of work, and a Division needs to be created within all three Departments of the Ministry of Agriculture & Farmers Welfare to promote the same.

Chapter 2

Avenues in Secondary Agriculture

Emerging market trends indicate and identify potential avenues of generating income by utilising the slack time available from occupation in primary agricultural activities. This Chapter categorises the avenues of Secondary Agriculture and lists them to take forward in their promotion and adoption.

2.1. Introduction

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 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.

2.2. Opportunities in changing Consumption Pattern

Between 1987-88 and 2009-10, the proportion of expenditure on food items across all the income groups declined by about 10 per cent and 16 per cent in rural and urban areas, respectively³. The per capita fat consumption in India has registered a higher growth, while the calorie and protein source in the Indian diet are diversifying with increasing availability of fruits / vegetable and animal based nutrients. Between 1987-93 and 2005-10, protein from milk; meat/fish/egg; and fruits/vegetables increased from 5.4, 3.1 and 2.4 gms/day respectively to 6.7, 3.9 and 3.1 gms/day respectively. This change reflects a growth of 24, 26 and 29 per cents in milk; meat/fish/egg; and fruits/vegetables respectively. During this period, there was an increase in the calorie intake from fruits & vegetables (43 per cent), vegetable oils (39 per cent), milk (6 per cent) and meet, egg & fish (25 per cent) (National Council of Applied Economic Research, 2014). Highlighting this trend, the share of high-value agriculture (fruits, vegetables, livestock products, fisheries) between 1983-84 and 2007-08 increased from 37.3 per cent to 47.4 per cent (Vijay Paul Sharma, Dinesh Jain, 2011)

The changing food consumption pattern not only suggests a change in the production pattern of agriculture & allied sectors as a part of primary agriculture activity, but also brings forth the opportunity to pursue Animal Husbandry as an avenue of secondary agriculture utilising the land and manpower resources more efficiently. Integrated farming that uses the productive resources should be made the corner stone of production systems in agriculture given the changing consumption patterns in the country.

While taking up animal production is certainly a potential means of income generation, several income generation avenues in the value chains of animal & fishery production systems viz., feed and fodder production, rearing of calves, lambs, chicks etc., servicing through Rams and Bulls, offer an immense opportunities.

2.3. 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.

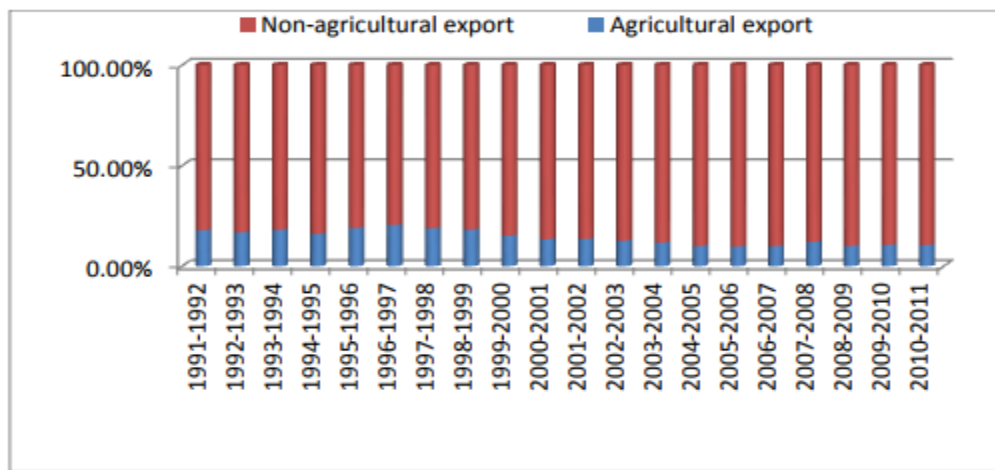
Interestingly, the liberalisation and various trade agreements between India and other countries paved the way for greater opening up of the markets. This trend has resulted in the need for stringent adherence to quality standards in terms of grades & standards, inert material, chemicals used in production / protection from diseases and pests, harvesting & storage

³<http://www.iimahd.ernet.in/assets/snippets/workingpaperpdf/5337679172012-08-02.pdf>

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.

Figure 2.1 Proportion of agricultural and non-agricultural exports of India



Source: - Directorate General of Commercial Intelligence and Statistics, Government of India

The substantive growth in fruits and vegetable sector calls for substantial pre-conditioning of horticulture produce and generating large scope for deploying manpower in such income generating activities. The move to promote rural primary agricultural markets (GrAM/PRAM) for direct retail and as aggregating hubs – where produce gets pre-conditioned and prepared for travel to markets – is an activity that not only helps village level enterprises capture greater value, but also provides employment to the local populace.

In the absence of gainful employment for the manpower moving out of rural areas into the sectors of manufacturing and services, owing to the high-skill centred production systems in these sectors, it is imperative that various means of secondary agriculture that can complement the income from primary agriculture, are established and promoted.

2.4. 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

The avenues discussed, are indicative in nature, and the same need to be evaluated for their techno-commercial feasibility to be taken up for income generation purposes.

2.3.1. Type A: Value addition to Primary Agriculture Production Systems

This category broadly contains activities with respect to a) inputs; b) production systems; and c) harvest / post-harvest segments of the agriculture value chains.

Table 2.1 Avenues of secondary agriculture under Type A

Inputs – Centric	Harvest / Post Harvest - Centric
Nursery for horticulture crops	Pre-conditioning produce for markets: Fruits, vegetables, flowers, spices, etc. Assaying, packaging, pre-cooling and dispatch hubs
Nursery for forest species	
Nursery for field crops	Micro and Small Enterprises that can process the primary agriculture produce: garlic extracts / paste, turmeric powder, pickles, jams, etc.
Nursery for flowers	
Vermicompost	Custom Hiring Centres
Anaerobic digested compost	
Bio-fertilisers production (Azospirillum, Azolla etc.)	Agro-tourism
Bio-pesticides (concoctions, bio/plant extracts, etc.)	
Water, Soil Testing / Analysis	Weaving, breeding, flavours, dyes, ayush medicines, etc.
Animal feed / fodder production (including urea enriched straw blocks)	

This category encapsulates those vocations that add value to the primary agriculture activity. In other words, the activities of Secondary Agriculture in this domain primarily depend on the agricultural activities. While contributing to the productivity enhancement in crop cultivation or other production systems of primary agriculture, they also generate additional income to the rural youth.

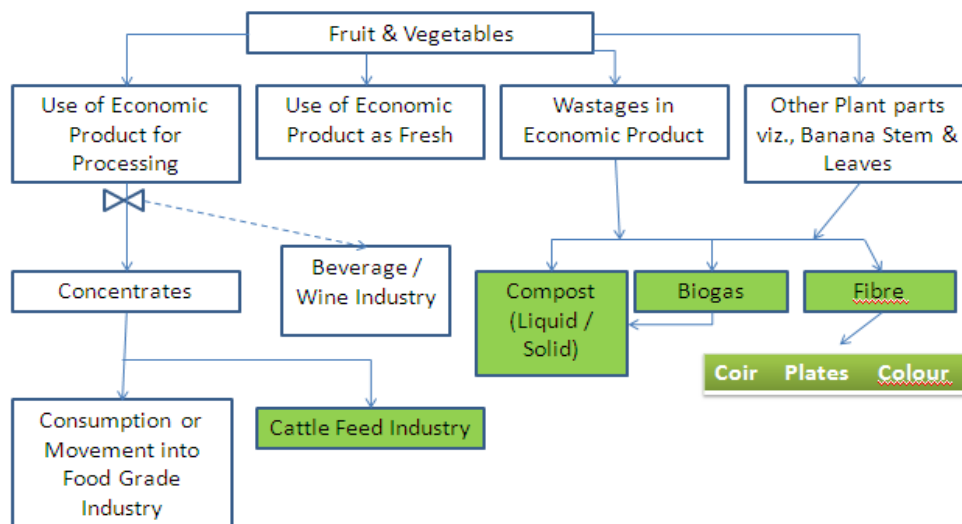
Currently, the agriculture input industry is skill and capital intensive, and the products manufactured elsewhere are moving to rural areas with a net capital drain into urban areas. With growing markets for organic products nationally and internationally, the opportunity to produce various agriculture inputs appears immense. This calls for promotion of agriculture input production activity as enterprises in the rural areas. Promotional initiatives may include specific policy support for wholesale purchase and dissemination of inputs for organic cultivation especially to farmers by Farmer Producer Organisation (FPOs). Further, partnerships between Research and Development agencies with FPOs and local manufacturing clusters to promote enterprises working in the domain would help.

In this category of Secondary Agriculture avenues, attention is to be paid to productise various package of practices or commodities that feed into primary agriculture activity. Further, the increasing emphasis of the Government on the Food Safety Standards owing to the need for

alignment with international standards, traceability of the production processes and geographies calls for special skill development programmes and recognising them as job roles to be able to promote and ensure sustenance of such activities. In this direction, identification of key commodities / value chains that have high scope in national and export markets and clusters / geographies needs to be taken up on high priority. Such identification may be backstopped by specific promotional initiatives including the involvement of private sector entities to boost investments into the initiatives.

Among various avenues of income generation, production of composts from agricultural wastes needs a special mention. Research in this domain has demonstrably proved the feasibility of compost generation from both agricultural wastes and food processing industry wastes. In case of wastages from agriculture fields, agriculture production centres form the principle geographies for secondary agriculture avenues of income generation. In case of wastages associated with the food processing industry, the compost units necessarily are to be located close to respective industrial belts. Wastage (from fruits and vegetables) utilisation cottage units can form the downstream units linked to bigger food processing industries. Downstream industries are defined as those that utilise the primary product or the wastage generated in an industry. This is very similar to capital industries like the Iron and Steel Industry in India, where a large Steel Production unit is surrounded by numerous ancillary and downstream units that work in unison with the production processes of the bigger unit.

Figure 2.2 Wastage from processing industry and its scope for income generation



While the compost products emerging out of the units form the Type A Secondary Agriculture Avenue, the coirs, plates and colouring agents that are extracted from such vegetable waste form Type C Avenues of Secondary Agriculture.

Waste from agriculture fields necessitates the aggregation of the waste directly from production centres to meet the minimum volumes for processing or trading. Given the high transaction costs associated with the aggregation of such wastes, role of people's institutions such as

Farmer Producer Organisations would be indispensable for commercial viability.

The DFI Committee notes here that the composting as a production activity has been attempted for several decades now in the country, and calls for a fresh approach by focussing on the commercial viability of enterprise through studying the financial viability and marketing feasibility of products developed from such enterprises.

The Committee strongly recommends the need for expenditure on extension and marketing (including branding, promotion, supply chain management) to ensure that the economic activity assumes business proposition. Since, such businesses hold large scope of employment and income generation, exemption or low GST rates, special category financing and linkages; and linkages with Swatch Bharat Abhiyan may be accorded special attention.

2.3.2. Type B: Alternative Enterprises

Various vocations that can generate income without competing for the resources (land and manpower) employed in primary agriculture constitute Category B of Secondary Agriculture Avenues. Indicative list of alternative enterprises that can be promoted include:

Table 2.2 Type B- Avenues of Secondary Agriculture

Bee Keeping	Palmyra Palm Products	Eucalyptus
Need Products	Broomstick Production	Bamboo Products
Coir Extraction & Products	Daincha	Mahua Products
Venom Farming	Kitchen Gardening / Sack Vegetable Cultivation	Integrated Farming Philosophy
Hydroponics	Aloe Vera	Babui Grass Products
Corn Powder Production	Ram Servicing	Lac Cultivation
Rural Tourism/Agri Tourism	Bull Servicing	Sericulture, silk works

While these vocations have been adopted in different parts of the country, mainstreaming them through specific promotional activities and incorporating into various department schemes and funding support opportunities are the need of the hour. Since, these vocations need specific skill sets and equipment, special provisions that support the vocations are to be put in place. For the fact that several of these vocations do not have mature markets, efforts to establish their supply chains and integrating them into the markets are the need of the hour.

The Committee notes that specialised agricultural operations such as repair of equipment for mechanised agriculture, precision agricultural technical advisories and extension, need skill development of rural youth. Recognising the efforts of start-ups and private sector agencies in such secondary agriculture avenues and the need for investments, the Committee recommends special recognition and consideration while these start-ups and the private sector initiatives avail benefits from various government schemes. This is expected to trigger economic activity in rural areas and thus generate incomes in the associated rural households.

The new GST requirements for formalised agricultural aggregation and marketing agencies, especially FPOs mean daily accounts and invoice uploading etc., brings forth various skills missing in rural areas. While these skills do not specifically fall under the domain of Secondary Agriculture, the Committee would like to make a special mention of the large number of part time employment opportunities that such an activity can generate.

Establishment of custom hiring centres by youth can create a whole layer of service industry in rural areas. Given the need for capital investments and capacity development, support from various state and union government schemes including integration with private sector equipment manufacturers is the need of the hour, if the country needs to stall the rural to urban migration and generate sufficient income for the rural households.

A new and emerging area with additional non-farm income stream for farmers, especially in rainfed areas is solar based electricity generation and sale to grids. Union Government's efforts to join hands with the state governments in supporting the installation of solar water pumps and supply of solar power to grid, offers large scope of income generation and uptake of complementary livelihood opportunities. However, solar power generation by farmers will need support by way of purchase of non-used energy (particularly during non-production seasons) by the Distribution Companies. A facilitative policy to this effect should be put in place.

2.3.3. Type C: Enterprises that rely on residues and wastes of primary agriculture

Type C Enterprises of Secondary Agriculture constitute various income generation activities that make use of residues and wastes of various field crops, horticulture crops, products of animal origin and forest produce.

Table 2.3: Type C – Avenues of Secondary Agriculture

Cotton Stalk Products	Fibre Boards etc., from Rice Straw	Agave / Banana Fibre Extraction & Products
Dung logs, bio-gas, leather extracts, etc.	Urea Enriched Fodder Block from Rice Straws	Cutlery plates from Wheat Husk, Arecanut Leaves, Siali Leaves, etc.

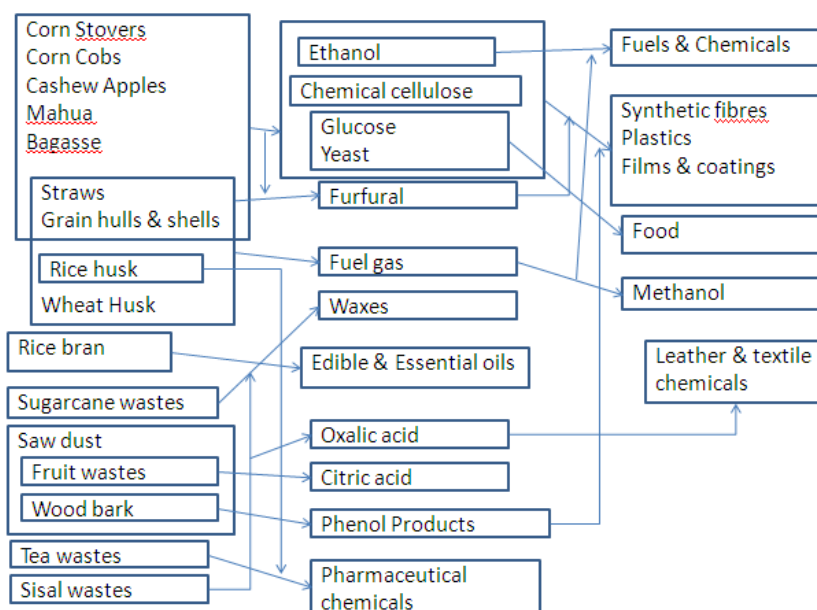
While the economic products of primary agriculture activities directly contribute to the economy and to the income of rural households, in several instances the residues and wastes of crops and animals do provide opportunities of income generation.

Further, various by-products emerging out of the agriculture commodity processing viz., paddy husk, chaff, peels of fruits such as pomegranate, mango, and banana also form Type C Secondary Agriculture. On one front, the use of agricultural waste for energy production (briquette making), various consumer goods / products (leaf plates, fibre products viz., ropes, mats, chairs and other handicrafts) form a principle category of Secondary Agriculture Avenue. On the other, as discussed in 2.3.1, extraction of pigment / colouring agents from fruits and

vegetables can form another significant avenue for income generation activity. While, the nature of raw material (being an output from industrial process) can certainly bring up discussion on the qualification of such activity of agriculture domain, the opportunity of income generation by rural households given the availability of land and manpower resources (especially during off season times) calls for its inclusion in this Volume of DFI Report.

Further, various crop residues such as corn cobs, cashew apples, groundnut shells, are used for production of industrial chemicals. While, production of such chemicals from agricultural waste calls for large investments and infrastructure, the activity of the waste aggregation, pre-conditioning and supply (read as supply chain management) to the industries can be a potential avenue for income generation in the rural areas that can complement the current income levels of rural households. While, these means of rural-urban industrialisation appear feasible, their techno-commercial feasibility needs to be studied, piloted before such avenues are explored for rural households.

Figure 2.3 Chemicals and agricultural wastes



Source: Augustine, B. and Roy, G.K. 1981. Recover of Chemicals from Agricultural Residues – A Critical Review. Journal of Institutional Engineers, 62:(36-41).

Similarly, organic and vegetable wastes in urban areas especially in the market areas do offer scope for their aggregation and conversion into organic compost to find their way into the rural areas creating new employment opportunities. However, RuRban (Rural-Urban) clusters need to be carefully identified and involved in these activities with clear focus on creating income generation opportunities, especially banking on the slack resources of land and time available in the rural areas. Similarly, the rice-straw / husk surplus geographies and fodder deficient geographies may be formed into cluster to bring in resource efficiencies, employment creation/ income generation in addition to the environmental benefits such activities can offer to the society. The prevailing or announced initiatives need further policy and operational support to translate the concepts into viable enterprise opportunities.

2.4. 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.

2.4.1. Meaning of microenterprise

The term Micro-enterprise under secondary agriculture must be understood with reference to economically productive and farm-oriented activities that generate income. Micro-enterprises are activities that employ less than 10 persons including the owner and family members. In contrast to wage employment, micro-enterprises represent opportunities for self-employment, which farm women can take up with appropriate support.

From a gender perspective micro-enterprises represent an opportunity for women to gain direct access to income when they may have limited avenues for alternative employment. From the perspective of economic empowerment micro-enterprises provide the women a platform for developing and exercising competence in managing an activity, handling funds, taking responsibility for business transactions and taking decisions.

2.4.2. Why promote microenterprises?

The micro-enterprises are different avenues that provide opportunities for income generation and involve different work-production relationships such as-

- Unpaid family work
- Piece-rate work
- Wage work
- Own account work: self-empowerment
- Own account work, within a group whether informal or formal like cooperatives.
- Micro-entrepreneurship

By promoting micro-enterprises the work-production relations open up and women can justifiably select the sector for generating income. The added advantages of promoting micro-enterprises are as follows:

- Generate additional income that will lead to savings and improve investment capacity.
- Empower women as decision-makers.
- Build scope for women as information seekers and help them overcome the fear of failure and provide access to peer support.

2.4.3. Insight into women as micro-entrepreneurs

- They become prime actors in income generating activities, helping them become powerful instruments in socio-economic upliftment of their families.
- They can become vocal as they gain economically.
- Women are capable of shifting their domestic management skills to enterprise management.
- Women who enter in an entrepreneurial role are often confronted with resistance from family and face various challenges.
- Women will be called upon to balance and harmonise their multiple roles as household managers, family nurturers and entrepreneurs.
- They will have to develop capability of taking right decision at the right time, linking with banks/financial institutions for obtaining/repayment of loans and maintain quality & consistency in production.
- A new enterprise will start with low profit margins, but gradually profits increase with strengthening of the enterprise.
- They must weigh the strengths and weakness of an enterprise along with their personal likes and resources before starting the enterprise.

2.4.4. Planning for women's micro-enterprises

- Start with exposure visit to the market or sharing of experiences of other entrepreneurs to provide a platform for awareness generation and decision-making.
- Make women feel confident regarding their contribution to the activity both in terms of time & skill output and economic gain by planning out appropriate training strategies.
- Provide simulation games for awareness generation on transaction of and making money, assessment of day-to-day market conditions, decisions, decision
- Provide education on quality parameters and need for maintaining certain quality parameters for end use or sale of product/produce.
- Identify a basket of enterprises that would be suitable to women. There are many activities that involve value addition, which women take for the family. Some examples are pickle making, juice making etc. which can easily be escalated as micro-enterprises.

2.5. Annotation

- India is undergoing a skill and capital intensive growth skipping the phase of labour intensive growth which otherwise is considered the norm of economic growth. In this context, the inability of manufacturing and service industries to absorb the manpower moving out of agriculture is a cause of concern
- Changing consumption pattern; competition in international agricultural commodity markets; technology enabled linkages between production centres and processing industry; and increased awareness of consumers on food safety standards, is throwing up potential opportunity to build cottage and village industries in rural areas, that can potentially create self-employment and incomes in rural areas under the aegis of Secondary Agriculture
- Sources of proteins and calories in India are changing from conventional foodgrains to animal products, fruits and vegetables. The changing consumption pattern and thus the production systems are opening up various options for Secondary Agriculture given the limited resources of land, water and labour.
- Opening up of domestic markets for international trade is calling for strict adherence to quality standards
- Various initiatives of government are paving the way for streamlining of production systems and standardisation of commodity handling and trading, opening up as a result avenues for Secondary Agriculture
- The rapidly growing processing industry offers to create employment in the function of commodity pre-conditioning for consumers.
- Avenues of secondary agriculture can be categorised into Type (A) Value addition to agriculture production systems; Type (B) Alternative Enterprises; Type (C) Enterprises that add value to and strive on crop residues and wastes of primary agriculture.
- Wastes from agricultural produce do hold scope for income generation activities through composting activities. In addition, scope of aggregation, pre-conditioning for markets and supply chain management, provides opportunities of income generation, even in case of wastes from food processing industry.
- Secondary Agriculture can contribute to Total Factor Productivity (TFP) in agriculture. A variety of such activities that contribute to TFP are discussed in Volume VII of this Report. They include services and inputs in INM, IPM, agricultural mechanisation, etc. Where the activities, the ownership and employment structure, fulfil the definition of secondary agriculture, these may be developed and provided special support.
- While many of these technologies are known for a long time, and some of these have been practised with reasonable success, the potential that exists has not been fully utilised. It calls for dedicated government support to creating a facilitative environment, that address multiple requirements of skill impartation, infrastructure creation, capital

support on easy terms, marketing etc. The Agriculture Ministry should necessarily house a dedicated wing to promote Secondary Agriculture.

Key Extracts

- The twenty first (21st) Century Agriculture through various push and pull factors, is opening up various avenues of creating employment and income for rural households.
- Avenues of adding value to primary agriculture activities; taking up alternative enterprises that can utilise the land and labour available as slack after their use in primary agriculture activities; avenues that add value to and utilise the residues and wastes of primary agriculture – hold a great potential for such employment and income generation activities in the rural households.
- Women led micro-enterprises at village level should be actively promoted to organise the existing work-production relationship between women and agricultural sector.

Chapter 3

Agro-processing Industry Development

Secondary agriculture can be the first step to feed the Agro-processing Industry or imitate the large secondary sector on a smaller mini or micro scale. The large scale industry finds special support through Department of Industrial Policy and Promotion and are key to remain technologically competitive in a global economy. Secondary agriculture can be a stepping stone for the industry to ensure quality raw material and integrate more closely with their source

3.1. Introduction

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.

3.2. 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. A broad list of products that can be output from agro-based industries is indicated below.

Absorbents/adsorbents	Honey, Lac
Activated carbon	Industrial oils
Adhesives	Inks, dyes, pigments
Agricultural chemicals	Industrial materials/soil amenders
Alcohol/butanol	Lubricants, rust inhibitors, other functional fluids
Alternative fibres	Oils, waxes, binders, stabilizers
Animal feed	Packaging materials
Antioxidants	Paints/coatings
Aromatic oils	Panels, Laminates, Composites
Bio filters	Paper & paper products
Bio-based fuels	Phytoremediation
Biodegradable plastics	Phytoceuticals and neutraceuticals
Bonded fabrics	Proteins
Bone charcoal	Rendering
Cardboard	Rubber
Cellulose, cellulose membranes	Solvents & co-solvents
Chemicals, surfactants, detergents	Specialty chemicals, fatty and acetic acid
Cosmoceuticals	Sugar, Sweeteners
Enzymes	Vitamins
Ethanol/Butanol	Water & wastewater treatment products
Fertilizers, phytostimulants	Waxes
Foods, beverages, nutrients	Whey protein
Fragrances	Wines
Fuel additives	Xylose, glucose, lignin, D-ribose
Gases/methane/CO ₂	
Gelatin	
Gluten	

These could be categorised into non-food and food industry segments-

Non-food processing industry, inter alia includes,

- Dyes & colour additives – pigments, intermediates, reactives, etc.
- Fibres – clothe and non-clothing materials, silk, paper, wool, jute, bamboo, etc.
- Medicinal – oils, extracts, active ingredients, concentrates, etc.
- Bio mixtures – fertilizers, phytostimulants, biocides, vermicomposting, etc.
- Bio based fuel and oils – ethanol, butanol, castor oil, wax
- Flowers – dried floral items, floral extracts, etc.
- Fodder and animal feed – pet food, cattle feed, etc.
- Tobacco and products – cigarettes, leaves, betelnut, scents, etc.
- Industrial chemicals – adhesives, acids, paints, perfumes, cosmetics, etc.
- Industrial materials – building material, composites, cardboard, bone charcoal, etc.

Food processing industry, inter alia includes,

Beverages – tea, coffee, juices, carbonated, wine, alcoholic, etc.

Bakery and Confections – breads, biscuits, sweets, pastries, etc.

Edible Oils – cooking oil, fats, refined, raw, etc.

Milk & Dairy – butter, ghee, ice cream, cheese, powder, etc.

Meats - frozen, preserved, canned, concentrate, additives, etc.

Foodgrains - flour, meals, ready-to-cook, ready-to-eat, etc.

Spices & Condiments – powders, masalas, vinegar, sauces, etc.

Dehydrated fruits and vegetables.

Preserves – pickles, jams, chutney, juice, etc.

These industries, output a wide variety of products, and there is scope to scale up and develop such industries, on the strength of primary output of agriculture in the country. The farmer alone cannot achieve the scale and capacity of many of the agro-industries but provides the raw feedstock to the 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.

The currently under-utilised opportunities that should be considered as thrust areas are as follows-

- i. Millet based food products – promotion of minor millets is also recommended recognising the crops' ecological and nutritional significance.
- ii. Bio-fuels – since India is import dependent for its crude oil requirements, bio based diesel and ethanol as fuel can be tapped to add to economic growth and be more environmentally friendly in our consumption.
- iii. Medicinal & aromatic products and other by-products – extracts, perfumes, energy and composite materials can be scaled up within India. The use and reuse of agri-waste, pulp, briquettes, press-mud, bagasse, etc. allows farmers a market for left over raw material and saves valuable resources protecting the environment.

Industrial technologies keep evolving over time. The agro-processing industry provides new opportunities with such developments. However, the opportunity is realised readily if also met

with an innovative approach towards traditional practices and business models. A case in example is sugar cane industry. Traditionally associated with sugar, the cane crop has multiple industrial uses, besides sugar. Whereas, at the traditional level, sugar is extracted, and by-products like molasses and press-mud comes into other varied uses, there is opportunity to develop cane complexes, with “sugar cane” varieties that are not sugar intensive but energy intensive. Cane zones could be producing cane varieties that are technologically better for extracting bio-fuel, while sugar is a by-product rather than the main product. Agricultural researchers need not look at a crop in isolation, striving to increase physical yield, but instead focus on varieties that result in higher income yield and greater capital formation as industrial investment lined to farming. The varied uses of sugarcane are discussed in Volume VIII of this Report.

3.3. Annotation

Household level cottage industry and village producer organisations can support large scale industries by providing primary processing services. Industry can strategically deploy vendor development budgets to train the village community for taking up such activities.

The high-tech processing industry needs to also join the nation building agenda of doubling farmers' income, by sponsoring or integrating their requirements with the National Agri-Value System Platform, as proposed in Volume-IV of this Report.

Key Extracts

- The types of secondary manufacturing industry, that depend on agriculture are many and an important market for primary producers.
- These industry types provide opportunity, as buyers of the raw harvest and as employers of manpower. However, they could benefit from passing on appropriate primary processes as secondary agriculture activities to be undertaken at village level.
- The proposed National Agri-Value System Platform is an opportunity for large industries to develop a supply chain that integrates village level enterprises, linked as organised and committed suppliers.
- The rural community too would need to be undertake education and skilling to be able to compete for the employment options at these industries.

Chapter 4

Programmes for New Skills and Upskilling

Towards realising the potential of Secondary Agriculture and creating an environment for generation additional income for the rural households, it is important that Secondary Agriculture is provided special emphasis and underlying activities are promoted with new vigour. The chapter encapsulates various government schemes and explores the opportunities therein to promote Secondary Agriculture towards doubling of farmers' income. The DFI Committee suggests way forward for Secondary Agriculture in the country and steps to unleash its potential.

4.1. Background

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.

Examples include specialised handling, breeding and care of bees, extracting honey and wax, maintaining of bee-hives, etc. Similarly, skills are unique in enterprises that undertake pickling, jam making, mushrooms, vermicomposting, ripening of fruits, preconditioning the produce for markets, segregating waste for feeding bio-energy plants, etc.

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.

4.2. Government Schemes and Promoting Secondary Agriculture

Various ongoing schemes are analysed in the following paras, with respect to the contours discussed in section 4.1.

i. 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 de-risking them.
- To ensure flow of credit to the agriculture sector by incentivizing the institutional credit system.

Recommendations:

- Accord special status to the rural income generation activities that are dependent on agricultural production activities and provide insurance for business risks.
- Promote partnerships between agricultural departments, insurance agencies and NBFCs/MFIs for last mile insurance literacy and extension.

ii. 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.

Recommendations:

- In addition to the commodities of agriculture and allied sector, trading / marketing of various products, secondary agriculture trade be integrated into agricultural markets.
- Similarly, the prices and volumes of such secondary agricultural commodities be listed and tracked on agmark.nic.in and such other price display portals.

iii. 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.

Recommendations:

- Various secondary agriculture options such as ‘Micro-Irrigation Technicians’, ‘Barefoot Engineers’ and the like be accorded special status and promoted through separate funding streams, with specific focus on 96 deprived irrigation districts, given the Union Government’s emphasis on ‘Har Khet ko Pani’.
- Such entrepreneurs should be trained in the use of GIS based planning to support design and implementation of new focus in 96 deprived irrigation districts.
- The scheme should be connected to water user associations (WUAs) created through various government programmes (e.g. 10,000 such groups just in Maharashtra) to rejuvenate dysfunctional aspects of their command area irrigation systems and also improve Participatory Irrigation Management (PIM) through facilitating support by selected private and not-for profit agencies working in collaboration with agriculture departments.

iv. 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.

Recommendations:

- Separate Cell be created and funds allocated under RKVY for the purpose of promotion of secondary agricultural activities. As suggested in volume IV, restructure the Division of RKVY as the Division of Capital Investments, Secondary Agriculture and Entrepreneurship; or two separate Divisions of:
 - Capital Investments and another one called the Divisions of Secondary Agriculture and Entrepreneurship
- Integrated farming activities to form the principal vehicle of Secondary Agriculture under RKVY.
- Special emphasis be laid for Category A and Category C avenues that have a more direct bearing on the farmers’ income from the primary agriculture output.
- Scale up successful production-aggregation-marketing models (especially social enterprises working with farmers) so that farmers participate the marketing chain.

- Incentives and subsidies to attract farmers and industry participation in promoting secondary agriculture.

v. **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)

Recommendations:

- Production of bio-fertilisers and bio-pesticides to be recognised as an emerging avenue of income generation; and as sunrise industry for sustainable agriculture practice.
- In addition to the support for production activities, special projects be supported that build awareness and business skills of such organic product entrepreneurs.
- Promotion of village level micro-enterprises to develop the market for bio-pesticides and bio-fertilizes; and various clusters to be identified across the country, that can support production of inputs for organic cultivation. For example, States / Districts with large animal husbandry; fruit and vegetable production offer sufficient ground to produce bio-pesticides and bio-fertilisers at commercial scale.
- Scale up successful organic production-aggregation-marketing models created through interventions like UPNRM in each agro-climatic zone as a demonstration and value based supply chain driver.

vi. **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.

Recommendations:

- Soil Testing to be taken up as a Secondary Agricultural activity and promote viable models that create self-employment.
- Create an eco-system for privately driven soil health card system.

vii. 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.

Recommendations:

- A separate cell to promote value addition to wastes and residues of coconut and banana crop, may be created under the aegis of Secondary Agriculture. In this cell, special emphasis may be provided to development of products, their marketing and building consumer awareness towards promotion of relevant cottage industries in rural areas.

viii. 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.

Recommendations:

- Secondary Agriculture to given special Status, especially in the backdrop of its income generation potential. Income generation from agro-forestry be tightly linked to the ecosystem benefits of interventions funded under Agro-forestry.

- In addition to projects of Agro-forestry, special emphasis may also be given to income generation activities that support the agro-forestry programmes. Support may be given to both farmers FPOs and interventions, that will help in creating self-employment.
- Projects that innovate on aggregating the Agro-forestry produce given the dispersed nature of their production and that connect the production centres with buyers to be given special emphasis. On one front, ICT and other technologies may be deployed. On the other, pharmaceutical, beauty and wellness industries be targeted, given the oleo-resin and similar extracts feasible from agro-forestry plantations.

ix. 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

Recommendations:

- Various avenues of Secondary Agriculture such as fruit & vegetable nurseries, agro forestry nurseries, be given special emphasis in the backdrop of their potential to create income in addition to the income from primary agriculture.
- Given the growing demand for organic fruits & vegetables and growing retail chains in the market, projects that produce various bio-inputs and that promote organic cultivation in the horticulture crops, be encouraged.
- Specific interventions that use technologies or institutions (FPOs) for commodity aggregation and connecting them to the Business to Business, Business to Consumers and Farmers to Consumer platforms, may be encouraged. The same may be clearly stated in the guidelines to encourage different stakeholders to submit the proposal on the subject.

x. 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.

Recommendations:

- Given the major mandate of skilling the huge manpower of the country, NSDM plays a very critical role in shaping the sectors and economic development. For the fact, that NSDM has a substantive role to play in skilling a large proportion of rural population moving out of agriculture in search of economic opportunities, special emphasis on Secondary Agriculture is essential under it.
- Specific skilling targets need to be allocated for avenues of Secondary Agriculture, under various reward schemes under the Mission.
- Skill Certification and Credit Opportunities to be directly linked to pave the way for the success of such enterprises. In this direction, convergence among the schemes of NSDM, MSME, other entrepreneurship centred schemes and Priority Sector Lending (PSL) facility be promoted through a special purpose cell established for the purpose.
- Establish linkages between NSDM and various incubators (in leading academic and research institutions), that support technology / innovation start-ups.
- Business Skills / Enterprise Skills be accorded special place among Vocational Skills of National Skill Qualification Framework (NSQF), and further these be made mandatory for credit linkages.

xi. 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.

Recommendations:

- NAPS scheme be extended to 'Secondary Agriculture' avenues considering their scope for setting up enterprises and creating employment opportunities.

xii. 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 self-employment options

Recommendations:

- Separate allocations (proportion based) may be provided for avenues of 'Secondary Agriculture' under DUSY, given the immense scope that exists for creating self-employment for rural population.

xiii. Name of Scheme: Inspire (Innovation in Science Pursuit for Inspired Research Program)

Department: Department of Science & Technology (DST) (Ministry of Science & Technology)

Salient features:

- To communicate to the youth of the country the excitement of creative pursuit of science, attract talent to the study of science at an early age and thus build the required critical human resource pool for strengthening and expanding the Science & Technology (S&T) system and Research and Development (R&D) base.

Recommendations:

- 'Secondary Agriculture' be recognized as an important domain of Research Pursuit.

xiv. Name of Schemes: Deendayal Upadhyay Grameen Kaushal Yojana (DUGKY)

Department: Ministry of Rural Development

Salient features:

- To expand the scope of livelihood opportunities to the rural poor.
- To promote entrepreneurship under the categories of micro and cottage industries in the villages.
- To discourage distress migration of rural people to urban centres in search of jobs.

Recommendations:

- Avenues of Secondary Agriculture form an important vehicle in achieving the objectives of DUGKY. Hence, this category be made a special mention under the Scheme Guidelines that will enable availment of funds based on submission of domain specific proposals.

xv. Name of the Scheme: Small Farmers' Agri-Business Consortium (SFAC)

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

Salient features:

To link the small farmers to agricultural value chain which includes investments, technology and markets in association with private, corporate or cooperative sector

Recommendations:

- Avenues of Secondary Agriculture be recognized as a domain of special emphasis and separate provision be made in the budget (and mention in the Guidelines) to promote the same.

xvi. Name of Schemes: MSME Market Development Assistance

Department: Ministry of Micro, Small & Medium Enterprises

Salient features:

- To encourage small & micro exporters in their efforts at tapping and developing overseas markets.
- To increase participation of representatives of small/ micro manufacturing enterprises under MSME India stall at International Trade Fairs/ Exhibitions.
- To enhance export from the small/ micro manufacturing enterprises.

Recommendations:

- Relevant Secondary Agriculture avenues be included under the ambit of this scheme, providing MSME status for the same.

xvii. Name of Schemes: Sustainable Finance Scheme

Department: Small Industries Development Bank of India

Salient features:

- Promote energy saving in micro, small and medium enterprises (MSMEs) in India, by providing financial assistance to MSMEs, directly by SIDBI as well as through refinance to Primary Lending Institutions (PLIs) and Non-Banking Financial Companies (NBFCs).
- Reduce the emission of greenhouse gases, especially carbon dioxide (CO₂) to contribute towards climate change mitigation and achieve a reduction or avoidance of emissions and pollution through the introduction of financial products.
- Support MSMEs towards development, up-scaling, demonstration and commercialization of innovative technology based projects.

Recommendations:

- Energy saving operational models such as ‘solar water pump’ and sustainable technologies like ‘thermal energy banks’, ‘waste digester & composting’, ‘dung log making’, for farmer groups may be favourably considered for funding under the scheme.

xviii. Leveraging potential from schemes announced during budget 2018

- Fisheries and Aquaculture Infrastructure Development Fund (FAIDF) for fisheries sector and an Animal Husbandry Infrastructure Development Fund (AHIDF) for financing infrastructure requirement of animal husbandry sector with a total corpus of Rs.10,000 crore (Rs.8,000 cr + Rs.2,000 cr respectively).
 - Establish agencies that work with farmers/FPOs to study their requirements and gaps in technology and the market upgradation needs, to link them to this intent to access funds and supports.
- Upgradation of existing 22,000 rural haats into Gramin Agricultural Markets (GrAMs) to take care of the interests of more than 86 per cent small and marginal farmers. These GrAMs, will be electronically linked to e NAM and exempted from regulations of APMCs.
 - State governments should identify and develop time bound plans for establishment of such GrAMs and train rural youth, especially women, to run retail market linked initiatives – aggregation of produce; sale-purchase transaction; management of agri-logistics etc.

3.3. Annotation

- Secondary Agriculture holding a clear opportunity to generate additional income utilising the slack resources, needs special emphasis, mention and special budget allocation under different government schemes.
- For the fact that various government schemes that promote self-employment, income generation, credit linkages, economic empowerment in rural areas is not restricted to the Ministry of Agriculture but includes various schemes of Ministry of Skills & Entrepreneurship, Ministry of MSME, Ministry of Rural Development etc. Thus, doubling of farm income necessitates convergence with other Ministries in addition to the steps to be taken in the Ministry of Agriculture & Farmers' Welfare.
- Evolution of Secondary Agriculture as a discipline and the avenues it offers as potential enterprises are in a stage of exploration and crystallisation. The avenues, options recommended for each of the schemes are to be evaluated for their merit before making budgetary allocation for the same. In other words, all proposals for funding are to be evaluated on merit, given the fact that such enterprise opportunities are supported for the first time (in many of the cases).

- There is a thin line between forward linkages of agriculture supply chains and backward linkages to the value chain of a food processing facility. Locus of the economic activity in rural areas (geography), principal gainers of the economic activity (rural or urban people) and scale of investment that fall in the rural domain - are to be used as filters to decide an activity as a Secondary Agriculture Avenue. This is in addition to the tenets articulated in Chapter 2 for qualifying an activity for Secondary Agriculture.
- Research and Development in Secondary Agriculture Avenues need promotion and budget allocation.

Key Extracts

- Special emphasis, mention and budget allocation be made for the avenues of Secondary Agriculture under different schemes, as also independently. A budget head may be created for this purpose.
- Secondary Agriculture activities be recognized as priority sector and as sunrise sector of rural industrialization.
- Convergence with enterprise promotion, incubation and credit linkage dimensions of Schemes under various ministries, is pre-requisite to facilitate income generation activity in Rural India.
- Create a Division of Secondary Agriculture and Entrepreneurship in each of the three departments of the Ministry of Agriculture and Farmers' Welfare, and a coordination platform in addition.

Chapter 5

Operationalising Secondary Agriculture

It would be necessary to adopt an operational framework within the Ministry/Departments of Agriculture, Animal Husbandry, and at DARE/ICAR at central level, as also at state government levels to promote secondary agriculture. This chapter examines aspects relating to this.

5.1. Delineation of enterprises

As discussed in chapter 2 and chapter 4, 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 strive on crop residues and wastes of primary agriculture.

Nature of activities under each of these types has been illustrated in chapter 2.

5.2. 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.

5.3. 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 (as discussed in chapter 4) 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.

5.4. 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.

In the chapters that follow, some specific cases have been taken up that can be promoted as secondary agriculture activities. They are illustrative, belonging to one or sometime more, of Types A, B and C enterprises, as defined in chapter 2. There are many more activities that are closely linked to agriculture, as also detailed in Volume III, IV and VII, which can be taken up as secondary agriculture

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Chapter 6

Beekeeping

Humans have harvested honey from wild bees for ages, and along with the advent of agriculture, the domestication or the organised management of beehives has evolved into the scientific practice of apiculture. Bees play important part in pollination and reproduction of flowering plants and additionally provide various valuable items that generate income.

6.1. Introduction

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.

6.2. 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 bio-diversity 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.

Experiments on effect of bee pollination on various crops were conducted by Central Bee Research and Training Institute (CBRTI) and various Agricultural Universities under All India Coordinated Project on Honeybee Research and Training (ICAR). A cross section of the cross fertile crops, self sterile crops with different degree of self-sterility and even self fertile crops benefited by bee pollination are: **oilseed** (mustard, rape seed, toria, lahi, safflower, sunflower, etc.), **orchard crops** (apple varieties, pears, plums, cherry, strawberry, raspberry, persimmon, litchi, citrus varieties, grapes, cucumbers, squashes, melons, almond, peach, guava, gooseberry, etc.), **legumes** (alfalfa, berseem and other clovers, vetches, broad beans, dwarf beans, Arhar, etc.) and **vegetables** (radish, cabbage, turnip, carrot, onion, cauliflower, gourds, etc). The increase in yield of various crops due to bee pollination are given as under:

Table 6.1. Yield Benefit from Increased pollination

Oilseeds	% increase in yields	Legume/ pulses	% increase in yields
Mustard	128.1 to 159.8	Alfalfa	23.4 to 19,733.3
Rai	18.4	Berseem and other Clovers	23.4 to 33,150
Rapeseed	12.8 to 139.3	Vetches	39 to 20,000
Toria	66 to 220	Broad Beans	6.8 to 90.1
Sarson	222	Dwarf beans	2.8 to 20.7
Safflower	4.2 to 114.3	Kidney beans	500 to 600
Linseed	1.7 to 40	Runner beans	20.6 to 1,100
Niger	260.7	Arahar	21 to 30
Sunflower	20 to 3,400	Other pulses (Arahar, etc.)	27-30 (RAU)
Orchard crops	% increase in yields	Vegetables for seed/ fruits	% increase in yields
Apple varieties	180 to 6,950	Radish	22 to 100
Pears	240 to 6,014	Cabbage	100 to 300
Plums	6.7 to 2,739	Turnip	100 to 125
Cherry	56.1 to 1,000	Carrot	9.1 to 135.4
Straw-berry	17.4 to 91.9	Onion	353.5 to 9,878
Raspberry	291.3 to 462.5	Brinjal	35-67
Persimmon	20.8	Cucumbers	21.1 to 411
Litchi	4,538 to 10,246	Miscellaneous crops	
Citrus varieties	7 to 233.3	American cotton	5 to 20
Grapes	756.4 to 6,700	Egyptian cotton	16 to 24
Squashes	771.4 to 800	Buckwheat	62.5
Guava	70-140	Coffee	16.7 to 39. 8
Papaya	22.4-88.9	This increase in yield is in addition to the value of honey and other hive products. Bee pollination also improves the quality of seed/ fruit.	
Mosambi	36-750		
Orange	471-900		

Source: National Bee Board

Honey bees have also been identified as major pollinators for spice crops including cardamom, clovers, fennel, coriander, cumin seeds (jeera), fenugreek seeds (methidana), carom/thymol seeds (ajwain), etc. The bee pollination not only results in higher yields, and a better quality of produce (fruits/ seeds). Further, efficient pollination of flowers may also serve to protect the crops against pests. The number of honeybee colonies required for optimum pollination of different horticultural & agricultural crops including fruits, vegetables, oilseeds, pulses, etc. are presented in the following table:

Table 6.2. Estimated requirement of honeybee colonies

Crop	Colonies required/ ha	Crop	Colonies required/ ha
Almond	5-8	Cucurbits	5-8
Apple	3-4	Okra	1-2
Citrus	2-3	Onion seed	14-16
Papaya	2-3	Radish seed	4-5
Grapes	2-3	Turnip	3-4
Guava	3-4	Cardamom	3-4
Litchi	3-4	chillie	2-3
Carrot	7-8	Coriander	3-4
Cabbage	5	Cauliflower seed	5
Mango	7-8 (in some varies up to 15)	Cucumber	2 for monoecious, 8 for dioecious
Apricot	2-3	Asparagus seed	3-4
Avocado	4-5	Bean (Lima)	2-3
Blackberry	6-7	Blueberry	7-8
Brassica (canola, oilseed rape)	4-5	Clover seed (white)	3-4
Cotton	7-8	Eggplant	2-3
Gourds	3-4	Kiwifruit	7-8
Mandarin	3-4	Melon	6-7
Peach & nectarine	2-3	Pear	3-4
Sunflower	2-3	Watermelon	4-5
Strawberry	7-8	Pumpkin, squash, gourd	3-4
Safflower	2-3		

Source: National Bee Board

It is worthwhile to highlight that beekeeping /honey bees work as an input of agriculture which is essentially required for its development. Therefore, beekeeping/ honey bees should be treated as fifth input for overall development of agriculture in sustainable manner in the country. It regulates the efficacy of other four inputs used in agriculture, particularly in the crops which need pollinators for pollination support. Worldwide, about 85 per cent of the crops grown need pollinators for pollination and setting of fruits & seeds and honey bees are the best and most important pollinator which can sustain with changes in atmosphere/ climate.

6.3. 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.

6.4. Diversified Beehive Products

A large variety of beehive products and services are possible, as discussed below:-

6.4.1. Honey:

Honey is the primary saleable product from beekeeping and has a high commercial value. Honey is consumed directly and also used as a preservative for fruits and cakes. In ancient times Egyptians employed it as an embalming fluid, and doctors have applied it as an antiseptic to treat burns and lacerations. In Europe, honey was often mixed with wine or beer and could be fermented to produce a popular alcoholic beverage known as “Mead”. For many thousands of years, honey was the only sweetener ever used by most of humankind. Today it is a very popular health food.

6.4.2. Beeswax:

Beeswax is a substance secreted by the worker bees. It is recovered by beekeepers primarily from de-capping honeycomb cells, and also from cull combs & wax pieces. It has the highest melting point of natural waxes, and can be sold in either the raw or refined form. Like honey, prices for beeswax can vary considerably from place to place. Beeswax is also used in certain pharmaceuticals, ointments & cosmetics, in candle making, skin creams, waxing of some horticultural produce (eg. apples), in polishes and varnishes, crayons, leather preservatives, waterproofing of textiles and paper, paints, veterinary wound cream, adhesive lotions, etc.

6.4.3. Propolis:

Propolis is also a high value beehive product. It originates as a gum secretion gathered by bees from a variety of plants, and can vary in colour depending on the plant species of origin. It is used by honeybees as an antiseptic to varnish the interiors of comb cells/beehives and for general hive cleanliness purposes. Propolis has therapeutic qualities, and is much sought in some countries for the treatment of a range of human ailments, and for cosmetic purposes. The market for raw material and secondary products containing propolis will probably continue to grow as they find more acceptance in pharmaceutical uses and cosmetic manufacturers realize their benefits and market value.

6.4.4. Pollen:

Pollen can also be harvested by beekeepers, at a rate of around 8-10 kg per hive per year. Pollen is used by bee colonies as a source of protein, and harvesting pollen by the beekeeper requires detailed knowledge of resources, hive management, species flowering variations and timing, and hive response to different honeys and pollens. Pollen is collected via specialized pollen traps fitted to beehives. Pollen should be processed immediately after collection (usually via freezing or drying) to avoid excessive moisture absorption and fermentation. Many beekeepers harvest pollen to feed back to their bees during periods of natural pollen deficiency. Pollen has been rated as a super food and the pollen consumer market seems to be growing in industrialised countries. Pollen tablets are a common feature of health food stores and command an excessively high price. Collection of pollen and encapsulation may become an independent cottage scale business at village level. Most of the buyers and large scale sellers of pollen are also honey traders.

6.4.5. Royal Jelly:

A milky white smooth jelly secreted by nurse bees, used to feed bee larvae. The production of royal jelly is a very specialized procedure, and flora conditions must be ideal before production can be considered. Royal jelly is used as a tablet, or mixed into creams and shampoos. Royal Jelly can also be sold in its fresh state, unprocessed except for being frozen or cooled, mixed with other products, or freeze-dried for further use in other preparations. In its unprocessed form it can also be included directly in many food and dietary supplements as well as pharmaceutical uses or cosmetics. For larger industrial scale use, royal jelly is preferred in its freeze-dried form, because of easier handling and storing. The production of freeze-dried royal jelly requires specialized equipments including freezer, dryer, etc., sufficient production volume and an accessible market for the raw material or its value added products are also required. Various uses of Royal Jelly are summarized as under:

i. **As dietary supplement:** Royal jelly belongs to a group of products generically described as “dietary supplements”. These are products which are consumed not for their caloric content nor for pleasure, but to supplement the normal diet with substances in which it might be lacking.

ii. **As ingredient in food products:** A mixture of royal jelly in honey (1-3% royal jelly)

is probably the most common way in which it is used as a food ingredient. Among the advantages of this product are that no special technology is required. The blending of royal jelly with honey may also be one of the good options for value addition in honey. The final product is pleasant-tasting and it provides the beneficial effects of both the products.

iii. **As ingredient in medicine-like products:** In medicine-like formulations, royal jelly is generally included for its stimulatory effects. However, it is also used to solve specific health problems. A variety of formulations are available, often containing ingredients otherwise used to alleviate particular afflictions or as medicine.

iv. **As ingredient in cosmetics:** Except in Asia, probably the largest use of royal jelly is in cosmetics. Royal jelly is included in many dermatological preparations, but mostly in those used for skin refreshing, and skin regeneration or rejuvenation. It is also used in creams or ointments for healing burns and other wounds.

v. **Others:** The only other known uses for royal jelly are in animal nutrition. In particular, royal jelly has occasionally been used (fresh or freeze-dried) to stimulate race horse. For experimental purposes it is also used as a food for rearing mites and insects. The most popular use of royal jelly is to enhance the fertility in human beings.

Royal Jelly collection: Royal jelly is produced by stimulating colonies to produce queen bees outside the conditions in which they would naturally do so (swarming and queen replacement). It requires very little investment but is only possible with movable comb hives.

6.4.6. Bee venom:

Bee venom is processed, and used in the preparation of pharmaceutical materials. The venom can be used to detect hyper-sensitivity or allergic reaction to bee stings. Bee venom is a highly specialised product with only very few buyers. The market volume is relatively small. The main venom producers are USA, Brazil, etc., Prices in 1990 varied greatly between US\$100 and US\$200 per gram of dry venom (Schmidt and Buchmann 1992). Prepared for injections or sold in smaller quantities, prices can be much higher. However, the beekeeper often does not get this price. The prevailing prices in European and Asian markets are generally slightly lower.

6.4.7. Live honeybees:

The production of queen bees, and of entire colonies of bees, is an important diversification for beekeepers. Profitable honey industry is dependent on availability of queen bee. Live bee exports is a potential growth area for the beekeeping industry, as further markets develop. Package bees and nucleus colonies are other forms of live bee production, and are sold both within the country and overseas. In India, where great potential of beekeeping exists marketing for live bees can be much more.

6.4.8. Production of specialised/mono-floral honey:

The colour, flavour and even aroma of honey differ, depending on the nectar of flowers visited

by the bees that made it. There are a number of unique types of honey available in India each originating from a different floral source. Their shades range from nearly colourless to dark brown, while flavours go from subtle to bold; even the aroma of honey may be reminiscent of the flower. There is a vast possibility of production of specific/mono-floral honey in the country. On account of bio-diversity, India holds immense potential for development of different kinds of honey specific to a particular region and also a crop. Many honey hubs in India can be potentially developed at a large scale, e.g., Jammu and Kashmir and Himachal Pradesh can be positioned in apiculture as apple honey hub; Muzaffarpur, Bihar as litchi honey hub; Alwar and Bharatpur as rape-seed mustard honey hub; Kerala, Karnataka, Tamil Nadu as coconut honey hub; Andaman and Nicobar islands, Sikkim & NE states as organic honey hub; Kota (Rajasthan), Madhya Pradesh and Gujarat as coriander honey hub; Rajasthan as fennel, ajwain, cumin, mustard and coriander honey hub, and Maharashtra as multi-flora honey hub, etc. Such multi and mono floral honey has appeal to differentiated tastes of the consumers and create a market for varying products.

6.4.9. Paid pollination services:

Some beekeepers receive payment for placing hives in close proximity to flowering crops, according to contractual arrangements with farmers. For example, rates for pollination services in inland Australia varied between \$25 and \$35 per hive in 1996, with variations between crops. It was estimated that at least \$2.9 million was earned, based on total payments received for pollination services in Tasmania (Gifford 1989).

Similar concept is picking up throughout the world including India. In Himachal Pradesh, this practice has already started and is likely to be followed in other states as the awareness about pollination benefits is realized by the farming community. Honeybee pollination is essential for some crops, while for others it raises yield and quality. In addition to the crops, a wide range of pastures, including lucerne and clover, are pollinated by honeybees, hence estimates may understate the potential value of the pollination services. Beekeeping also increases production of fruit and vegetables, particularly cross pollinated crops such as cabbages, cauliflowers, carrots, turnips, radishes, and other vegetables.

6.5. Economics of Beekeeping

In India, two types of honeybees viz.; *Apis cerana* & *Apis mellifera* are domesticated. The economics of both of these species varies from place to place/ season to season. For good returns, commercial/migratory beekeeping is the preferred option. Migratory beekeeping requires moving beehives from one location to another, depending on growing season of agricultural crops.

Apis mellifera provides better returns over *Apis cerana*. The economics of beekeeping is directly linked with the market prices of honey & other beehive products and price of beecolonies, beehives, etc., which fluctuate time to time.

The species-wise economics of both the species viz.; *Apis mellifera* & *Apis cerana* for a unit

of 100 honeybee colonies and adopting scientific beekeeping are given as under:

6.5.1. Economics of *Apis mellifera*:

a. Migratory Beekeeping-

Honey Bees: <i>Apis mellifera</i> (100 colonies)- Man power required: At least one regular basis –plus two casual labour			
(Assuming Rs. 100/ kg prevailing market prices of honey and prevailing market prices of other beehive products & price of bee colonies).			
S.N.	Items	Rate/per Unit cost (Amt. in Rs.)	Total cost (Amt. in Rs.)
A.	One time cost for establishment/ Fixed cost		
1	100 Beehives with supers & tools, stand, etc.Rs. 2400/-per set	2400	240000
2	100 bee colonies each of 8 frames @ Rs. 300/- per frame (Rs. 2400/- per colony)	2400	240000
3	Honey extractor (SS) and other equipments, including food grade plastic containers, honey extraction net, tent, bee, veil, etc. @ Rs. 50000/per set/unit	50000	50000
	Sub total of A.		5,30,000
B.	Recurring cost/working capital per year		
1	Comb foundation sheets (Wax Sheets) 200 kg for 100 colonies (Rs.300 per kg)	300	60000
2	500 kg sugar for feeding in dearth period (Rs.50 per kg)	50	25000
3	Interest on fixed capital (12% per annum)	12	63600
4	Depreciation on fixed capital (20% per annum)	20	106000
5	Miscellaneous expenses including labour charge, etc. per annum	-	100000
	Sub total of B.		3,54,600
C.	Per year income from 100 colonies in beehives		
1	Honey production @ 40 kg per colony. Total production 4000kg. (Rs.100 per kg)	100	400000
2	Cost/ sale price of bee colonies of 8 frames each multiplied during the year i.e. atleast 100 colonies (100x250x8) hence @ Rs.2000/- per colony of 8 frames.	2000	200000
3	Production of Bee pollen (500 kg) @5 kg/colony (@Rs. 500/kg)	500	250000
4	Production of Bees wax (50kg) @ 1/2kg/colony @ Rs. 250/kg.	250	12500
	Total Income (C)		862500
D.	Net income per year (C-B)		5,07,900

Note: In addition to above direct income from sale of honey, wax, bee pollen, etc., farmers will also get a huge increase in yield of the crops in the area, due to pollination support by

Honeybees.

(ii). Stationary Beekeeping-

Honey Bees: <i>Apis mellifera</i> (100 colonies)- Man power required: At least one regular basis –plus two casual labour			
(Assuming Rs. 100/ kg prevailing market prices of honey and prevailing market prices of other beehive products & price of bee colonies).			
S.N.	Items	Rate/per Unit cost (Amt. in Rs.)	Total cost (Amt. in Rs.)
A.	One time cost for establishment/ Fixed cost		
1	100 Beehives with supers & tools, stand, etc.Rs. 2400/-per set	2400	240000
2	100 bee colonies each of 8 frames @ Rs. 300/- per frame (Rs. 2400/- per colony)	2400	240000
3	Honey extractor (SS) and other equipments, including food grade plastic containers, honey extraction net, tent, bee, veil, etc. @ Rs. 50000/per set/unit	50000	50000
	Sub total of A.		5,30,000
B.	Recurring cost/working capital per year		
1	Comb foundation sheets (Wax Sheets) 200 kg for 100 colonies (Rs.300 per kg)	300	60000
2	800 kg sugar for feeding in dearth period (Rs.50 per kg)	50	40000
3	Interest on fixed capital (12% per annum)	12	63600
4	Depreciation on fixed capital (20% per annum)	20	106000
5	Miscellaneous expenses including labour charge, etc. per annum	-	50000
	Sub total of B.		3,19,600
C.	Per year income from 100 colonies in beehives		
1	Honey production @ 20 kg per colony. Total production 2000kg. (Rs.100 per kg)	100	200000
2	Cost/ sale price of bee colonies of 8 frames each multiplied during the year i.e. atleast 50 colonies (50x250x8) hence @ Rs.2000/- per colony of 8 frames.	2000	100000
3	Production of Bee pollen (300 kg) @ 3 kg/colony (@Rs. 500 per kg)	500	150000
	Total Income (C)		4,50,000
D.	Net income per year (C-B)		1,30,400

Note: In addition to above direct income from sale of honey, wax, bee pollen, etc., farmers will also get a increase in yield of the crops in the area, due to pollination support by Honeybees.

6.5.2. Economics of *Apis cerana*:

Stationary Beekeeping-

Honey Bees: <i>Apis cerana</i> (100 colonies)- Man power required: At least one regular basis –plus two casual labour			
(Assuming Rs. 100/ kg prevailing market prices of honey and prevailing market prices of other beehive products & price of bee colonies).			
S.N.	Items	Rate/per Unit cost (Amt. in Rs.)	Total cost (Amt. in Rs.)
A.	One time cost for establishment/ Fixed cost		
1	100 Beehives with supers & tools, stand, etc. Rs. 2000/-per set	2000	200000
2	100 bee colonies each of 8 frames @ Rs. 250/- per frame (Rs. 2000/- per colony)	2000	200000
3	Honey extractor (SS) and other equipments, including food grade plastic containers, honey extraction net, tent, bee, veil, etc. @ Rs. 40000/per set/unit	40000	40000
	Sub total of A.		440000
B.	Recurring cost/working capital per year		
1	Comb foundation sheets (Wax Sheets) 100 kg for 100 colonies (Rs.300 per kg)	300	30000
2	600 kg sugar for feeding in dearth period (Rs.50 per kg)	50	30000
3	Interest on fixed capital (12% per annum)	12	52800
4	Depreciation on fixed capital (20% per annum)	20	88000
5	Miscellaneous expenses including labour charge, etc. per annum	-	50000
	Sub total of B.		250800
C.	Per year income from 100 colonies in beehives		
1	Honey production @ 10 kg per colony. Total production 1000kg. (Rs.100 per kg)	100	100000
2	Cost/ sale price of bee colonies of 8 frames each multiplied during the year i.e. atleast 50 colonies (50x250x8) hence @ Rs.2000/- per colony of 8 frames.	2000	100000
3	Production of Bee pollen (200 kg) @ 2 kg/colony (@Rs. 500 per kg)	500	100000
	Total Income (C)		300000
D.	Net income per year (C-B)		49200

Note: In addition to above direct income from sale of honey, wax, bee pollen, etc., farmers will also get a huge increase in yield of the crops in the area, due to pollination support by honeybees.

6.6. 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. The status of beekeeping Industry in India may be seen as below:

- i) In India, two types of honey viz; apiary honey (of domesticated bees) and squeezed honey (of wild bees) are produced. *Apis cerana* and *Apis mellifera* are two types of bees which are being domesticated and kept in hives.
- ii) At present there are about 34 lakh bee colonies in India, with an estimated annual production of around 1,05,000 tonnes of honey including from wild honey bees (2017-18).
- iii) India is one of the major honey exporting countries. The major markets for Indian honey are Germany, USA, UK, Japan, France, Italy, Spain etc.
- iv) In India, very small quantity of honey is used in the form of food and its per capita per year consumption is less than 50 gms. But in other countries, for example in Germany, per capita honey consumption is more than 2 kg per annum. Within Asia, Japan has the highest per capita consumption i.e. about 700 gms. Average global per capita consumption is 250-300 gms.

6.7. Potential/ Opportunities

- i) India has vast potential for Beekeeping. The diversity in flora and fauna provides more opportunities for the development of beekeeping industry. The National Commission on Agriculture had visualized the need for deploying about 150 million Bee colonies for pollinating the agricultural crops in the country. This industry does not need any sophisticated technology, high capital investment or infrastructure. Compared to the potential, not even the fringe of it, in terms of number of honeybee colonies has been achieved. There is thus great potential and scope for the development of beekeeping

industry in India.

ii) Beekeeping industry has great self-help potential for the rural people, tribal society, marginal and small farmers, land-less labourers, etc. The potential and opportunities in beekeeping are as under:

- a) As per the cropped area under the major insect pollinated crops, about 200 million bee colonies are required in the country to enhance the yield levels of these crops at par with the yield levels of developed countries. It will provide jobs to about 215 lakh persons.
- b) Honey has great food value and provides cash income.
- c) Beeswax which is twice as much costly as honey is in great demand.
- d) Other products, viz., bee-collected pollen, propolis, bee-venom and royal jelly are several times costlier than honey and beeswax.
- e) Providing bee pollination service to farmers for increasing crop production & quality and productivity of honeybees is an independent activity by itself.
- f) Maintenance of biodiversity by pollination of flowering plants.
- g) Apitherapy medicine using bees' products.
- h) Processing and value added products of bee-hive products.

iii) Further, natural flora of Indian forests is more varied than that of any other country of similar area. This is due to its geographical nature, varying climates from temperate to tropical, torrid to arctic and from total aridity to a maximum of humidity. While about 33 per cent of the geographical area of the country is notified as forest, good canopy cover exists over atleast 20 per cent of the geographical areas of the country. Large quantities of deodar, cedar, rosewood, sal, teak, etc are grown for timber. Several of these species provide forage to honey bees. Afforestation programmes should also keep in mind the needs of beekeeping in choosing their species. For example, eucalyptus and karanj covered under afforestation provide bee forage.

iv) India's total geographical area is 329 million hectares. Of this, 195-200 million hectares is gross cropped area, of which about 70 per cent is under foodgrain crops including pulses. Further, about 25 million hectares under oilseed crops like ground nut, sunflower, safflower and mustards, is useful to honeybees (except for groundnut). Among other commonly cultivated plant species useful to honey bees are coconut, areca nut, red oil palm, date palm, mango, custard apple, cinnamon, clove, cashew, coffee, lemon, orange, plum, pear, peach, cherry, jamun, fodder legumes, coriander, clove, dill seed, fennel, fenugreek, onion and other spice and condiment crops. The road-side plantations that contribute to honey production include eucalyptus, karanj, tamarind, gulmohar, copper pod and soap nut hedges; and fence plants like the Indian privet, duranta, mulberry, justicia and jatropha, also add to the bee forage value of farms and orchards which provides good potential and opportunities in the country.

v) In addition to this, the commercial plantations viz.; coffee, orange and other citrus fruits, apple and other pomaceous fruit species, cardamom and rubber tree, etc. are important from beekeeping point of view. Rubber plantations are found in southwestern and northeastern parts of India, where tropical humid climate prevails. Kerala, Tamilnadu, Karnataka and Tripura have large areas under rubber plantation. The nectaries on young leaves of rubber trees secrete nectar profusely in the refoliation stage, before the tree blooms. Next in importance is the litchi tree. The entire north and eastern India from West Bengal to Jammu has large areas under litchi orchards that constitute an excellent source of nectar during March to May.

vi) It is possible to assess the beekeeping potential of the cultivated vegetation, based on the honey potential of the component plant species. Unlike the species under natural vegetation, crop plants are usually found in dense populations. The agro-climatic conditions are often controlled by agronomic practices. Due to these reasons, the honey potential figures are often close approximations of the actuals.

vii) Agricultural crops are seasonal and provide bee forage for limited periods. Bee colonies cannot be sustained throughout the year in any cultivated area, unless it has an integrated intensive agriculture, agro-forestry and social forestry systems. During the forage scarcity periods between two crop seasons, bee colonies will have to be moved to forest areas. Thus, the beekeeping potential for the cultivated vegetation becomes a part of the potential contained in the natural vegetation.

6.7.1. Urban / roof top beekeeping

(i) Urban beekeeping is a good way to reconnect urban dwellers with nature; and becoming a beekeeper is part of a growing movement towards greener surroundings and overall a greener planet. Urban beekeeping is environmentally vital and beneficial as a small enterprise, in recognition of which beekeeping is slowly being adopted for rooftop garden/kitchen garden to pollinate their plants for a better quality and quantity of the yield. Beekeeping in cities would help introduce more beneficial pollinators in gardens, allow a greater diversity of plants/trees and help to protect the vital part of the ecosystem. Seeds, fruits and berries eaten by birds and small mammals are all from plants that are pollinated by bees. In this way, the food supply chain and the biodiversity of the species are maintained.

(ii) As a part of urban beekeeping, the hives can be placed in backyard or on the roof spaces of cafes, restaurants, hotels, offices, schools and college etc. as it hardly requires any space; in the city, where backyard space may be scarce or non-existent. Hives should be positioned or rotated in a way to avoid excrement dropping on neighbouring washing lines, vehicles and buildings.

(iii) Urban beekeeping may have more availability of pollen and nectar because of lesser competition and higher chance of survival possibly due to less pesticide use, etc. However,

it faces the problems of pollution & lightings in nights and sometimes the dearth of bee flora as well as damages due to lack of knowledge among the public about the importance of honeybees apprehending danger of stings.

6.8. 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.

6.8.1. Government initiatives for promotion of beekeeping

The following initiatives/ efforts have been made by the Government of India for promotion & development of beekeeping in the country:

- i. After independence, Govt. of India adopted the policy of reviving & promoting various traditional cottage and village industries, and thus All India Khadi and Village Industries Commission (KVIC) came to be was set up in 1954. At the state level, Khadi and Village Industries Development Boards (KVIBs) were set up. Through coordinated efforts of KVIC, State KVIBs, Beekeepers' Co-operatives, Public Institutions, etc., the beekeeping industry came on the map of village industries of India within two decades. In 1981 an All India Coordinated Research Project on Honeybee Research and Training was launched by ICAR involving State Agricultural Universities.
- ii. In 1994-95, the Ministry of Agriculture, launched a Central Sector Scheme called "Development of Beekeeping for Improving Crop Productivity", during the VIII Plan. A Beekeeping Development Board also come to function to coordinate beekeeping activities. Therefore, the scheme got subsumed under the Macro Management Scheme, with effect from October, 2000. The Department formed the National Bee Board as a Society through the Small Farmers' Agri.-Business Consortium (SFAC) in 2000. With effect from May, 2005, beekeeping was included as an activity under National Horticulture Mission (NHM) for promoting cross pollination of Horticultural Crops.
- iii. Re-structuring of National Bee Board (NBB): National Bee Board (NBB) was reconstituted by the Ministry of Agriculture and Farmers Welfare in June, 2006 and further in Oct, 2008. The main objective of the NBB is overall development of scientific beekeeping in India by popularizing state of the art technologies relating to nucleus stock production, capacity building and training of bee breeders and beekeepers,

- processing, etc. and to increase the productivity of crops through pollination and increasing the honey production for enhancing the income of the beekeepers/farmers. NBB has been recognized as a National Level Agency (NLA) under MIDH for development and promotion of scientific beekeeping in the country. After restructuring of NBB by this Department, the scientific beekeeping has been promoted in a big way in the country and there has been good progress in this field.
- iv. Beekeeping is being promoted by the Department of Agriculture, Cooperation & Farmers Welfare (DAC&FW), under the component of “**Pollination Support through Beekeeping**” under Mission for Integrated Development of Horticulture (MIDH). The scheme is being implemented by the State Governments. Under this scheme, assistance for production of quality nucleus stock, production of bee colonies by bee breeders, distribution of honey bee colonies, beehives, supers, etc. and beekeeping equipments. Similarly, the assistance for organising trainings/exposure visits of the farmers/beekeepers, seminars/workshops etc. is also provided under the scheme.
 - v. Beekeeping is also being promoted under other schemes of DAC&FW, viz.; RKVY, NFSM, NMOOP, etc. There is needed to make efforts to marry and integrate the beekeeping programme with other programmes of agricultural and rural development at all the levels.
 - vi. National Bee Board has proposed a “**National Beekeeping and Honey Mission (NBHM)**” for overall promotion and development of beekeeping. In this scheme, among other activities, promotion of scientific beekeeping for pollination support & honey production, setting up of Integrated Beekeeping Development Centres (IBDCs), setting up of honey & other beehive products collection, primary processing, packaging, branding, etc. centres, storage, etc. and setting up of honey processing & export units/plants, etc. have been proposed.
 - vii. NBB has commissioned 16 Integrated Beekeeping Development Centres (IBDCs) as Centres of Excellence (CoEs) for beekeeping during the years 2015-16, 2016-17 & 2017-18 in 12 States - one each in Haryana (Kurukshetra), Delhi (IARI, PUSA), Bihar (KVK, Piprakothi, Motihari), Punjab (PAU, Ludhiana), Madhya Pradesh (KVK, Morena), Uttar Pradesh (IIVR, Varanasi), Manipur (CAU, Imphal), Uttarakhand (KVK, Dehradun), Jammu & Kashmir (SKUAST, Srinagar), Tamil Nadu (TNAU, Coimbatore), Karnataka (UHS, Bagalkot), Himachal Pradesh (Krishi Vishwavidhyalay, Palampur), West Bengal (ICAR-CISH, Malda), Tripura (Director of Horticulture & Soil Conservation), Arunachal Pradesh (College of Horticulture & Forestry, Pasighat) and Andhra Pradesh (Dr. Y.S.R Horticultural University, Venkataramannagudem)
 - viii. As on 28-February-2018 NBB has trained 24,246 farmers/beekeepers have been trained in scientific beekeeping and 7665 beekeepers/beekeeping & honey societies/firms/companies etc. with 12.55 lakh colonies have been registered
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Govts. have been requested to address the problems of Beekeepers /Beekeeping relating to migration of honeybee colonies, harassment of beekeepers by Forest, Revenue & Police Deptts., marketing of honey, etc.

- x. The number of bee colonies have increased by 14 lakhs in last four years (2014-15 to 2017-18) i.e. from 20 lakhs in 2013-14 to 34 lakhs in 2017-18 (estimated). Honey production increased by 28.57 % i.e. from 2,86,950 MTs in 2010-14 to 3,68,930 MTs in 2014-18 (including estimated 1,05,000 MTs for the year 2017-18).
- xi. NDDDB/GCMMF/Dairy Cooperative system is exploring marketing of honey by utilising milk routes/NDDDB's infrastructure/ cooperative network in the field. Safal Brand of Honey launched by Mother Dairy under technical guidance/advice & support of NBB and honey is being sold at Safal Outlets in NCR.
- xii. Ministries of HRD and Women & Child Development have been requested to allow honey as an item in Mid Day Meal & other Programmes.

6.9. Expanding Beekeeping – Overcoming Constraints

Organised Beekeeping is a non-traditional activity. In the present context it also needs positive and technological attitude of all beneficiary sections, viz. beekeepers, traders and exporters, etc. Extension agencies, Govt. Departments and Scientists also need to think in totality and come out of their water tight mindsets. With this in view following aspects are suggested for creating a facilitative environment.

- One major problem in planning for beekeeping development in India is the lack of accurate scientific database. Different national organizations involved in beekeeping R&D programs give different and contradictory figures about potential and present status and future prospects of the beekeeping industry in India. It should become part of national census.
- Beekeeping should be recognised as an important agricultural activity for increasing the productivity of agricultural / horticultural crops and the Departments concerned should have a cell / division mandated to promote beekeeping.
- A comprehensive roadmap for beekeeping development (as an agricultural activity) and for commercial production of honey should be prepared based on the bio-diversity (honey and floral) and other resources, with an emphasis on pollination of crops and organic honey production.
- Concerted efforts should be made to enhance domestic consumption of honey through developing honey based food / consumer products and intensive generic promotion of honey through education and advocacy. There need to be an effective promotional and awareness campaign to allay the myths about honey and bees.

- Different Honey Standards are laid down under different organizations / Acts in India, namely, Agmark, BIS, PFA and Export (Q.C & Inspection) Act 1963. The multiplicity of liberal standards in the country is creating problems for the beekeeping industry. This facilitates the inflow of poor quality honey in the domestic market from both local and import routes. Therefore, only one domestic Standards of honey at par with international (Codex & EU) Standards should be formulated. This will improve the quality of honey in domestic market and help stop import of poor quality honey into the country. The BIS standard / with MRL included could be adopted by all the enforcing agencies.
- The quality control facility of honey in the country is extremely inadequate. Therefore, a 'National (Central) Honey Laboratory' (with referral lab facilities) and five regional laboratories should be established.
- Beekeeping and pesticides (if used rationally) are both essential inputs for modern agriculture management technology. Ignoring any one of them/ either would adversely affect food production. But at the same time pollination of crops is seriously affected by the indiscriminate use of insecticides and other chemicals. Unscientific use of agro-chemical based pesticides has reduced or even destroyed the populations of useful insects and indirectly affected the farm production and the crop yields. Application of pesticides should be judicious and sprays during the flowering period of the crops avoided.
- While recommending various IPM schedules for different crop pests, it should be made mandatory to highlight their effects on honey bees and pollinators. Only practices safe to bees and pollinators should be considered for inclusion in package of practices.
- In the face of increasing human population and urbanization, forest area and canopy cover are under stress. The flora useful to bees should not only be protected, but promoted, to support increase in the number of honey bee colonies. Multipurpose tree species/ bee friendly species/ flora that provide food to bees during their flowering besides having other economic utility should be considered for afforestation. The emphasis now being given on agro-forestry, farm forestry, roadside forestry, canal side forestry, social forestry, etc. can be taken advantage of to promote beekeeping by incorporate species favourable to them. Drumstick, *Emblic myrobalan* (amla), Indian beech (karanj), soapnut, shikakair soap pod, *Chebolic myrobalan* (harad), copper pod (peltophorum), neem, and *jamun*, etc., for example, are a few multi-purpose tree species which flower in different months and provide nectar and pollen to honey bees continuously (Suryanarayana *et al.*, 1983).
- Different forest areas and hills in India show different climatic and floristic conditions. Fortunately, it so happens that when there is acute floral dearth in forest areas in monsoon or winter, there are kharif or rabi crops on adjacent agricultural plains. And when there is dearth of flora on agricultural plains there is abundant bee flora in hills

and forests. Thus bee forage seasons in forests and agricultural plains alternate. Advantage of this alternate forage situation can be taken by inter-migration of bee colonies between farms and forests, and to utilize bee colonies for honey production, colony multiplication and pollination of crops.

- Organic farming should be integrated with organic honey production. Organic honey can be produced by a countrywide campaign to explore the forest flora for honey production in various geographical zones. Products from such local niches may be labelled accordingly and promoted appropriately in the market.
- The beekeeping research facilities are very meagre. AICRP centers should be established in all the SAUs and major Agriculture Institutions. The Central Bee Research Institute (CBRTI), Pune should be strengthened & developed as National Institute of Apiculture either under National Bee Board or ICAR for its effective functioning.
- Beekeeping should be diversified by using the bees for pollination; by developing package bees and queen trade and by adding production of pollen, propolis, royal jelly and bee venom in the apiary.
- India is the richest country in the world in bee genetic resources with four to seven species of honeybees. Although, native *A. cerana* has many valuable characteristics of biological and economic importance. However, the exotic bee, *A. mellifera* has been adopted by most of the beekeepers due to its characteristics of high production of honey in comparison to *A. cerana*. There is need for further research for improving/developing quality nucleus stock of *A. cerana* as well as *A. mellifera* because both have their own advantages for beekeeping. Therefore, there is a need to address the following issues:
 - Exploration and evaluation of different races/strains of *A. cerana*
 - Development of productive bee strains through selective breeding
 - Conservation of bee genetic resources
 - Zonation of beekeeping areas for *A. cerana* and *A. mellifera*
 - Developing quality nucleus stock for *A. mellifera*
 - The most important part is hybridization in honeybees by using *A. dorsata* & *A. mellifera* or *A. mellifera* & *A. cerana* or *A. cerana* or *A. dorsata* or by using strands of all three for better result in beekeeping.
- Farmers and beekeepers are to be properly educated about the mutual benefits they derive from each other. Beekeeping is of great value to beekeepers for the honey, wax and other products they get from the bee colonies and to the farmers for the pollination service the honey bees offer. The insecticide application schedules should be so adjusted, that they are least harmful to honey bees. The crop rotation or cropping

patterns can also be modified so as to provide forage to bees for a long period.

6.10. Recommendation to Promote Beekeeping

6.10.1. Year-wise Targets: The following year-wise targets have been projected by NBB, DAC&FW for honeybee colonies & production of honey for the period 2017-18 to 2021-22.

SN	Years	No. of Bee Colonies in lakhs	Total Honey Production (MTs)
1	2017-18	34	105000
2	2018-19	40	123000
3	2019-20	46	142000
4	2020-21	52	172000
5	2021-22	60	210000

This target provides an opportunity for enterprise development in the country.

6.10.2. Entrepreneurship in migratory beekeeping

Beekeeping industry is a source of livelihood for rural poor/tribals/forest based population. Unemployed youth can start this business with minimal funds (Rs. 1.00 to 2.00 lakhs). Bee keeping utilises the natural resources like nectar and pollen which otherwise go waste, encourages ecological awareness, helps increase national income, helps in rural development and promotes small village industry, encourages bio-diversity and will definitely help in doubling farmer's income by complimenting in the agriculture.

Unlike beekeeping with *A. cerana*, commercial beekeeping with *A. mellifera* is possible only by adopting migration as a regular management practice. The productive efficiency can be achieved only when appropriate number of colonies are maintained in an apiary in good strength. It is difficult to get adequate bee forage for these colonies in one location throughout the year. It is necessary therefore for *mellifera* beekeepers to have detailed information on the availability of different floral sources near their apiaries, seasons of their availability and migration schedules for optimal utilization of the available floral resources.

The problem of depleting floral resources is a threat to beekeeping potential in India. A beekeeper cannot afford to grow bee flora exclusively for honeybees. However, under social forestry programme, which advocates growing of various tree species, those that serve as bee forage should be identified and their plantation be undertaken in wastelands of low agricultural value. This can also be taken up as part of river front development program.

Preparation of extensive floral calendars for different ecological zones can be developed. The bee flora for subtropical, intermediate and temperate areas reveals that the country has rich vegetation which provides opportunities by (i) protection and better conservation of existing forest stands; (ii) systematic reafforestation of barren hills by designing mixed stands of arboreal

species which provide bee forage along with timber and other economic products; (iii) plantation of such species of plants which could fill floral gaps and acute dearth periods; (iv) regeneration of local pastures which provide cattle forage as also bee forage and prevention of uncontrolled grazing by cattle through a rational system of rotational grazing; (v) inter-cropping of fruit orchards with short duration autumn and spring season legumes; (vi) introduction, trial and extension of better bee plants in the local cultivated and wild flora.

It is also important to ensure:

- Surveillance of bee diseases, pests and predators in various eco-geographical zones in South Asia.
- Enforcement of strict quarantine, isolation, certification of disease free status measures through legislation.
- Creation of a network of laboratory facilities for the identification, testing and control of bee diseases and pests
- Capacity building and awareness training programmes should be organized in terms of management plans and training manuals, honey festivals, seminars, conference for farmers, fruit growers, extension workers, NGOs and policy makers to promote migratory beekeeping as full-time occupation among beekeepers. In order to induce beekeepers to migrate colonies during prolonged dearths, or for different flows or for pollination, a subsidy can be provided to cover the expenditure of migration.

6.10.2. Marketing of beehive products

An effective and efficient system of marketing of bee products is critical to incentivize the beekeepers. The following deserve attention:

- i) Marketing of high value beehive products like beeswax, propolis, bee collected pollen royal jelly, etc to be encouraged besides honey.
- ii) Quality control of bee products should be assured for sustained creditability in the market.
- iii) Export market for bee products be explored and incentivized.
- iv) May consider to offer support price for bee products.
- v) Marketing organization and marketing channels may be established to avoid excessive stocking of honey in any region.
- vi) To treat beekeeping as an agricultural activity and products of beekeeping as agricultural products should be exempted from all taxes including GST, etc. and income from beekeeping should also be exempted at par with agricultural income.
- vii) Unification of honey standards: Currently there are 3 different standards for honey, PFA (now FSSAI), AgMark & BIS. There a need to reconcile these differing standards, and also bring then in synch with international standards, so that exports are promoted.

6.10.3. Research needs

- (i) Standardization of beekeeping equipment
- (ii) Standardization of bee management methods for different zones of India.
- (iii) Protection of bees from pesticides, and other agro-chemicals
- (iv) Maintenance and conservation of all the species of honeybees and assessing their utility as pollinators
- (v) Improving the strains of honeybees by selection from local stocks, imbuing in them disease resistance and high honey yielding qualities
- (vi) Assessment of crops and other flowering plants for their degree of utility to honeybees
- (vii) Preparation of a list of multiple tree species region-wise having staggered flowering and use to honeybees during their flowering
- (viii) Coordinating with agro forestry, farm forestry, social forestry wings for introduction of multipurpose plant species that are useful to honeybees
- (ix) Quarantine operations to ensure bio-security
- (x) Developing technologies/ protocols/ system for diagnosis of diseases of honeybees.
- (xi) Developing Quality Nucleus stock of honeybees.
- (xii) Hybridization in honeybees by using *A. dorsata* & *A. mellifera* or *A. mellifera* & *A. cerana* or *A. cerana* or *A. dorsata* or by using strands of all three for better result in beekeeping.
- (xiii) Research & developing protocol of migration vehicle for smooth migration of honeybees. A pilot project using refrigerated vehicle for migration was developed.
- (xiv) Research in improvements in wild honeybees viz.; *A. dorsata*, *A. florea*, etc.

6.11. Annotation

Beekeeping being intertwined with flora is naturally integrated with crop production. It has a symbiotic relation with agriculture. The crops benefit from bees on account of pollination and the latter benefit from crop for their food, the nectar.

The value of honeybee as a pollinator, that contributes to enhanced yield in crops is being recognised. Further, honey and various other products of beehive are being increasingly recognised world over as health foods. Hence, the farmers and landless agricultural labour have an opportunity in adopting beekeeping as an enterprise and generate for themselves additional jobs and income.

India being home to different species of honeybees offers wider scope for beekeeping. The diversity of flora and multiple products apart from honey create a conducive environment for establishing an enterprise for both domestic and export markets.

Chapter 7

Lac Cultivation as an Enterprise

Lac production is primarily linked to various host-trees that grow in forest regions. However, new technology has made it possible to adopt it as a farming activity too. Lac cultivation holds potential for generating additional employment by using slack time of the farmer and accruing additional income to the lac grower family. The current status, challenges and intervention for upgradation are discussed.

7.1. Introduction

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 is the only natural resin of animal origin secreted by a specialized group of insects called lac insects. Nine (9) genera and 99 species of lac insects have been reported from across the world. 26 species under two genera have been observed in India. Indian lac insect, *Kerria lacca* (Kerr) is the most important lac insect utilized for cultivation of lac. *Kusmi* and *rangeeni* are two strains of *Kerria lacca* which can be distinguished based on: nutritional requirement, quality of the lac produced, time taken to reach crop maturity and productivity. Other important lac insect species commercially exploited for cultivation of lac are *K. chinensis* and *K. sharda* (Trivoltine).

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

7.1.1. Appropriateness of lac cultivation

Lac culture has certain inherent strengths, that facilitate its adoption for generating additional employment and income, for the inhabitants in forested areas. These include:

- i. It is **commercially viable** - the yield is economically remunerative and the profit size significantly impacts a family's livelihood, and there is no degradation threat to the chief assets (host trees, soil, and environment) because of cropping.
- ii. It is **ecologically sound** - having found a utility of these host plants (a grower's *Kamadenu*) felling of trees is resisted by lac cultivators. Further, the cultivation is complementary to the biotic and the abiotic factors around it.
- iii. **Geo-climatic pattern** especially of Eastern India suits lac cultivation. The area is gifted with lot of host trees and mild summers, which provides favorable conditions for lac culture. The infrastructure to be developed is of low cost.
- iv. It is **culturally in tune** - compared to other livelihood sources that may be promoted, the tribal community seems to have a great affinity to lac. This is because of it being a traditional occupation of the people who are still dependent on forests as a source of income.
- v. It has no **gender bias** - all activities from pruning, inoculation, and harvesting, even trading can be carried out by women also. In short the possibility of accommodation of the marginalized section - the poorest, women-forest dwellers is high through this sector.
- vi. Operations of this occupation **match with the labour surplus times** of the agricultural calendar.
- vii. It is **adaptable** - the technology is simple and transferable with some designed trainings and guided follow-ups.

7.2. Role of Lac Cultivation in Disadvantaged Areas of India

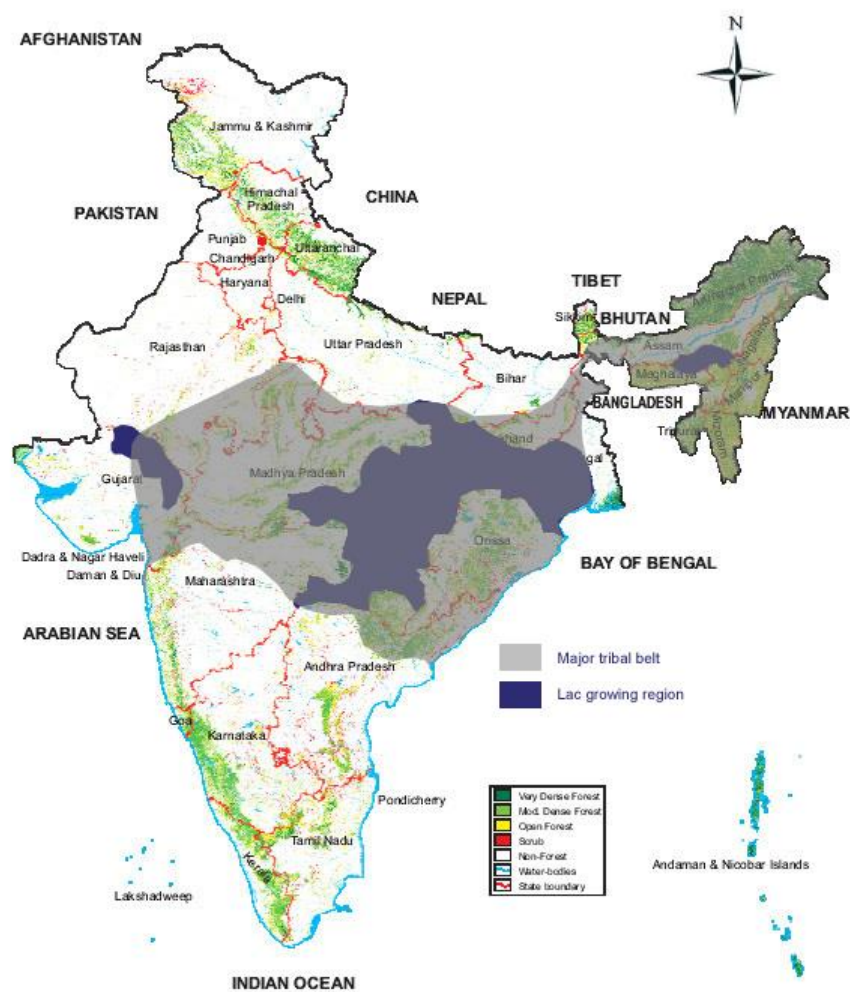
There exists 80,000 square km of area under lac cultivation comprising 200-250 millions of host trees across the country, but not all of these trees are utilized for lac cultivation. Employment generation in lac cultivation is about 80-90 million person days per annum, and about one (1) million farm families are supported.

The lac growing regions are characterized by high proportion of tribal population, families living below poverty line and low literacy percentage (Fig. 7.1). 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 (**Table 7.1**). 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.

Figure 7.1 Lac growing areas overlap with major tribal belt of the country



Majority of the backward districts being rainfed, opportunities in agriculture sector are limited, and hence lac culture plays an important role in enhancing livelihood options.

**Table 7.1 Disadvantaged districts where lac is produced and /
or have potential for lac cultivation**

State (no. of districts)	Disadvantaged Districts* (150)	Lac growing districts (45)	Districts having potential ** (30)
Andhra Pradesh	-	-	Vishakhapatnam
Arunachal Pradesh (1)	Upper Subansiri	-	-
Assam (5)	Dhemaji, Karbi Anglong, Kokrajhar, North Cachar Hills, North Lakhimpur	Karbi Anglong, North Cachar Hills	Kamrup, Marigaon, Nagaon
Bihar (15)	Araria, Gaya, Darbhanga, Jamui, Katihar, Lakhisarai, Madhubani, Monghyr, Muzaffarpur, Nawadah, Purnea, Samastipur, Sheohar, Supaul, Vaishali,	Gaya	Jehanabad
Chhattisgarh (10)	Bastar, Bilaspur, Dantewada, Dhamtari, Kanker, Korla, Sarguja, Jaspur, Raigarh, Rajnandgaon	Bastar, Bilaspur, Dantewada, Dhamtari, Kanker, Korla, Raigarh, Rajnandgaon	Balarampur, Durg, Gariaband, Janjgir-Champa, Korba, Mahasamand, Narayanpur, Raipur
Gujarat (6)	Banaskantha, Dangs, Dohad, Narmada, Panchmahals, Sabarkantha	Banaskantha, Dangs, Dohad, Narmada, Panchmahals, Sabarkantha	Vadodara
Haryana (1)	Satyamev Puram	-	-
Himachal Pradesh (1)	Chamba	-	-
Jammu & Kashmir (2)	Doda, Kupwara	-	-
Jharkhand (14)	Chatra, Dumka, Garhwa, Godda, Gumla, Jamtara, Latehur, Lohardagga, Pakur, Palamau, Sahebganj, Saraikela, Simdega, Singhbhum West	Garhwa, Gumla, Latehur, Palamau, Saraikela, Simdega, Singhbhum West	Chatra, Garhwa, Khunti, Palamu, Ranchi
Karnataka (3)	Bidar, Chitradurga, Davanagere	-	-
Kerala (1)	Wayanad	-	-
Madhya Pradesh (15)	Balaghat, Barwani, Betul, Chattarpur, Dhar, Jhabua, Khandwa, Khargone, Mandla, Seopur, Shahdol, Shivpuri, Sidhi, Tikamgarh, Umariya	Balaghat, Betul, Jhabua, Shahdol, Umariya	Anuppur, Chhindwara, Dindori, Hoshangabad, Mandla, Narsinghpur, Seoni
Maharashtra (11)	Aurangabad, Ahemdnagar, Bhandara, Chandrapur, Dhule,	Bhandara, Chandrapur,	-

State (no. of districts)	Disadvantaged Districts* (150)	Lac growing districts (45)	Districts having potential ** (30)
	Gadchiroli, Gondya, Hingoli, Nanded, Nandurbar, Yawatmal	Gadchiroli, Gondya	
Manipur (1)	Tamenlong	-	-
Meghalaya (1)	South Garo Hills	South Garo Hills	-
Mizoram (1)	Siaha	-	-
Nagaland (1)	Mon	-	-
Orissa (18)	Bolangir, Boudh, Deogarh, Dhenkanal, Ganjam, Jharsuguda, Kalahandi, Keonjhar, Koraput, Malkangiri, Mayurbhanj, Nabarangpur, Nuapada, Phulbani, Rayagada, Sambalpur, Sonapur, Sundergarh	Keonjhar, Mayurbhanj, Nabarangpur, Rayagada	Balasore, Koraput, Sundargarh
Punjab (1)	Hoshiarpur	-	-
Rajasthan (5)	Banswara, Dungarpur, Karauli, Sirohi, Udaipur	Banswara, Udaipur	
Sikkim (1)	North Sikkim	-	-
Tamil Nadu (5)	Cuddalore, Nagapattinam, South Arcot, Thiruvannamalai, Villupuram	-	-
Telangana (8)	Adilabad, Anantapur, Cudappah, Khammam, Mahbubnagar, Nalgonda, Rangareddy, Warangal	Adilabad, Mahbubnagar	-
Andhra Pradesh including Telangana (8)	Adilabad, Anantapur, Cudappah, Khammam, Mahbubnagar, Nalgonda, Rangareddy, Warangal	Adilabad, Mahbubnagar	Vishakhapatnam
Tripura (1)	Dhalai	-	-
Uttaranchal (2)	Champawat, Tehri Garhwal	-	-
Uttar Pradesh (15)	Banda, Barabanki, Chitrakoot, Hamirpur, Hardoi, Fatehpur, Kushinagar, Lakhimpur Kheri, Lalitpur, Mahoba, Mirzapur, Raebareli, Sitapur, Sonabhadra, Unnao	Mirzapur, Sonabhadra	Allahabad
West Bengal (6)	Bankura, Dinajpur West and North, Malda, Midnapur West, Murshidabad, Purulia	Bankura, Midnapur West, Purulia	-

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**Some of the districts don't fall under the category of disadvantaged districts

7.3. 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 cultivation can be done on stand-alone tree hosts, bushy plants like *semialata* or it can also be integrated with general agriculture. These approaches are discussed below:

Figure 7.2 Kusum plantation



Figure 7.3 Twig of ber with lac encrustation



7.3.1. Lac cultivation on major stand alone host-trees

- i. *Kusum (Schleichera oleaca)*: It is major host plant for *kusmi* lac cultivation. Mainly two crops of *kusmi* strain (summer season-*jethwi* and winter season-*aghani*) are harvested annually. *Jethwi* crop is cultivated during Jan –Feb to June –July and *aghani* crop is cultivated during June –July to Jan –Feb.
- ii. *Palas (Butea monosperma)*: It is major host plant for *rangeeni* lac cultivation. Mainly two crops of *rangeeni* strain (summer season-*baisakhi* and rainy season- *katki*) are harvested annually. *Baisakhi* crop is cultivated during Oct-Nov to June –July and *katki* crop is cultivated during June –July to Oct-Nov.

- iii. *Ber (Zizyphus mauritiana)*: It is major host plant for both *kusmi* and *rangeeni* lac cultivation and is employed for winter season *kusmi* crop or summer season *rangeeni* crop.

The tribal population mainly depends on rainfed agriculture and forest produce for livelihood. Lac production is an important source of cash flow to the marginal, small and large farmers having very low investment and labour capabilities.

In tribal areas, lac contributes 28 per cent of a farm family's animal income, and is therefore substantive. It also generates employment opportunities for both men and women, particularly in the off-agricultural season (**Tables 7.2 and 7.3**).

Table 7.2 Income generation by cultivation of lac on major lac-host trees (Rs. / ha)

Particulars	<i>Palas</i>	<i>Ber</i>	<i>Ber</i>	<i>Kusum</i>
Lac insect strain	<i>Rangeeni</i>	<i>Rangeeni</i>	<i>Kusmi</i>	<i>Kusmi</i>
Spacing/planting system	3.6*3.6m	4*4m	4*4m	12*12m
Number of trees/plants	100 trees	100 trees	100 trees	100 trees
1. Gross income	83000	158000	258800	1122000
2. Gross cost	72524	117199	128814	375906
3. Net income	10476	40801	129986	746094
4. Net income per tree	104.76	408.01	1299.86	7460.94
5. Net income per hectare	80770	255006	812413	522266
6. (Trees per hectare)	(770)	(625)	(625)	(70)
7. BC ratio	1.144	1.348	2.003	2.985

Table 7.3 Employment (man-days / ha) generated by cultivation of lac on major lac-host trees.

Lac-host (No. / ha)	Lac insect strain	Man-days generated		
		Male	Female	TOTAL
<i>Kusum</i> (70)	<i>Kusmi</i>	268	212	480
<i>Ber</i> (625)	<i>Kusmi</i>	85	73	158
<i>Ber</i> (625)	<i>Rangeeni</i>	59	139	98
<i>Palas</i> (770)	<i>Rangeeni</i>	57	44	101

7.3.2. Intensive lac cultivation on trained / bushy plants

i. *Ber* (*Ziziphus mauritiana*): A novel high density plantation system for quicker establishment of *ber* plantation for lac cultivation has been developed. *Ber* is a perennial and hardy host for lac cultivation, and is hence well suited to lac cultivation. In this system, plants were raised under triple hedge, maintaining a plant to plant distance of 1.0m (within) and row to row distance of 0.75m (between) and inter-strip space between two triple hedges at 2.5 m. Thus, 7,445 plants can be accommodated in one hectare. The plants are ready for inoculation of brood lac in three years, whereas in case of normal planting it takes 5-6 years for establishment. Moreover, the plantation is not susceptible to grazing by animals, which is a common problem with other quick growing bushy hosts like *F. semialata*. All cultivation operations can be carried out from ground level and more number of plants per unit area can be accommodated which gives more yield.

Figure 7.4 High density plantation of ber for lac cultivation



ii. *Flemingia semialata*: This leguminous plant is a potential quick growing bush suitable for lac cultivation, as the plantations of *semialata* can be raised within a year and lac crop can be raised in second year of planting.

Figure 7.5 Semialata plantation



Figure 7.6 Lac on semialata



Management of lac crop on *semialata* is easy as all activities can be carried out from ground itself. The gestation period between two crops is only six months. Intensive lac cultivation on *semialata* is highly remunerative (Table 7.4).

Table 7.4 Returns from lac cultivation on *Flemingia semialata* (per hectare)

Particulars	<i>F. semialata</i>	<i>F. semialata</i>
Spacing/planting system	Paired row system	Single row system
Type of lac	<i>Kusmi</i>	<i>Kusmi</i>
Number of plants / hectare	8000 plants	10000 plants
1. Gross income	798000	810000
2. Gross cost	340925	406347
3. Net income	457075	403653
4. Net income per plant	57.13	40.37
5. BC ratio	2.341	1.993

7.3.3. Integration of lac cultivation with agriculture

Owing to continuous and large scale deforestation and also felling from personal holding for different uses, host-trees are becoming a limiting factor in lac cultivation. As a result, the lac production in India is either declining or has been stagnant at the same level since the last few years, despite increasing global demand for lac. A number of quick growing and promising host-plants species namely, *Flemingia* spp., *Albizia lucida* (*galwang*), *Acacia auriculaeformis* (*akashmani*) etc. have been recently identified as a substitute to slow growing traditional host-tree species. These hosts have tremendous potential and can be used for intensive lac cultivation which may also fit well in different agro-forestry systems to increase overall productivity and profitability.

(i) Principle of integration

Like most other plants of perennial nature, lac-host plants are also planted at a fixed distance according to their shape and size, so that during early stages of plantation raising and thereafter, sufficient inter-spaces between host-plants, remains vacant. These vacant spaces get infested with obnoxious weeds which ultimately compete for available moisture, radiant energy and plant nutrients. The competition results in reduced plant growth and consequently plants either remain lanky in growth or completely die. On the other hand frequent weeding means an additional burden on plantation raising. Thus, integration of agricultural crops/grasses with host plants by adopting scientific methods plays an important role in making lac cultivation more attractive and a profitable proposition.

Intensification and inter-cropping enable the lac farming community to get an additional income, better employment opportunity throughout the year from a particular piece of land besides improving the soil health.

(ii) Advantages of integration:

- a. Integration with agricultural crops not only helps the lac grower to fetch more income during the off-season, but also to cover the risk of lac crop failure due to vagaries of weather, pests and diseases.
- b. The agronomic advantages of inclusion of legumes as inter-crops lie in fixation of molecular nitrogen symbiotically that offer an opportunity to enhance the nitrogen content of the soil and improve the soil fertility. Even after plucking of pods from legume crops, there is appreciable quantity of nitrogen besides P_2O_5 and K_2O added to the soil, if leaves, stems and roots are ploughed back into the soil.
- c. Adoption of such practices generates a good deal of income, increases the productivity and profitability and provides more family employment throughout the year and an additional income during the off period
- d. Cultural operations such as weeding, hoeing etc. can be done simultaneously for both inter-crops as well as host-plants.
- e. The host-plants either exist naturally or are raised on degraded, handicapped upland which are usually undulating and severely subjected to soil erosion and run off. Under such circumstances, this practice proves useful in preventing degradation and deterioration of precious soil.
- f. Lac host-plants and companion crops differ in their nature of growth; their roots are confined to different zone of the soil, which minimises competition for moisture, nutrients, etc.
- g. Soil moisture and nutrients, are efficiently made use of by growing short duration or annual inter-crops simultaneously with host-plants.
- h. Since pruning / harvesting of host-plants are generally done in January-February, June-July and October-November, there is no dearth of available solar energy during the period of growth and development of integrated crops. Moreover, it is ideal to raise shade loving crops, so that they can utilize filtered light to the maximum extent.

(iii) Selection of agricultural crops for integration:

While selecting agricultural crops for inter-cropping, the following points require special attention:

- a. Inter-crops should be of site-specific and favoured by soil and climatic conditions under different agro-climatic regions.
- b. Companion crop should be complementary in nature and not competitive. While selecting inter-crops, due attention should be given to those which do not have specific or similar nature of requirements.
- c. The associated crops should be of consumption orientation or one that can meet the diversified need of the farmers.

- d. Selection of companion crops also depends upon the irrigation facilities available on the farm. For rainfed condition, strategy should be different; short duration crops which can withstand limited moisture should be preferred.
- e. Efficient crop combination should always be used, so as to properly utilize the space, solar energy nutrients, moisture etc.
- f. Care must be taken into consideration that associative crops should not harbour any insects and pests.
- g. Selected crop should be easily saleable in the nearby market.

(iv) Suitable crops/fodder grasses for integration:

Traditionally, lac is cultivated on three conventional host-plants species, namely, *palas*, *ber*, and *kusum*. Although, several crops can be grown in lac plantation, it is necessary that some choice is exercised, since all crops are not found to perform well under the prevailing plantations. To improve the productivity, profitability as well as for risk management, a number of possible upland agricultural crops and annual and perennial fodder grasses which have been tried are : *gora* paddy/improved paddy for upland, ragi, green and black gram, soybean, maize, rhizome, tuber crops, annual grass like *Dinanath* (*Pennisetum pedicellatum*), Napier grass (*Pennisetum purpurium*), andropogan (*Andropogan gayanus*) and (*Brachiaria brizantha*). For mixed plantation of *bhalia* (*Flemingia macrophylla*) and *galwang* (*Albizia lucida*) the best suited inter-crops are rhizomes, tuber colocacia etc.

The mixed plantation of *bhalia* and *galwang* is very suitable for lac cultivation especially for women as all the operations can be carried out from ground level. *Bhalia*, a shrub and *galwang*, a small tree are planted in rows. In one hectare land 3,600 plants of *bhalia* and 1200 trees of *galwang* are planted. One can start lac cultivation after 4 years of planting. *Bhalia* is utilised for winter crop and *galwang* for summer crop of *kusmi* lac.

(v) Returns from Integrated Crops:

Experiments conducted at the Research Farm of the Indian Institute of National Resins and Gums, Ranchi have shown that *Dinanath* grass (*Pennisetum pedicellatum*) is the best suited fodder grass apart from tuber, rhizome, *gora* paddy, ragi, soybean etc. Integration of various agricultural crops have shown that growing of *Dinanath* grass + tapioca + turmeric as inter-crops leads to 68.8 per cent increase in the gross income over sole lac cultivation on *palas*; growing sweet potato + ginger + turmeric in mixed plantation of *bhalia* and *galwang* results in 241.2 per cent increase in gross return. Similarly, profitability of *kusum* orchard may also be increased.

7.4. Processing for Value Addition - Empowering the Farmers

Lac growers, mostly tribal communities have to sell raw lac immediately after harvesting sometimes at much lower prices due to associated storage problems as it requires large space

with adequate ventilation. Raw lac if stored in bags forms lump which is difficult to crush during processing leading to deterioration in its quality. Primary processing of lac at village level leading to manufacture of seed lac will not only add value to the raw lac, but also prevent distress selling of the produce by the farmers. ICAR – IINRG, Ranchi has developed a **Small Scale Lac Processing Unit** (capacity – 100 kg/day sticklac) that comprises a set of four machines *i.e.* Lac scraper-cum-crusher, Lac washing machine, Lac winnower and Lac grader, which is suitable for making seed lac from stick lac. In this primary processing of lac, five major unit operations are involved *i.e.* crushing, washing, drying, winnowing and grading. These machines can be driven manually or with electric motor.

Lac is a natural and eco-friendly resin having application in different sectors like varnish, pharmaceutical, perfumery, cosmetic, fruit coating formulation, handicraft items, *etc.* Promotion of processing units will further lead to opening of avenues in cottage industry for manufacture of handicraft items, varnishes, *etc.* If processing unit remains functional even for six months in a year, about 750 man-days of employment can be generated from the unit. A set of machines costs Rs. 1.80 lakh. Minor tools like pruning knife, secateur, tree pruner and sprayer required for lac cultivation operations like pruning of branches, brood lac selection and harvesting of mature lac will cost an additional sum of Rs. 0.20 lakh. Recently, the Institute has developed an **Integrated Lac Processing Machine** combining crushing, grading and washing operations to requirement of labour and time.

There is huge scope in lac sector for value addition (seed lac, lac dye, shellac, buuton lac, bleached lac, aleuritic acid and iso-ambrettolide) and employment generation (lac production, processing and handicraft making). Primary processing of lac at growers' / farmers' level in villages and production catchment areas of lac can be done at village level itself. The unit can be established by rural youth or by Self Help Groups (SHGs) on custom hiring basis. It would enable the farmer to sell the processed lac directly to the industry avoiding middlemen, negotiate the price with traders and thereby make lac cultivation more remunerative.

Figure 7.7 Lac processing machines



7.5. 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).

The processing and refinement of lac includes - crushing, sieving, washing, drying, and cleaning by winnowing of granulated lac and ultimately conversion of granulated lac into flakes. Of these steps, sieving, drying of seed lac and winnowing are carried out exclusively by women, while for crushing, washing and conversion of seed lac into shellac, women assist men counterparts. Overall, in the indigenous methods, women contribute 50-55 per cent of physical input in terms of labour upto preparation of seedlac stage. Most of the industries in the country are involved only in refining of lac. On an average, 630 tons of seed lac and 475 tons of shellac are produced per month in the country, which generates around 2,000 mandays per day. Refining of one ton of stick lac involves about 90 mandays.

- (ii) **Manufacture of Lac-bangles and ornaments:** The unit can be started with only Rs 10,000 as a capital investment. At present many units are being run exclusively by women in many parts of the country. A unit with three (3) working women, can earn around Rs 300 to 500 per day. The advantage is, that such units can be developed in village itself and provide ample opportunity to rural women for their livelihood.
- (iii) **Manufacture of sealing wax:** Like lac bangles, women can run this unit also and many such units are already working. A unit of 3 women can give an earning of about Rs 100 per woman per day.
- (iv) **Varnish for wooden furniture:** The simple method of preparation of varnish for wooden furniture and its application can involve women also in this particular field. Besides these, there are many big lac based units manufacturing bleached lac, de-waxed decolorized lac, lac-dye etc. which involve women at various steps. A few lac-based products are easy to manufacture and women can be involved in such units.
- (v) **Particle board:** The by-products of lac processing industry can be utilized as a binder for manufacturing particle board from agro-based material like jute and lac sticks, non-

woven jute, craft paper, coil etc. These particle boards of desired impact and strength can be manufactured by using agro-waste materials of different sizes.

(vi) **Coating of fruits and vegetables:** A rapid drying coating emulsion useful for application to citrus fruits, melons and other fruits and vegetables to provide a pleasing glossy appearance as well as to retard their aging can be prepared by using mainly bleached lac. The diluted water based formulation wets all fruits and vegetables readily and may be applied by dipping or spraying.

(vii) **Slow-release of insecticidal activity:** Coating of many granulated pesticides with lac based formulations result into slow release and prolong their activity, which avoids multiple application. Lac, in very small quantity causes slow and prolonged activity of the insecticides. This can be applied by brush at places where cockroaches are generally hidden during day / time.

7.6. Action Plan for Development of Lac Sector

Lac production has shown stagnation over the past few years due to various socio-economic factors despite availability of improved technology that ensures higher lac production. The country has the potential to more than double the production fulfil the gap between the demand and supply.

7.6.1. Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis

Strengths

- India is the world leader in the field of lac production and IINRG is the premier research organization on lac production, product development and processing.
- There are vast untapped areas in the country ecologically favourable for lac production.
- Unique and strong R&D, export promotion cooperative and NGO support to the sector.
- Good infrastructure and skilled manpower for processing of lac.
- Availability of high population and widely diverse lac hosts.
- Indigenous traditional knowledge and skill.
- Relatively low cost production technology, requiring meagre inputs (like water, fertilizer, pesticides etc.) and investment.
- Suitable technology available for production under rainfed condition.
- Assured source of income during drought years.
- No comparable product, either natural or synthetic, having such versatile range of diverse applications.

Weaknesses

- Conventional major hosts available in scattered manner. Population of these is slowly declining.

- Lack of developmental agency at national level for promotion of production and utilization.
- Weak linkages among the stakeholders.
- Absence of organized marketing system and assured support price.
- Exploitation of lac growers by the middlemen.
- Violent periodic fluctuations in prices.
- Old and traditional processing units.
- Lack of awareness of BIS standards for product quality.
- Subsistence type of agriculture in vast majority of lac cultivation areas, and insufficient knowledge of intensive cultivation.
- Resource-poor and educationally backward farmers / tribals.
- Lack of awareness of economic potential of the commodity.
- Weak brood lac supply networks and poor inter-institutional linkages.
- Lack of good modern storage facilities for maintaining buffer stock.
- Restrictions on free inter-state movements of lac by some state governments.
- Lack of crop insurance and credit facilities to growers.

Opportunities

- Lac is the only source of natural resin besides wax and dye, all of which are reportedly safe for different applications especially for human consumption and contact.
- Lac resin is highly versatile used for a wide range of application areas unmatched by any other single resin.
- Growing global demand for eco-friendly and safe natural products with renewable source of supply.
- Vast potential for increasing both domestic and overseas consumption by spreading awareness about merits of lac.
- Scope for reasonable and steady price level of lac through buffer stock creation, which would help in increasing the demand through uninterrupted supply.
- A vast area in the country having suitable agro- climatic conditions for lac production.
- Tremendous scope for utilization of wasteland / upland and marginal lands not competing with agriculture or horticulture etc.
- Attractive option for generation of subsidiary incomes.
- *Kusmi* lac being the best quality of lac in the world offers maximum competitive advantage. Further studies in this direction could augment the comparative advantage.

- Easy integration of lac production with agriculture and agro-forestry, for diversified land use.
- Interest by cultivators in lac production from non-lac producing areas.
- Ample scope for revitalizing older cultivation and processing technologies, making them more cost-effective, competitive, environment-friendly and energy efficient.

Threats

- Comparatively higher cost of product vis-a-vis cheaper synthetic resins, dyes etc.
- Unhealthy competitive trade practices like adulteration, leading to unreliable product quality, damaging the industry.
- Dependency of the industry on overseas export market.
- Deforestation of lac-growing areas, leading to shrinking of production base.
- Violent fluctuations in price affecting commercial feasibility of developed lac -based products.
- Threat from organized cultivation of other agricultural crops invading lac cultivation areas. Crop like “*Jatropha*” may compete for the waste-land.
- New entrants and increasing production of lac in other South East Asian countries, and import of lac into India without quarantine checks.
- Migration of lac cultivators to other remunerative alternatives.

7.6.2. Pertinent questions that need answers for improving lac sector are:

- Despite prevailing of highly favourable conditions for lac cultivation, production of lac is not increasing at the desired rate. *What could be the possible reasons for this scenario and how can one increase the production?*
- Good quality lac fetches better price and has got better marketing avenues. But production of good quality lac is not even 30 per cent of the total lac production. *What steps should be taken to i) improve the quality of the lac produced; and ii) to increase the production of good quality lac?*
- Marketing is an important link in the chain of events which can affect overall production of lac. In lac sector there is no open /organized marketing system which hinders the growth of lac. *Should one introduce some alternate system of marketing or are there any means to improve the existing system?*
- The country is dependent on overseas buyers for marketing of lac. As per available records about 70 per cent of lac produced is exported. In the event of decrease in demand, price of lac crashes and *vice versa*. To offset the unforeseen situation, domestic consumption needs to be increased substantially. Increased domestic consumption will

indirectly lead to increased production of lac. *What are the various ways which can help increase the domestic consumption of lac?*

- Higher the number of applications a commodity has, greater is its consumption. *Though, there are several applications of lac, are there other areas where lac can be introduced? Which are those areas where usage of lac should be pushed more vigorously?*

7.6.3. Major issues to be addressed

i. Declaration of lac as an agriculture produce: relevancy of the agenda

Lac production has been categorized as a Non-Wood Forest Produce which hinders its expansion and extension activities. Extant forest laws sometimes, not only restrict its movement but also the income generated from production of lac is considered as taxable. It discourages the progressive farmers to take lac cultivation on a larger scale.

However, lac is no longer a Non-Wood Forest Produce simply collected by the forest dwellers. Lac farmers practise just like in other agricultural crops. The farming activities include land preparation, seed sowing / nursery preparation, transplanting, manuring and use of fertilizers, pruning, inoculation of brood lac spraying, inter-cultural operations and harvesting of lac crop for sale in local market.

In the recent year, ICAR-IINRG has made efforts to integrate lac cultivation with agriculture. **Lac Integrated Farming System Models** are becoming popular among the farmers which have led to 15-20 per cent increase in farming income through land use diversification.

Lac is a green product and its cultivation is labour intensive and an environment friendly activity. It needs to be promoted among the farmers for supplementing their income and simultaneously empowerment of women. It is labour intensive and therefore bears large employment potential - large number of producers and /or exporters; hi-tech products with high export earning potential also is its character.

Agricultural and Village industry products including lac based value added products are presently covered under Vishesh Krishi and Gram Udyog Yojna (VKGUY) in the Foreign Trade Policy 2015-2020.

Hence, there is urgent need to declare lac as an agricultural produce to accelerate its growth and livelihood potential.

ii. Formation of National Lac Development Board

Inconsistent policies and lack of coordination among the lac stake holders in all the states regarding the cultivation and marketing of the lac calls for early resolution. It has been classified as nationalized or non-nationalized or monopoly item in different states and there are different organizations actions responsible for promotion of lac as seen below:

- Research on lac is the mandate of IINRG (ICAR, Ministry of Agriculture)
- Most of the lac production still comes from forest / sub-forest areas (ICFRE, Ministry of Environment and Forests)
- Promotion and export of lac is looked after by SHEFEXIL (Shellac and Forest Products Export Promotion Council, Ministry of Commerce)
- It is cultivated mostly by tribals (Ministry of Tribal Affairs).

On account of involvement of multiple agencies there exists a problem in developing a holistic approach for promotion and development of lac / NRGs. Hence, a policy intervention at national level is required to address this disparateness.

Lac is exported to more than 60 countries of the world and top ten importing countries of Indian lac are Egypt, Germany, Pakistan, Bangladesh, Indonesia, USA, Italy, UAE, Spain and Nepal. Earnings of foreign exchange through export of lac based products has increased from Rs. 1,250 million in 2007-08 to Rs. 2,475 million during 2015-16. Share of lac export in India's total export may not be high, but it is very important in terms of social and livelihood security, environmental stability, soil fertility and sustainable development. The ratio of domestic and overseas demand is about 60:40. It shows the scope for more favorable and strong market set up in the country.

IINRG, with all India mandate, is the only Institute working on lac production, processing, and value addition. Due to shortage of scientific and technical manpower, its four (4) Regional Field Research Stations (RFRSs) and five (5) Regional Testing Laboratories were gradually phased out over a period of time. Three RFRSs sanctioned in early nineties also never really came into being as no additional manpower was provided. Therefore, IINRG does not have the required wherewithal for production and development of lac across the country. This requires to be corrected.

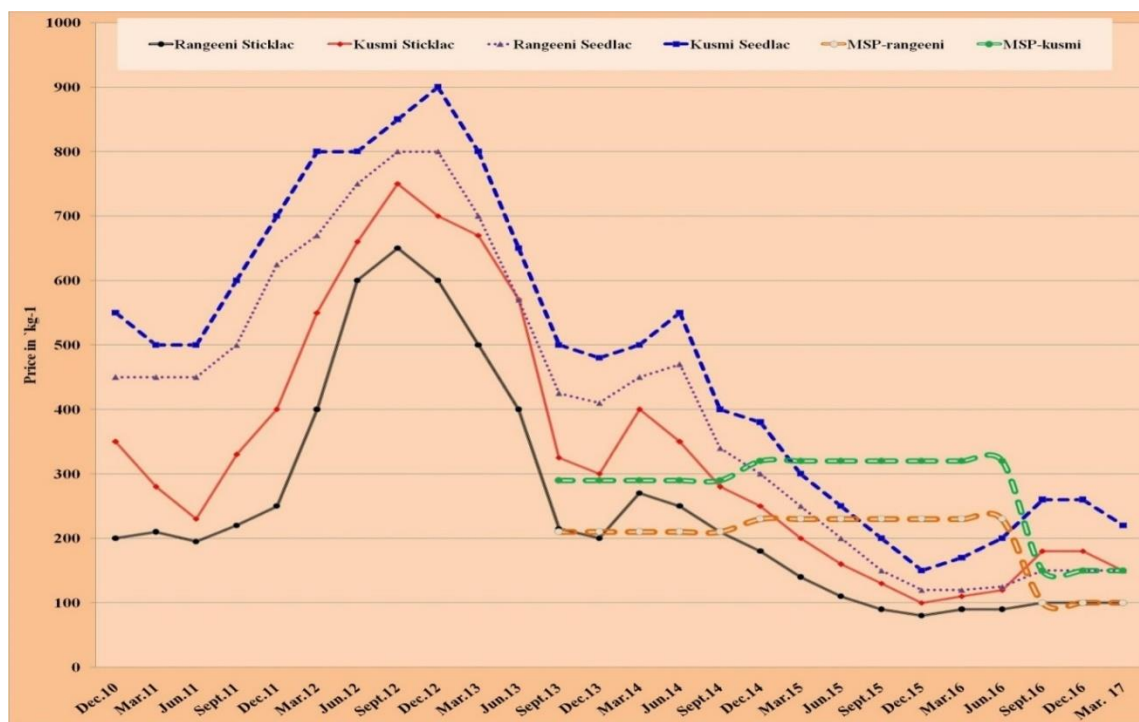
Formation of various commodity specific boards has promoted the production and export activities of these commodities. Hence, it is necessary to promote lac as a brand through a national governing body to benefit the stakeholders across the nation. Hence, the need for setting up National Lac Development Board (NLDB) under the Ministry of Agriculture with an aim of substituting exploitation with empowerment, tradition with modernity, stagnation with growth; and transforming lac cultivation into an instrument for the development of rural people, checking distress migration of tribals for livelihood, and to provide the much needed fillip to accelerate the production of lac.

iii. Implementation of minimum support price (MSP)

Being an export oriented commodity, lac is prone to violent price fluctuations (Fig. 7.8) depending upon the demand and unhealthy practices followed by the export houses. Since the last three years (beginning 2015-16), Minimum Support Price (MSP) is being declared by the Ministry of tribal Affairs; but unscientific methodology in arriving at MSP and its ineffective

implementation by the state governments has failed to create the desired impact on the prevailing market prices.

Figure 7.8 Violent price fluctuation in lac procurement



7.7. Policy Interventions

To achieve the desired target of doubling lac production, the following points and suggestions provide the basic frame work. An economic activity to be established, popularized and sustained over a period of time needs necessary policy intervention by the government.

- i. Inter-departmental linkages:** It is seen that lac cultivation programmes are pursued by different Departments within a Government that lack strong inter-departmental linkages. State Minor Forest Produce Trade and Development Cooperative Federations (Department of Forest), Development Commissioner, Department of Rural Development, Department of Welfare, Cooperative Department etc. work in isolation. Lac cultivation requires convergence of the existing development programmes and projects (*viz.* Joint Forest Management, District Poverty Initiatives Project, Rural Livelihood Projects, Watershed Management Project, Integrated Wasteland development Project, Swarna Jayanti Gramin Swarozgar Yojana, Integrated Tribal Development Project) preferably through a single window system.
- ii. Abolition of Transit Pass:** Lac considered as a minor forest produce, requires in some of the states, a Transit Pass (TP) issued by the Department of Forest for its movement from the area of its production to market or processing unit even by the producer, gatherer or trader. Violation of the rule leads to confiscation of the material and the vehicle that carries it. In an attempt to encourage and popularize the lac enterprise, it should be kept free from

the need of a Transit Pass.

- iii. Access to common property resources:** Availability and access to host trees to communities is an essential requirement in the promotion of lac cultivation among the resource poor. Unutilized host trees of lac insect on the community land, also those on forest and Revenue lands should be distributed to the resource poor in the area either through Institutional arrangement or through *Tree patta* for lac cultivation. Auctioning of host-trees on Panchayat land to people for lac cultivation for a specific period or providing to Self Help Groups and Joint Forest Management should be encouraged.
- iv. Encouraging lac growers:** Promotion of lac cultivation and facilitating lac growers on suitable occasions would play an important part in encouraging lac growers and attracting local people towards the enterprise. Such lac growers should be facilitated to transfer the technology of lac cultivation and encouraged to become local leaders of change.
- v. Establishment of broodlac nurseries:** As the area under lac cultivation begins to expand and number of lac growers swell, there would be an increase in the demand of broodlac. In order to address this crucial issue, the department concerned should develop broodlac nurseries in each one of the districts. The location and area for brood lac nursery should be identified based on the available resources and envisaged demand.
- vii. Federation of lac growers:** Efforts should be made to organize beneficiaries into Self Help Groups. After the stability and maturity among the members of SHGs, they should be federated into an association. Such associations can work for betterment of the lac growers, besides promoting skill based training for small groups for a fee as well as producing quality brood lac. There exists vast scope to promote FPOs including farmer producer companies of lac growers.

A plethora of factors which hamper lac production have been identified. Some of the important ones are classified into different categories for convenience. These, along with possible solutions are:

- **Environmental:** Weather plays an important role in lac production. Heavy rain during the brood inoculation period washes away the crawling brood causing poor settlement of lac insects. Hail storm too damages the lac crop, when it hits the twigs chipping away the lac encrustations. Fogs during winter also cause damage to the lac crop. Recently, large scale pre-summer mortality has been witnessed especially in Jharkhand and West Bengal. Providing insurance cover or declaring large scale lac crop failure due to environmental hazards should be declared a natural calamity by the respective state governments.
- **Biological:** It is a general practice to use the same brood lac in the same area for inoculation during every successive cropping season. It may cause degradation of the quality of the brood and resultant yield. Lac growers take little care during inoculation and crucial crop growth stages in the management of predators and parasites of lac insects resulting in yield losses as well as their establishment.

Research interventions are required to develop strains that bring in higher yielder with certain quality traits, including early maturity, resistant to certain diseases, predators or parasites and location specificity. Focus needs to be on developing strains for specific regions to overcome climatic adversities (like a heat tolerant strain for hot areas; a high waxy strain for food industry; a high resinous strain for cosmetic and automobile industries; and / or a strain with high dye for dye industry). With expansion in area under lac cultivation, there are chances of emergence of many production constraints.

It is recommended that there be a system in place to identify these issues, document them region and location wise while prioritizing them for initiating research. The Indian Institute for Natural Resins and Gums should propose a Network Research Project on lac to touch all production related issues in all the potential lac producing states in India.

- **Financial:** Lac is a cash crop, yet financial institutions have not recognized it. In spite of it being a high value crop, availability and access to institutional credit is not easily available. It is an established fact that a majority of the lac growers are resource poor, forest dependant or belong to tribal communities, with limited access to cash and credit. Thus, their ability to invest and cope with crop loss or yield loss is limited.

There should be a policy intervention to extend credit for lac cultivation by recognizing formally that lac is a cash crop. Lac growers should also enjoy the facility of Kisan Credit Cards (KCC), where one can draw the required amount from any nationalized Bank to invest in lac cultivation. Presently, KCC is only limited to agricultural crops (extended to livestock also only recently, Union Budget 2018). Crop loan is another instrument which can be thought of for extending financial support for lac growers. Crop Insurance for lac crop does not exist, though the scheme is in place for agricultural crops and milch animals. Policy makers have to focus on this area where a majority of the growers are socio-economically disadvantaged.

- **Commercial:** Despite being a cash crop and of industrial importance as well as an export commodity, there is no effective policy to assure minimum support price through procurement of lac. Fluctuating prices and uncertain markets affect growers the most. Most of the lac growers inhabit rain-fed agro-ecosystem belonging to complex diverse risk prone group. Neither are they organized nor do they have the desired voice to influence policies in their favour.

Most of the value addition of lac is carried out away from the area of its production, bringing little or no benefit to the locals. But in other sectors, industries come up where the raw materials are available in plenty. Vegetable and fruit processing industries in Punjab, sugar mills in Maharashtra, milk industry in Gujarat etc. are a few examples.

There is also a need to link small growers to the export units or markets. In the era of open market options to discourage import of raw / semi-finished lac from Indonesia or Thailand may not have many takers, but it is also a fact that it has a role to play in pulling down the price of

lac. Seed lac and Shellac constitute the bulk form of the lac exported from India. Majority of the value addition of lac is done in the importing country. Value addition needs to be done at local level on priority for increasing domestic consumption and enhance export earnings.

- **Technical:** Living in hostile terrain and voiceless, the production constraints of these vulnerable groups of producers and gatherers are seldom heard. Diagnosis of the problem and information sharing, as well as executing participatory need-based On-Farm Training is not a regular feature. Brood lac is the most important input for lac cultivation, but there is a wide gap between the demand and supply. Unscrupulous elements take advantage of this situation and supply poor quality of brood lac at exorbitant prices.

Considering the limitations of the public sector, it will be worthwhile to encourage rural youth among the lac growers after proper skill-oriented training to take to brood lac production. Apart from ensuring brood lac availability, its quality should also be assured through a brood lac certification system which needs to be developed.

7.7.1. Interventions and outcomes

In the context of the issues examined in the preceding paragraph, the interventions needed and the agencies responsible along with expected outcomes are presented in Tables 7.5 and 7.6.

Table 7.5 Interventions required for doubling the lac production

Intervention	<i>Agencies to be involved</i>	Expected increase in Production (%)
Policy interventions like formation of National Lac Development Board, Declaring lac as agricultural produce, Effective implementation of MSP, Establishment of Regional Stations and Quality Evaluation Laboratories	Ministry of Commerce, Ministry of Agriculture and Farmers Welfare, Tribal Affairs Ministry and State Governments	30
Increasing production by introducing lac in newer areas	IINRG and State Govt. Agencies	25
Enhancing lac productivity (per tree and unit area)	IINRG and other research institutes	15
Increasing domestic consumption and assuring quality of export material	SHEFXIL, IINRG, State Forest Department, SAUs and lac growers	15
Introducing Lac Integrated Farming System Models for assured livelihood in rain fed agriculture	IINRG, SAUs and lac growers	5
Publicity and awareness	IINRG and State Departments	5
Credit and insurance to lac growers	States, Banks and Insurance agencies	5

Table 7.6 Interventions with actionable points and issues to be addressed

SN	Recommendation	Action	Issues to be addressed
A. Policy Issues			
1.	Formation of National Lac Development Board	Ministry of Commerce, Lac growing States, IINRG	<ul style="list-style-type: none"> • Abolition of Transit fee • Promotion of lac at state level • Maintaining buffer stock of lac • Price stabilization through effective implementation of MSP • Regularizing Export / Import of lac
2.	Establishment of Regional Stations and Quality Evaluation Laboratories	ICAR	<ul style="list-style-type: none"> • Introduction of lac in newer areas • Demonstration of Lac Integrated Farming Systems • Evaluation of developed lac insects • <i>In-situ</i> conservation of lac insects
B. Developmental Issues			
3.	Creation of adequate infrastructure and data base on lac	Nodal Deptt. on lac of State Govts.	<ul style="list-style-type: none"> • Inventorisation of lac host-plants, • Exploitation of idle lac-host plants, • Lac in Joint Forest Management, • Broodlac farms at district level • Raising plantations of lac-host trees,
4.	Consortium of lac stake holders (Research Institutes, NGOs, Financial Institutions, Industry)	IINRG, Cooperatives, NABARD NGOs, Lac Industry	<ul style="list-style-type: none"> • Cluster based business model of cooperative lac cultivation. • Assured lac marketing • Value addition/primary processing at village level
C. Researchable Issues			
5.	Research problems identified:		
	<ul style="list-style-type: none"> • Identify good lac insects, host plant and / or combination of the two 	IINRG	<ul style="list-style-type: none"> • Developing superior lac insect breeds and host plants and lac insect-host plants combinations for enhanced / sustained resin yield
	<ul style="list-style-type: none"> • Broodlac certification 	IINRG	<ul style="list-style-type: none"> • Standardizing good quality broodlac
	<ul style="list-style-type: none"> • Tackling lac crop failure 	IINRG	<ul style="list-style-type: none"> • Large scale summer crop mortality
	<ul style="list-style-type: none"> • Effect of climate change on lac cultivation 	IINRG	<ul style="list-style-type: none"> • Lac culture under controlled climatic conditions • Heat resistant strains of lac insects
	<ul style="list-style-type: none"> • Reduction in cost of primary processing of lac and its application • Use of lac in newer areas 	IINRG	<ul style="list-style-type: none"> • Developing machines for automation in primary processing of lac and manufacturing buttonlac • Mechanizing polishing & varnishing of furniture • Development of lac based technologies for use in Cosmetics, Food industry etc.

	• Quick estimation of resin	IINRG	• Resin content in raw lac for price determination
D. Extension Issues			
6.	Transfer of Technology	IINRG, State Govts.	<ul style="list-style-type: none"> • Collection of basic data on consumption of lac • Commercialization of lac based technologies • On-farm / Front line demonstrations, • Training on Scientific methods of lac cultivation • Impact assessment of training
7.	Publicity and Awareness of lac cultivation and product technologies	State Govts., Lac Consortium	<ul style="list-style-type: none"> • Lac publicity at national level • Linkage with SAUs • Utilization of lac and processing wastes in household and handicraft items
E. Financial Issues			
8.	Credit-cum-insurance to lac growers	NABARD, Financial Institutions	<ul style="list-style-type: none"> • Providing subsidized loans to lac growers • Insuring lac crop

7.8. 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.

7.9. Annotation

Cultivation of lac not only provides livelihood to millions of lac growers but also helps in

conserving the vast stretches of forests, lac insects and associated biota. Lac growers give more importance to regular income from cultivation of lac over the years to one time income from timber or fuel. Thus, lac-culture plays a vital role in protection the nation's our bio-resources.

Lac also provides sustained high economic returns, generates employment opportunities and has potential to lay a strong foundation for lac based rural cottage industries. With increasing demand for natural products, the time is ripe to introduce lac in farming system and on idle lac host trees in the forests. It is evident from the fore-going account, that promoting and encouraging lac culture will not only check environmental degradation and help rebuild the ecological balance but also conserve endangered lac insects, associated fauna and flora for posterity.

Lac growers have traditional knowledge and can be easily trained in improved methods of cultivation of lac. Therefore, lac cultivation can be introduced on plantation basis especially on bushy lac host plants. Lac is a high value cash crop that has potential to provide employment and improve socio-economic conditions of the poor and marginal farmers and must be promoted whole-heartedly.

However, there is need for a robust policy framework, that addresses the current challenges of isolated interventions by different Ministries and Departments, as also de-risking the cultivation by covering lac cultivation under the facilities of institutional credit (interest subvention) Pradhan Mantri Fasal Bima Yojana (PMFBY) and minimum support price (MSP) buttressed with procurement.

Chapter 8

Agro-forestry

Agro-forestry is important as it brings about efficient use of scarce resources, contributing to well-being of farmers through diversity in production and income. It is an intervention that adds to stability of farm viability, jobs and income linked to agriculture. The financial viability of agro-forestry models in various agro-climatic zones has been presented in this chapter. The holistic policy framework is also suggested for developing agro-forestry in a sustainable way and enhancing its contribution to welfare of farmers and other stakeholders.

8.1. 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 bio-diversity, 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.

It is also recognized that agro-forestry is perhaps the only easy alternative to meeting the target of increasing forest cover to 33 per cent from the present level of less than 25 per cent, as envisaged in the National Forest Policy (1988). Moreover, in October, 2016, India ratified the Paris Agreement and committed itself to reducing the emission intensity of its gross domestic product (GDP) upto 33-35 per cent from 2005 level; to increase the share of non-fossil based power generation to 40 per cent; and to create an additional carbon sink of 2.5 to 3.0 billion tonnes of carbon dioxide (CO₂) equivalent through additional forest and tree cover by 2030 under Nationally Determined Contribution (NDC) submitted to United Nations Framework Conservation on Climate Change (UNFCCC). Likewise, the United Nations (UN) Sustainable Development Goals (SDGs) emphasize climate, forests and bio-energy as pillars to achieve all 17 goals by 2030. Given the nature of multi-functionality of agro-forestry also has roles to play in achieving the targets of SDG1 (on ending poverty), SD2 (on ending hunger), SDG 6 (on protecting water-related ecosystems), SDG 7 (on access to sustainable energy to all), SDG 13 (on combating climate change) and SDG 15 (on protect terrestrial ecosystems).

Although, the National Commission on Agriculture (1976), National Forest Policy 1988,

National Agriculture Policy 2000, Task Force on Greening India 2001, National Bamboo Mission 2002, National Policy on Farmers, 2007 and Green India Mission 2010, emphasized the role of agro-forestry for sustainable agriculture and improving vegetation cover (National Agro-forestry Policy, 2014), it is yet to reach the agro-forestry desired level of area estimated as 11.15 million ha, which is 3.39 per cent of country's geographical area (FSI, 2013).

In another estimate, the area under agro-forestry has been reported as 25.32 million ha or 8.2 per cent of the total geographical area of the country (Dhyani, et al. 2013). There is further scope of increasing the area under agro-forestry in future by another 28.0 million ha by 2050. The major share of the land to be brought under agro-forestry will come from fallows, cultivable fallows, pastures, groves and rehabilitation of problem soils (ICAR-CAFRI, 2015). Government of India has been implementing Sub-Mission on Agro-forestry (SMAF, 2016) under National Mission for Sustainable Agriculture (NMSA) to fulfil the objectives of the National Agro-forestry Policy, 2014.

8.2. 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. Dhyani 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).

According to another estimate of ICAR-CAFRI, the potential of employment generation is 943 million person-days annually from the 25.4 million ha. of existing area under agro-forestry (Table 8.1). Presently, the total yearly estimated employment generated under agro-forestry system is about 40 per cent of the employment generated (2358.4 million person-days) under Govt. of India's flagship employment generation scheme, namely 'Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)' during 2016-17 at a cost of Rs. 407,822 million incurred on wages under the scheme. It implies that the area expansion under agro-

forestry system is a viable and relatively cheaper source of employment generation for unskilled and semi-skilled labour in rural and semi-urban areas in country.

Table 8.1 Employment generation potential through agro-forestry in India

Agro-forestry system	Area (million ha)	Additional employment generation (person days /ha/year)	Total employment/year (million person days)
Silviculture	1.8	30	53.3
Agri-silviculture (irrigated)	2.3	40	91.3
Agri-silviculture (rainfed)	1.3	30	38.0
Agri-horticulture (irrigated)	1.5	50	76.1
Agri-horticulture (rainfed)	0.5	40	20.3
Silvipasture	5.6	30	167.4
Tree borne oilseeds (TBOs)	12.4	40	497.1
Total	25.4	260	943.4

Source: NRCAF (2007) and Dhyani, et al. (2009)

8.3. 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.

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 Planning Commission. The results in Table 8.2, show that all agro-forestry systems are financially viable and provide substantive returns to farmers in respective agro-climatic zones.

Table 8.2 Financial Analysis of prominent agro-forestry systems in various Agro-climatic zones, India

SN	Agro-climatic Zone/Region	Situation (Rainfed/Irrigated / Non arable land)	Agro-forestry system	Period (years)	Tree (Common name)	Tree (Scientific name)	Crop/ Grass	Total Cost discounted @15% (Rs/ha)	NPV (Rs/ha)	B/C ratio	FIRR (%)	AEV (Rs/ha)	LEV (Rs/ha)
1.	Western Himalayan	Rainfed	Agrihorticulture	15	Peach	<i>Prunus persica</i>	Maize, Soyabean	57,144	12,039	1.21	30	2,059	13,726
2.	Eastern Himalayan	Irrigated	Agrisilviculture	8	Kadamba	<i>Anthocephalus cadamba</i>	Paddy	43,776	24,348	1.56	32	5,426	36,173
3.	Lower Gangetic Plains	Irrigated	Agrisilviculture	10	Eucalyptus	<i>Eucalyptus hybrid</i>	Paddy, Wheat	86,237	114,532	2.33	33	22,821	152,138
4.	Lower Gangetic Plains	Rainfed	Agrisilviculture	15	Aust. Babool	<i>Acacia auriculiformis</i>	Jute	27,016	4,558	1.17	30	779	5,197
5.	Middle Gangetic Plains	Rainfed	Agrisilviculture	20	Sheesham	<i>Dalbergia sissoo</i>	Seasamum	14,360	9,030	1.63	36	1,443	9,618
6.	Middle Gangetic Plains	Non- arable	Silvipasture	10	Bamboo	<i>Bambusa vulgaris</i>	Marvel grass	24,796	18,907	1.76	56	3,767	25,115
7.	Upper Genetic Plains	Irrigated	Agrisilviculture	7	Poplar	<i>Populus deltoides</i>	Paddy, Wheat	82,292	190,241	3.31	69	45,726	304,843
8.	Trans Gangetic Plains	Rainfed	Agrisilviculture	20	Babul	<i>Acacia nilotica</i>	Bajra, Guar	17,263	27,788	2.61	39	4,439	29,596
9.	Eastern Plateau & Hill	Irrigated	Agrisilviculture	12	Gumhar	<i>Gmelina arborea</i>	Paddy, Linseed	69,140	50,857	1.74	34	9,382	62,548
10.	Eastern Plateau & Hill	Non- arable	Agrisilviculture	15	Anjan	<i>Hardwickia binata</i>	Dinanath grass	60,062	68,035	2.13	48	11,635	77,568
11.	Central Plateau & Hill	Rainfed	Agrihorticulture	8	Aonla	<i>Emblica officinalis</i>	Groundnut, Gram	86,494	7,409	1.09	28	1,651	11,007
12.	Western Plateau & Hill	Non- arable	Silvipasture	16	Siris	<i>Albizia amara</i>	Krishna Siris	63,236	43,768	1.69	44	7,351	49,005
13.	Southern Plateau & Hill	Irrigated	Agrisilviculture	15	Kapok	<i>Ceiba pentendra</i>	Groundnut	109,840	46,746	1.43	29	7,994	53,296
14.	Southern Plateau & Hill	Rainfed	Agrisilviculture	10	Imli	<i>Tamarindus indica</i>	Chilli	28,163	29,101	2.03	33	5,799	38,657
15.	West Coast & Ghat	Irrigated	Agrisilviculture	7	Beefwood	<i>Casurina equisetifolia</i>	Paddy	86,889	33,907	1.39	26	8,150	54,332
16.	West Coast & Ghat	Irrigated	Agrihorticulture	8	Coconut	<i>Cocos nucifera</i>	Elephant foot, Ginger	64,387	17,650	1.27	33	3,933	26,222
17.	West Coast & Ghat	Rainfed	Agrisilviculture	20	Teak	<i>Tectona grandis</i>	Sweet Potato	209,715	210,246	2.00	31	33,589	223,928
18.	Gujarat Plains & Hill	Rainfed	Agrisilviculture	20	Sheesham	<i>Dalbergia Sissoo</i>	Castor	7,080	8,037	2.14	31	1,284	8,560
19.	Western Dry	Rainfed	Agrisilviculture	20	Khejri	<i>Prosopis cineraria</i>	Bajra	35,665	54,409	2.53	37	8,692	57,950
20.	Western Dry	Non- arable	Silvipasture	10	Ber	<i>Ziziphus nummularia</i>	Cenchrus ciliaris	37,131	19,810	1.53	34	3,947	26,315
21.	The Islands	Rainfed	Agrisilviculture	6	Coconut	<i>Cocos nucifera</i>	Paddy	37,452	6,325	1.17	32	1,671	11,143

Source: Planning Commission (2001) Report of the Task Force on Greening India for Livelihood Security and Sustainable Development, Government of India, New Delhi.

Note: i) NPV: Net present value is determined by discounting all revenues and costs to the present; ii) B/C ratio: benefit/cost ratio is calculated by dividing the sum of discounted revenues by the sum of discounted costs; iii) FIRR: Financial internal rate of return is a discount rate at which an investment's NPV equal zero; iv) AEV: Annual equivalent value is an indicator that expresses NPV in annual equivalents distributed equally over the years of the lifespan of the investment; and v) LEV: Land expectation value is interpreted as the maximum amount of money a landowner can pay for the land and still earn the minimum acceptable rate of return of an agro-forestry investments

8.4. Policy linkage between agro-forestry and other related sectors

It is well documented that a combination of various policies influence to scaling-up agro-forestry in any country. Policy framework plays a seminal role in the multi-scaled and multi-functional nature of agro-forestry. For example, policy formulation on opening the opportunities for markets in ecosystem services from agro-forestry system will affect price policy for agro-forestry products, trade policy, credit policy, subsidy policy, energy policy and forest policy. In fact, there are trade-off and synergy influences among various sectoral policies, but priority should be based on national objectives of the country.

In India, where the average national income still needs to improve, there will arise apparent conflict between growth in per capita income and environmental security, but this issue can be resolved on the common principle of sustainable development. For example, farmers may not display keen interest in issues like carbon benefits to the society, and hence, such schemes need external and up-front funding to overcome establishment and other costs in agro-forestry.

The inter-sectoral policy linkages related to agro-forestry sector are presented in the following policy framework:

Table 8.3 Holistic Policy framework for development of agro-forestry in India

Policy type	Policy instrument	Linkage	Agro-forestry related effect
Macro-economic	Fiscal policies-taxation	Taxation on agro-forestry products	Capacities for reinvestment by farmers and wood-based industries
	Monetary and credit policies	Credit allocation and interest rate	Investment capacities in resource management
	Foreign investment regulations	Infrastructure development	Reduction or increase in agro-forestry based industries
	Trade policies: WTO commitments	To liberalize trade in industrial products include reductions in tariffs and removal of quantitative restrictions	Incentive or constraint to production and export
	Trade policies: exchange rate	Valuation of imported and exported commodities	Costly or cheaply import or export
	Import control	Custom duties and fumigation of imported products, which reduced imports of equipment and efficient technologies	Positive and negative impact on farmers and wood based industries respectively.
	Export promotion	Export subsidies	Overutilization of selected species
Structural adjustment	Public investment and privatization	Investment through Agro-forestry Mission and expansion of role of private sector	Social welfare and efficiency in production, marketing and trade
	Pricing policies for inputs and outputs	Correcting market distortions	Valuation of outputs
Land distribution	Legislation on land ownership	Land titling and tenure	Security of rights and exploitation of resources
	Legislation on right for production, transportation and trade	Adoption of agro-forestry systems and Investment	Production of Selective commercial tree species, forest reserves and encroachment of forest resources
Agriculture	Food policy	Food production versus wood	Intensification of agriculture through

Policy type	Policy instrument	Linkage	Agro-forestry related effect
		production	agro-forestry and complementarity between these two sector
	Pricing policy	Agricultural pricing versus wood pricing	Allocation of scarce resources due to price risk aversion
	Agricultural research policy	The investment on agricultural research and economic rates of return to agriculture /agro-forestry research	Share of agricultural research to total agricultural gross Domestic Products (GDP) and share of agro-forestry in agricultural research
	Agricultural marketing policy	Agricultural marketing infrastructure and dissemination of market information	Projection of species-wise demand and price in specific market across agro-climatic zones
Energy	Energy self-reliance	Household and industries consumption and fuel substitution	Fuelwood demand and pollution
Environment	Intended Nationally Determined Contribution (INDC) is to create an additional carbon sink of 2.5 to 3 billion tonnes of CO ₂ equivalent through additional forest and tree cover by 2030	Investment in plantation	Agro-forestry is viable option for area expansion under green cover of 33 per cent of total geographical area of country
Poverty	Income and employment generation policy	Resource poor marginal and small farmers and disguised unemployment in rural areas	Agro-forestry sector generates income and employment and reduce disguised unemployment to unskilled labour in rural areas

8.5. Challenges and Way Forward

Sustainable development of agro-forestry system needs two types of integration: agriculture with trees and trees with people. These integration must have suitable underlying conditions, which may be technical, economic and social. From a technical perspective, not all combinations of annual and perennial species are viable and certain tree practices or species may overly compete for water and other scarce resources, hence, suitable species and practices must be used.

From an economic perspective, farmers may be interested in tree products only, when they do not decrease crop production, or where agro-forestry does not limit their ability to farm with large equipment. In addition, farmers need to be informed about the profitability of any new system (FAO, 2013).

Saxena (1991_a) reported that the legal restrictions on the transport and sale of wood and other institutional factors, the gap in the farm gate price and the consumer price remained very wide. Wood markets have, on the whole, exploited the farmers, rather than helped them. They suggested that the relaxations in legal restrictions and competent organizations should carry out a separate assessment of the future demand, supply and prices for each species, the results of which should be given due publicity.

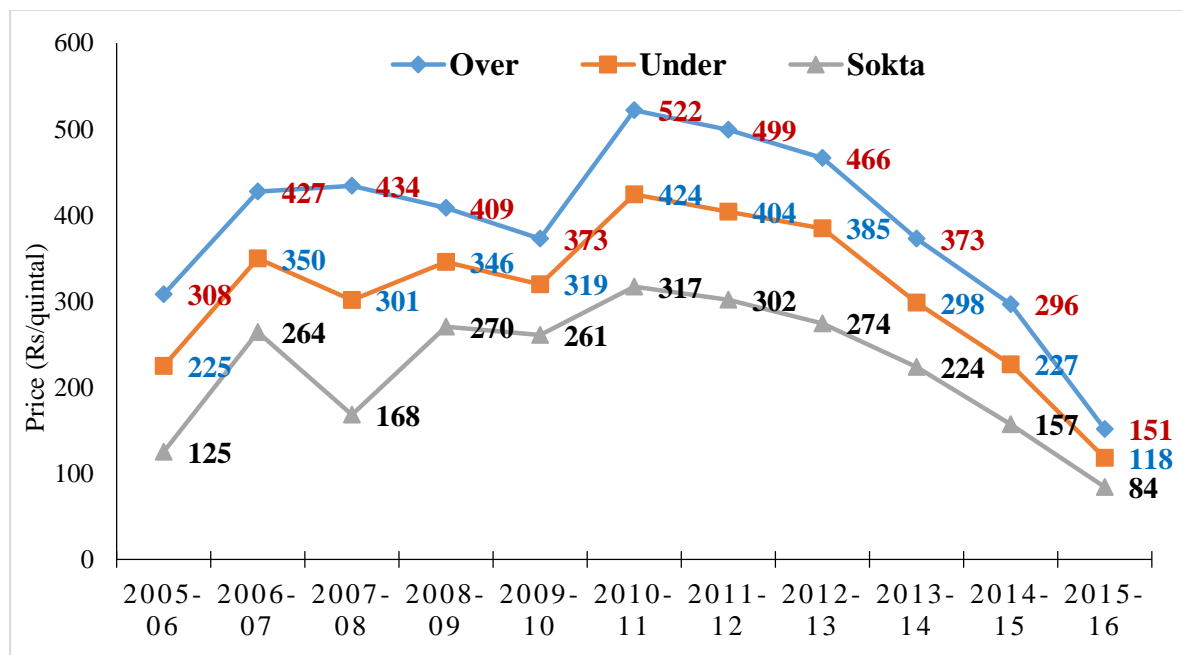
The expansion of area under agro-forestry is a herculean task, because of smaller size of land holdings and obviously the farmers would opt for field crop to meet their immediate / short term income needs. About 85 per cent of farm holdings are small & marginal with average size of 0.38 ha of land in the country (Agricultural Census, 2015). These account for 45 per cent of the arable land.

Tree planting needs more of initial investment and is riskier than field crops. If trees die the alternative means of income generation are limited on the farmer's small landholdings size. The loss of field crops due to tree was reported in majority of agro-forestry models except a few models such as *Prosopis cineraria* based model practised in Rajasthan. Saxena (1991_b) reported that the reduced profit margin due to crop losses was not perceived to be sufficiently high to cover risk of production and of fluctuating wood prices.

The price of the wood is an important factor, which determines the area under plantation of specific tree species on farmland. It is verified by the Country Report (2012-2015) on Poplar and Willows in India. Dhiman (2004) reported that an average of 1.5 to 2.0 million poplar plants were annually planted during 1993 to 1998 which rose further to about 4 million plants per annum during 1999 to 2001. But price crash reversed the trend and reduced the planting to 1.5 to 2 million during 2003.

With the rise in price of poplar wood again, the demand for planting stock grew and area under poplar reached 3.12 lakh ha probably due to poplar wood price peaking around ₹ 1200 per quintal during 2012-2013. The price thereafter crashed again to about ₹ 550 per quintal, and the sale of poplar plants from the nurseries declined to a very low level during the planting season in 2015 (ICFRE , 2016).

Figure 8.1 Trend in real price of poplar wood in Yamunanagar, Haryana-2005-06 to 2015-16



Source: DFI estimates.

The real price (base year 2004-05) of poplar in Yamunanagar Mandi during 2005-06 to 2015-16 is presented in Fig.8.1. It shows that the real price decreased to one-third during the last three and half years of the decade. The highest price for all categories of wood was reported in the year 2010-11, which declined continuously thereafter. It implies that agro-forestry farmers' real income also decreased if they did not experience reduction in cost of production during the corresponding period.

The status of major imports of wood and wood based products in India since 2013-14 is presented in Table 8.4. There was a price crash for wood in the market in the year 2013-14. It showed that despite of sharp price crash of wood, the value of imports of wood and wood-based products increased substantially during the period of 2013-14 to 2016-17.

It is verified that there is trade-off between policy support to strengthen agro-forestry and import policy of wood and wood-based products in the country. Nonetheless, the lion share of raw materials was supplied wood-based industries agro-forestry farmers and they were supported by various input subsidy policy. For example, there is provision of Rs. 10,000 assistance for block plantation of Poplar in the State of Punjab under 'Crop Diversification Programme (CDP) in Original Green Revolution States', a sub scheme of Rashtriya Krishi Vikas Yojana (RKVY) a flagship scheme of Government of India (MoA&FW, 2017). It is ironic that in a country with a wide scope for growing wood as a renewable resource, the country imports wood for its wood based industry (NITI, 2017).

Table 8.4 Import of wood and wood based products in India, 2013-14 to 2016-17

HS code (Harmonised System)	Commodity	(Value ₹ Crore)	
		2013-14	2016-17
44	Wood and articles of wood	16033	13403
47	Pulp of wood	8379	11088
48	Paper & paperboard	14518	18163
Total		38930	42654

Source: Ministry of Commerce and Industry, Government of India

8.6. 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 Agro-forestry Policy (2014) have been addressed through implementation of Sub-Mission on Agro-forestry (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.

The issue of payment for eco-system services (PES) should be resolved on priority and incentive payment for carbon sink to farmers is necessary to encourage them to take to agro-forestry. That this will lead to creation of job opportunities as well as mitigation of environmental issues is an adequate compensation for the additional cost involved. The expansion of carbon credit market will be helpful to enhance farmers' income through adoption of agro-forestry, especially by resource-poor farmers in fragile eco-systems.

Price risk is an important determinant for area allocation to agro-forestry, which can be minimized through policy research, price forecasting for longer period, strengthening of market intelligence, improvement in supply chain, contract/co-operative farming and reducing the distortion in raw wood markets in the country.

It is necessary to include counting of species-wise trees in quinquennial agriculture census for actual estimation of area under agro-forestry.

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.

Research institutions should also be strengthened with appropriate budget allocation, and they should prioritize their research on the basis of estimated return (ex-ante analysis) on investment in terms of welfare of intended clientele group, especially farmers along with other stakeholders.

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.

Chapter 9

Bamboo as a Component of Secondary Agriculture

Bamboo is widely grown in India. With its amenability to multiple uses, particularly as a substitute for the costly timber, demand for it is expected to grow. Bamboo offers an opportunity to the farmers to grow it on their farms and generate additional income. Further, farmers can take up household level value addition activities and create a self-employment window. This chapter examines such a scope.

9.1. Introduction

Bamboos is 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.

The principal bamboo genera occurring in India are Arundinaria, Bambusa, Chimonobambusa, Dendrocalamus, Dinochloa, Gigantochloa, Indocalamus, Ochalandra, Oxytenanthera, Phyllostachys, Pleioblastus, Pseudoxytenanthera, Schizostachyum, Semiarundinaria, Sinobambusa, Thamanocalamus etc. The National Bamboo Mission (NBM) has identified bamboo species grown in India which include Bambusa balcooa, B. bambos, B. nutans, B. pallid, B. polymorpha, B. tulda, B. vulgaris, Dendrocalamus bramdisii, D. giganteus, D. Hamiltonii, D. Strictus, etc. (FSI 2011).

It is distributed across 178 districts of the country and the estimated area is 13.96 million hectare (mha) (FSI 2011). Arunachal Pradesh has maximum bamboo bearing area (1.6 mha), followed by Madhya Pradesh (1.3 mha), Maharashtra (1.15 mha) and Odisha (1.03 mha) (Table 9.1). The yield per hectare in India is around 2 tonnes per annum and compares bamboo very poorly relative to China, Japan, and Taiwan. The reasons for low yield are poor management, unscientific exploitation and low investment in raising preferred bamboo species. It was estimated by then Planning Commission of India, that with the increase in consumption and population the demand for timber as a raw material would increase from 58 million cubic meters in 2005 to 153 million cubic meters by 2020, whereas its supply was projected to increase from 29 million cubic meters in 2000 to 60 million cubic meters in 2020 (Manoharan

2011). This gap is the reason for rising timber prices, presenting an opportunity for bamboo products, widely seen as more eco-friendly and quick in regeneration.

Table 9.1 State-wise distribution of bamboo area density-wise in recorded forest (km²)

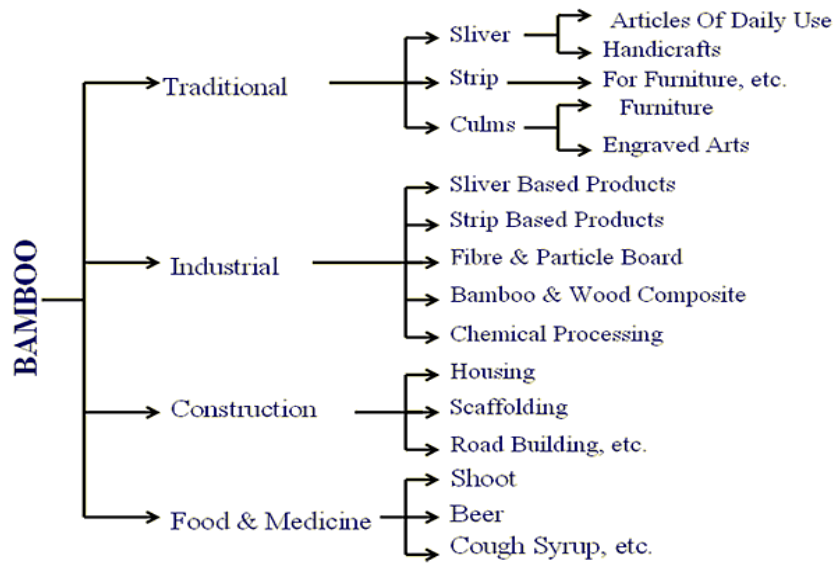
State/UT	Pure bamboo (km ²)	Dense bamboo (km ²)	Scattered bamboo (km ²)	Bamboo present but clumps completely hacked (km ²)	Bamboo regeneration (km ²)	No bamboo	Bamboo bearing area (km ²)	RFA (km ²)
Andhra Pradesh	26	1795	3963	309	2091	55630	8,184	63814
Arunachal Pradesh	217	8681	6953	144	88	35457	16083	51540
Assam	105	4049	2878	166	40	19594	7238	26832
Bihar	1	239	393	75	31	5734	739	6473
Chhattisgarh	54	3046	4577	1496	2195	48404	11368	59772
Dadra & Nagar Haveli	0	15	28	3	9	149	55	204
Goa	0	40	212	12	44	916	308	1224
Gujarat	0	799	2408	367	517	14836	4091	18927
Haryana	0	3	9	7	0	1540	19	1559
Himachal Pradesh	0	37	422	24	25	36525	508	37033
Jharkhand	14	898	1571	509	611	20002	3603	23605
Karnataka	0	1925	4390	297	1574	30098	8186	38284
Kerala	0	461	2105	86	230	8383	2882	11265
Madhya Pradesh	76	2732	5264	2284	2703	81630	13059	94689
Maharashtra	56	2618	4604	1466	2719	50474	11465	
Manipur	192	5825	3101	124	61	8115	9303	17418
Meghalaya	63	2815	1830	68	17	4703	4793	9496
Mizoram	226	6116	2757	104	42	7472	9245	16717
Nagaland	101	3064	1644	65	28	4320	4902	9222
Odisha	35	2479	5230	1066	1708	47618	10518	58138
Punjab	0	5	39	31	0	3009	75	3084
Rajasthan	0	516	1188	333	418	30185	2455	32639
Sikkim	0	481	684	8	8	4660	1181	5841
Tamil Nadu	5	650	1707	130	773	19612	3265	22877
Tripura	67	2039	1079	43	18	3048	3246	6294
Uttar Pradesh	2	311	647	189	164	15270	1313	16583
Uttarakhand	0	67	329	47	8	34200	451	34651
West Bengal	0	362	582	58	40	10837	1042	11879
Total	1240	52068	60596	9511	16162	602420	139577	741997

Note: Information of bamboo bearing area for A & N island, Chandigarh, Delhi, Daman & Diu, Lakshadweep, J&K and Puducherry is not given due to inadequate data. (Source: Forest Survey of India, 2011)

9.1.1. Importance of bamboo

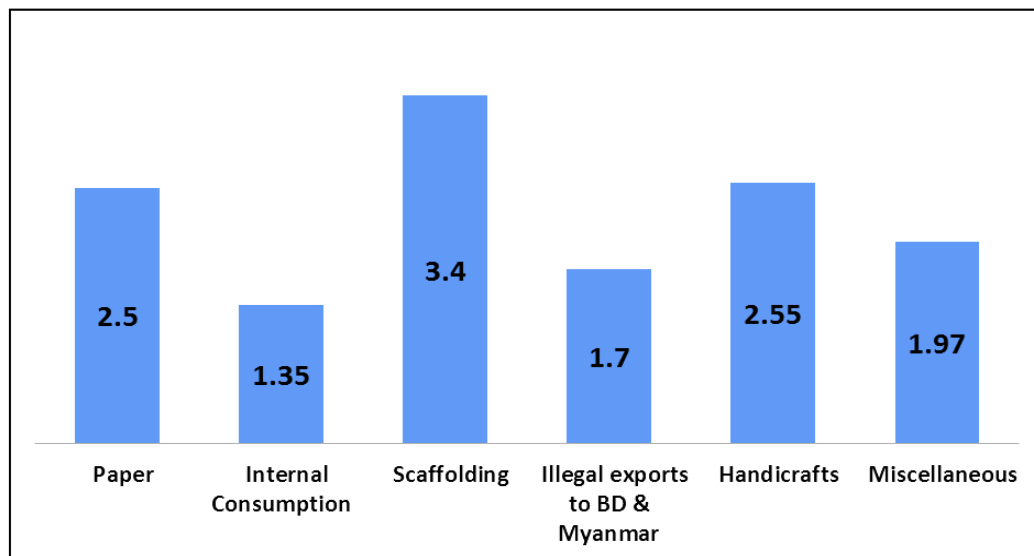
The importance of bamboo comes from its eco-friendliness and large bio-mass production, being a substitute for timber, soil erosion control ability, besides usefulness in maintenance of soil health and amelioration of micro-climate. It is amenable to multiple uses, and is therefore, well suited to value addition activities, generating thereby number of employment opportunities in the rural sector. The numerous uses of bamboos are depicted in Fig. 9.1.

Figure 9.1 Multiple uses of bamboo



The consumption of bamboo in different sectors in the country is depicted in Fig. 9.2 which bring out that 24 per cent of bamboo is being utilized for scaffolding, 20 per cent for pulp and paper, 19 per cent for handicrafts and 15 per cent for miscellaneous items. Illegal export to Bangladesh and Myanmar accounts for 13 per cent of usage.

Figure 9.2 Current usage of bamboo (MT) in different sector



Source: National Bamboo Mission

9.2. 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. Based on studies, the summary of employment potential of bamboo is given in Table 9.2. In terms of income generation, at an average wage of US \$ 2 per day, the annual wage bill will come to US\$ 1,032 million per annum (Swamy 2011).

Table 9.2 Summary of employment potential of bamboos

Use	Quantity	Man-days (Per annum in million)
Silviculture	25000 ha	75.00
Bamboo plantations	6 million tonnes	40.00
Harvesting	6 million tonnes	100.00
Transport/storage/handling	6 million tonnes	30.00
Weaving into products	3 million tonnes	240.00
Industrial labour	3.3 million tones	7.33
Cottage industries	40 000 tonnes	24.0
Total		516.33

Source: Swamy 2011

9.2.1. Exploring bamboo bio-mass for entrepreneurship

Bamboo provides an impressive opportunity as an alternative and sustainable source of bio-mass energy. It also possesses high ability to sequester atmospheric carbon and consequently mitigate climate change and help communities at grassroots to build resilience. Thus, there is an urgent need to recognize the role of indigenous bamboo in landscape restoration and creating livelihood opportunities.

Scope for rural entrepreneurship

Used over millennia for a wide range of day-to-day purposes, both as woody material and as food, bamboo has been the backbone of much of the rural life and will remain so with population increase. Bamboo continues to play an important part in the development of enterprises and transformation of rural environments. Its attributes and potential are being increasingly recognized all over the world. Rural communities with their skills evolved over centuries of usage, have been putting the material to aesthetic yet functional use. The people are also a repository of traditional knowledge, which can be extremely useful in developing the sector for generating income and employment, especially in remote areas and amongst communities, which have tended to be economically and socially disadvantaged.

For tribal communities and forest dwellers, ‘bamboo for living’ and ‘living with bamboo’ is still the norm, which offers an excellent entry point in increasing employment, income generation and improving the nutritional status of the rural poor. Since bamboo can provide the basis for building micro, small and medium-scale enterprises, there exists vast scope for

creating opportunities for gainful employment & income.

Establishment of cottage industries

For economic empowerment of village communities through employment and income generation, different types of cottage and small scale industries can be set up in rural areas based on different form and applications of bamboo.

Primary processing of bamboo

In order to empower the people at grass-root level and also to create employment opportunities in bamboo growing regions of India, setting up of clusters of mechanized primary processing units for bamboo merits attention. These units would be engaged in primary processing of bamboo.

Processing units established at the rural cluster level working with seven machines each for various operations can generate direct employment for about 10 persons. The clustering of units carries several inherent advantages. Clusters developed as hubs could encourage a range of downstream activities like supporting plantation, better harvesting, post-harvest treatment and grading. At the other end of the scale, they could become nodes feeding intermediates into higher value-added industry. Taking into account the present assessments of market potential, a number of clusters could be located in different parts of India, including the north eastern states, keeping in mind the availability of raw material, transportation and communication and proximity to markets.

New generation products

Bamboo requires to be promoted in different product segments to realize its potential both as environmentally preferred material/product and means for employment generation and revenue earning.

Housing and building materials

Bamboo is still a widely used material for rural, low cost and traditional housing. It has been a time tested and valued material for housing and continues to be so for communities in rural and urban areas. It is easy to work with and most importantly, it is affordable and abundantly available. India abounds in excellent examples of traditional, structurally sound, functional and aesthetic bamboo based uses.

As one of the strongest building materials, bamboo based products are a viable replacement for wood as structural material. Bamboo has been used by people since ages in many ways in construction of doors & windows, interiors, furniture, bridges, ladders, fence poles, supports, aqueducts, rafts etc. bamboo in a modern form can substitute plastics, steel and cement for housing needs with the application of sophisticated design knowledge and with the use of improved composite technologies that are available today.

Artificial boards

Bamboo artificial boards are made from primary processed bamboo materials through a series of mechanical and chemical processes. Woven plywood, particle board, floorboard, laminated board, pressed boards, compound board of bamboo and tree timber are some of the products developed showing excellent rigidity and negligible contraction and their structure and size can be easily adjusted according to the constructional and engineering needs.

FRP doors and door frames

With the scarcity of wood for building products, the alternative that merits attention is to manufacture low cost FRP building materials to meet the demands of the housing and building sectors. The doors made of FRP skins, sandwiched with core materials such as rigid polyurethane foam, expanded polystyrene, paper honey-comb, jute/coir felt etc. can have potential usage in residential buildings, schools, hospitals, laboratories etc. As structural sandwich construction has attained broad acceptance and usage for primary load bearing structures, the FRP doors can be manufactured in various sizes and designs using this technology. The FRP doors could be fabricated by various composite fabrication techniques viz. compression moulding or hand lay-up process.

The front and back sheets of the doors are fabricated separately. Wooden inserts are placed between two sheets for various fittings. The PU foam is sandwiched between the sheets by in-situ foaming process followed by painting and polishing to meet aesthetic requirement. Proper usage of additives imparts fire retardant properties to the doors. In addition, usage of composite material for the doors makes them totally water and termite resistant.

Bamboo charcoal and activated carbon

Bamboo charcoal is generally used by gold smiths. Being superior to charcoals from other sources, it is used in batteries. In Japan, bamboo charcoal is used in gardening, as it is believed to preserve the moisture available to plants. Carbonized filaments made from bamboo can be used as light-giving source for certain purposes.

Activated carbon mainly consists of elementary carbon in graphite like structure. It can be produced by heat treatment, or “activation” of raw materials such as wood, coal, peat, coconut shell, bamboo and other plantation wood. During the activation process, the unique internal pore structure is created and it is this pore structure, which provides activated carbon its outstanding adsorptive properties.

Fabrics

Bamboo fibres are the newest thing to hit the textile arena. Bamboo is now being made into a fibre that has wonderful characteristics. It is believed to feel like a cross between cashmere and silk. It has fluidity like silk or rayon and a softness of hand like cashmere. This fabric is naturally anti-bacterial, eco-friendly and is cooler than cotton in warm weather. Hand woven bamboo is the perfect compliment. The folk fashion craze has spurred demand for natural,

handmade-looking textiles that exude warmth, while synthetic fabrics with a sleek look has also got popular in recent times.

Sanitary applications

Bamboo sanitary materials include bandage, mask, surgical clothes, nurses wears, etc. Bamboo fibre has natural effects of sterilization and bacteriostasis, and is therefore widely preferred for manufacturing sanitary materials such as sanitary towel, gauze mask, absorbent pads, food packing and so on. In the medical scope, it can be processed into products of bamboo fibre gauze, operating coat and nurse dress, etc. because of the natural antibiosis function of its fibre. The finished products need not be blended with any artificially synthesized anti-microbial agent. This makes the products allergy-proof and competitive in the market from the price perspective.

Bamboo shoot processing

Bamboo shoot is the young culm of a bamboo harvested at the time or shortly after its appearance above the soil surface. It is rich in vitamins, cellulose, amino acids and trace elements and has the same nutritional value as an onion and is a good source of fibre. The average values for various species from different regions are carbohydrate (4.5%); protein (2.6%); fat (0.3%) and ash (0.9%). Bamboo shoot comprises 90 per cent water with an edible content between 40 and 50 per cents. Most bamboo species produce edible shoots. The shoots vary in size and degree of bitterness and most commercially marketed shoots are derived from a small number of chosen species. The Indian bamboo species suitable for producing shoots are *Bambusa pallida*, *B. polymorpha*, *B. tulda*, *B. nutans*, *Dendrocalamus brandisii*, *D. giganteus*, *D. hamiltonii*, *D. strictus*, *Melocanna baccifera* and *Phyllostachys bambusoides* (Sharma, 1980). Bamboo shoots could be hygienically processed and packaged for a good value-addition. At present bamboo shoots with limited shelf life, harvested under hot and humid seasons, are largely sold in unprocessed form. Some quantities are also sold as dried and are preserved with simple additives like salt and lemon. Value-added bamboo products, especially processed and packaged bamboo shoots have a growing demand in the national and international markets. Value addition to the shoot is done in various ways. *Sweet pickles, chutney and candies* are prepared from the pith of the bamboo shoots. Soft drinks are prepared from stalks of bamboo in China (Yang et al. 2008). Snacks, fried food stuffs and curries are made out of its shoots in Western Ghats of India (Bhatt et al. 2003). Bamboo shoots are canned or frozen for long term storage (Pan, 1995). In many countries bamboo shoots are made into powder and used for fragrance in cookies and other food items. In China, bamboo shoots are processed into juice by pressure-cooking which is used to make beverages, specific liquors and medicines (Qing et al. 2008). In the traditional system of Ayurveda, the silicious concretions found in the bamboo shoots known as banslochan or bamboo manna is known to be a good tonic for respiratory disorders (Puri 2003). The production of bamboo being seasonal with high demand throughout the year, especially in China, Japan, USA, Canada, Thailand, Nepal, Bhutan, Australia and India, there is a need to develop process technologies to preserve the bamboo shoots in consistent and imperishable forms to be used during the off seasons.

Bio-energy

As is the case for all bio-mass, use of bamboo, as a fuel is the last in the 5F' s i.e. after use as food, fibre, fodder and fertilizer. The status of utilization of bamboo in India is however at the primary level and with increased development in the usage, there is expected to be surplus available for use as a fuel or newer uses. The gases obtained by converting biomass into usable form of energy by gasification can replace diesel up to 70 per cent for a DG set thus catering to energy needs. The by-products of bio-mass gasification in the forms of volatiles are rich sources of chemicals. Also conversion of bamboo waste into charcoal by carbonization can supplement rural energy needs.

Promotion of bamboo cultivation through agro-forestry

Bamboo is not only grown in forests but is also raised in homesteads and farms. Forest Survey of India (2011), estimated about 2127 million culms outside forests with an equivalent weight of 10.20 million tonnes. Eastern Plains contribute maximum number of culms (943 million), followed by North East (289 million) and East Deccan (202 million). The equivalent weight was also maximum in the Eastern Plains (4.07 m tonnes) followed by North East (1.72 m tonnes) and East Deccan (0.97 m tonnes). Of all the clump forming bamboos, *Dendrocalamus strictus* is 45 per cent, *Melocanna babusoides* is 20 per cent, *Bambusa bambos* is 13 per cent, *D. hamiltonii* 7 per cent, *B. tulda* 5 per cent, *B. pallida* 4 per cent and all other species put together 6 per cent of the total growing stock. Bamboo can be planted under agro-forestry system where each plant receives individual care, and shows promising results. The current market demand and supply gap is a trigger for active promotion of the cultivation of bamboo outside the conventional or natural growth areas by adopting agro-forestry models which incorporate bamboo as a crop component. Bamboo based agro-forestry is useful for the farmers, as they stand to benefit from more than one sources of income from the same piece of land. Bamboo leaves may be used as fodder not only during lean period but throughout the year for the ruminants in particular in the fodder deficit areas. Shade loving crops such as turmeric, ginger, colocasia can be grown as inter-crops in bamboo based agro-forestry systems.

9.3. 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.

9.4. Issues in Promotion of Bamboo

Though there exists significant diversity in bamboo species and bamboo growing eco-systems across the states, both area and production in the country has been on the decline due to various issues such as over-exploitation by industries, forest fires, grazing, shifting cultivation, species displacement, gregarious flowering etc. (NBM, 2007). Some of key issues in this sector are:

Lack of awareness

Despite the high economic potential of bamboo and its substantive utility in the rural areas, it is yet to occupy its deserved status. There is a need for changing the 'forestry mind-set' to the 'farming mind set', and creating awareness on the commercial viability and profitability of the bamboo species. Research results available in the public and private domain do not regularly reach the farmers due to lack of a dedicated extension system. In this regard, extensive awareness and capacity building programmes are required at all levels viz. farmers, extension workers, village level societies, tree growers cooperative societies etc. With the recent amendment to the Indian Forest Act, 1927, releasing bamboo from the scheduled list of tree the scope for promoting it as a farm activity has improved. For it now does not need felling and transit permit.

Low priority for bamboo

Bamboo is a key species found in the forest areas. However, the focus of management of forest area is mainly on long rotation species like sal, teak, conifers and other economically important tree species. Bamboo therefore needs to be placed as a key species in the development agenda of forest areas having good bamboo density / population, notwithstanding the amendment.

Lack of database

Lack of reliable data on growth, bio-mass, productivity, growing stock, area is adversely impacting the resource strengthening initiatives in the country. Majority of growth and bio-

mass data available is only on one or two species i.e. *Dendrocalamus strictus* or *B. bambos* and *Melocana baccifera*. Further, the available data, is largely based on inferences drawn from the bamboo sale data maintained by the state forest departments. The removals by right holders, that form significant part of the annual bamboo production, are generally not included in these accounts. The present system of using different units viz., metric tonnes/notional tonnes/cubic metres/ numbers by different states make it difficult to collate data at national level. Thus there is urgent need of data management based on actual removals of bamboo from forests, both by right holders for domestic consumption and by the forest departments for commercial purposes. Efforts are also required to adopt uniform unit for recording bamboo harvest and sale data.

Limited choice of species and non-availability of quality planting stock

Choice of the species is one of the major constraints in ravine region of India. So far, two species viz., *D. strictus* and *B. bambos* are dominating the plantations. These species though hardy have lower productivity as compared to commercial. New species of bamboos, having proven track record of higher yield which could grow successfully under different climatic and edaphic conditions thus need to be screened for higher yield. Research conducted under NMBA sponsored project have revealed that *D. hamiltonii*, *B. balcooa*, *B. vulgaris* have higher productivity in sub-tropical conditions of the country.

Lack of quality planting stock

Quality planting material such as seeds, seedlings, clones, improved varieties, etc. are not available making it a major constraint. Due to gregarious nature of flowering, seed is not easily available and has to be procured from suppliers whose quality is not known. Vegetatively propagated plants are also not available for planting in the region. Majority of plantation in India is being raised from seed obtained from unknown sources with no mechanisms to certify the productivity credentials of its source. There are no nurseries where planting materials can be easily available. There is immediate need to initiate comprehensive programs for screening and developing genetically superior germplasm in respect of commercially important bamboo species, and making available the superior germplasm on mass scale through macro and micro propagation methods. Further, there is need to extend farmer-friendly propagation technologies through training programs.

Non-availability of quality planting stocks

This is one of the most important reasons as to why bamboo has not grown up to its potential. Since seed availability of good bamboo spp. are rare today, farmer wanting to raise bamboo clumps, does not know whom to approach. Some NGOs and state forest departments might be maintaining nursery plants of *D. strictus*, and *B. bambos* but these are not favoured by the farmers. Thus, to make bamboo cultivation successful, easy availability of planting materials by establishing decentralized nurseries of the preferred sp. is a pre-requisite. This will also provide an opportunity for promoting nursery as an enterprise.

Genetic improvement

No attention has been paid for genetic improvement for enhancing productivity, either by hybridization or by selection. The Forest Departments which control the production, sale and movement of bamboo have neglected these tree crops, because they are still considered as a minor forest produce. Genetic and breeding research to improve productivity through selection of superior clones is the need of the hour. Inter-varietal, inter-specific and inter-generic hybridization methods thus need to be taken up on urgent basis.

Need for rehabilitation of bamboo flowered forests

The poor rehabilitation of many bamboo areas in the country post-flowering is an important area of concern. Majority of the flowered bamboo areas come under weed infestation and the stocking of rehabilitated areas is drastically reduced. Protection of gregariously flowered area, provide conducive / suitable environment for the regeneration. Successful regeneration of such areas largely depends on cultural / silvicultural operations carried out from time to time after initial establishment of young shoots in the area. This removes broken / damaged culms and facilitates proper growth of new culms by providing sufficient space. There is an urgent need to initiate and implement focused programs to develop and rehabilitate the bamboo-flowered areas on-field demonstrations and establishment of clonal nurseries at farmers field.

Need for encouraging scientific bamboo farming

The growth and development of bamboo bearing forest areas is largely dependent on treatment provided to the area. In Indian forest, due to lack of proper management, majority of the bamboos show congestion which adversely affects the growth of rhizomes and lesser number of shoots come up due to competition for space. (Improvement work in bamboo coupes reduce the competition for space as broken/damaged culms are removed in the process and sufficient space is created for better growth of clump). The bamboo as an agro-forestry crop has been reported to have good potential for enhancing its production in the country. High density bamboo plantations have also good potential to meet energy requirements. The bamboo development policy announced by the National Bank for Agriculture and Rural Development (NABARD) clearly identifies bamboo based agro-forestry models in the scheme of financing models developed by it for promotion of the bamboo sector with an integrated approach. The strategy focuses on launching of interventions and developing business opportunities in the untapped domain of waste land development with suitable agro-forestry or farm forestry approaches. Therefore, there is urgent need to develop sound and replicable protocols and promote scientific farming of different bamboo species, including for high density plantations, across different agro-ecological zones in the country. These protocols would need to be based on selection of right species, assurance of quality planting material, improved management practices including irrigation, fertilization, pest management, and harvesting regimes.

Harvesting and transport restrictions

The full potential of the bamboo sector in the past was not utilized due to the problems being

faced by the cultivators like restrictive regulatory regime, requirement of permission for felling, transit and processing, export restrictions, royalty and transit fee on the products etc. These restrictions were basically designed to prevent pilferage from government forests, but they discouraged farmers / entrepreneurs from raising bamboo on their private wastelands on commercial basis. However, recently Government of India cleared an ordinance amending Indian Forest Act, 1927 which omits bamboo grown in non-forest areas from the definition of trees thereby exempting such bamboo from the requirement of felling/transit permit. This move will allow free movement of bamboo and would generate the demand for raw material leading to planting of bamboo trees on non-forest land, provide employment and encourage growth of small and medium industries in the villages and smaller towns, and reduce dependence on imports. Bamboo grown in forest areas shall however, continue to be governed by the Forest Conservation Act, 1980,

Need for value addition

Most of the handicraft sector in bamboo is traditional due to which the production level is low. For production of bamboo handicrafts, huge quantity of splits, sticks and semi-processed raw materials of various specifications are required which presently are obtained by manual processing of whole bamboos by artisans. This results in avoidable wastage and reduces the quality of the end product. Therefore there is immediate need to provide ready-to-use raw material including housing material, improved tools, machinery/skill development so that production can be enhanced without compromising with the quality.

Promoting bamboo as wood substitute

Bamboo has good potential as a substitute for timber. It can be used for plywood, various board products such as block board, wafer board, strip board, laminated boards, roofing sheets; earthquake-resistant housing and buildings; bridges, culverts, retaining walls, telephone/electricity poles; furniture; fuel-wood, charcoal and briquettes, active carbon; matchsticks, agarbattis, toothpicks, skewer sticks, etc; schooling: pencils, rulers, blackboards; pulp and paper, particle board, MDF, handicrafts etc. Bamboo based technology has attracted attention of a number of entrepreneurs and few industries have already been set up in the country. However, positive policy and technological initiatives are necessary to accelerate the use of bamboo encouraging their use in public sector where currently wood is banned, development of application techniques for various end products and evolution of code particularly in housing, construction, transport; dissemination of information about their utility through demonstration and exhibitions. Considering the vast social and environmental implications and employment potential, a policy thrust at national level is necessary for development of bamboo resources in general and promotion of bamboo composites in particular. The Restructured NBM can be expected to address these issues.

Marketing prospects

Global demand for bamboo is expected to rise. Though Indian landscape represents 45 per cent

of the global bamboo growth, the current market share enjoyed by the Indian bamboo products is merely 4.5 per cent of the global market share. There is a wide gap between demand and supply. The demand is only expected to grow benefitting 8.6 million people who depend on bamboo for their livelihood. However, reports suggest that, the bamboo value chain in India is suffering from different challenges at different levels of the value chain. The major constraints include over- exploitation, poor regeneration, low productivity, variety management and lack of market information, base line data deficiencies, labour availability, capital intensive production process, fragmented nature of the industry, undeveloped markets, poor quality perceptions and low level of awareness etc. Owing to these constraints, bamboo utilization in India is by and large confined to the cottage industries; micro home based enterprises such as handicrafts, and the traditional bamboo consuming paper and pulp industries (Baksy, 2013). To encourage the small farmers to take up bamboo plantations on their private wastelands, the marketing infrastructure (market yard, etc.), including “price discovery” mechanisms for bamboo needs to be encouraged. Presently, it is largely a buyer’s market and the middlemen get the major share in profit. There is a need to promote bamboo based industries in states having major ravine areas.

Policy for leasing revenue degraded ravine lands and liberalization of ceiling limits/restrictions

A large portion of degraded ravine lands, which could be profitably used for raising bamboo, are under the control of the Revenue Department/ Forest Department. Such lands are neither being developed by the Department nor leased away to the interested entrepreneurs for development. These lands can be economically utilized for promoting bamboos. Further, statutory ceiling limits on agricultural land holdings for wastelands may be considered for liberalization. Plantation of bamboo should be treated on par with plantations of commercial crops like rubber, tea, coffee, etc. for this purpose. Long term finance, fiscal incentives and tax benefits should be provided to promote technology based reforestation and farm forestry projects. For encouraging growth of bamboo sector in the country, import duties also need to be rationalised.

Capacity building

Bamboo is generally viewed as a group of plants having vast potential for improving socio-economic condition in rural areas in the country through its use in craft. There is, however, a need to create capacity of the people to develop high value bamboo articles. It is recommended that wide ranging national programs to build capacity of the rural artisans in bamboo craft be initiated towards developing bamboo based cottage industry in the country and enhancing cash incomes of rural artisan. Cottage industry holds a prominent position next only to agriculture in the rural economy.

Road map for promotional strategies

The diverse agro-climatic regions of the country and large number of industries using bamboo as raw material, offer vast scope for increasing both area and production of bamboo. Towards

this, it is necessary to develop and promote a linkage among different stakeholders for a complete value chain for the large scale bamboo plantation under different land use systems. This linkage can be developed by constituting a consortia of research institutes, nursery growers, farmers, bamboo based industries, financial and insurance institutes backed by a strong policy framework ensuring buy back of farmers' products at reasonable price and regular capacity building programme. The research institutes can develop and provide complete package of practice for growing different bamboo species and screening of suitable germplasm which can be multiplied on large scale by certified nurseries for growing by the farmers. The financial institutes such as NABARD and insurance sector can provide finance facilities on line with agriculture crops & commodities. The marketing issues can be resolved through buy back assurance by industry. A strong database on availability of bamboo growing stock in farmers' field and requirement of industry can help in promotion of bamboo at a faster rate.

9.5. Bamboo as Secondary Agriculture

The strategy for promoting bamboo cultivation as a farming activity has been discussed in the previous sections. 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.

As discussed in section 9.2, 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.

Chapter 10

Agri-tourism

A large section of Indian population is enjoying enviable purchasing power. This section that largely dwells in urban centres is caught in the vortex of machine-like personal life and tension-filled professional life. It is looking for stress-bursting and nature-centric tours outside the hustle and bustle of a metropolis. In parallel, the farmers living amidst the nature are looking for respectable avenues that can engage them gainfully and bring in additional incomes without having to leave their roots. Agri-tourism offers such an opportunity of integrating the two different sections and situations.

10.1. A context for Agri-tourism

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

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

The tourists can also enjoy hands – on experience by engaging themselves with activities such as bullock cart rides, milking cows and goats, fishing and picking farm fresh fruits and vegetables etc. In a way it would enable them to connect with their roots, from where their earlier generations may have begun the journey of out-migration. Below are placed some definitions of agri-tourism from different perspectives.

According to World Tourism Organization (1998) Agri-tourism:

“Involves accommodation being offered in the farm house or in a separate guest house, providing meals and organizing guests activities in the observation and participation in the farming operations”.

Agri-tourism from the farmers' perspective is considered as:

“A range of activities, services and amenities provided by farmers and rural people to attract tourist to their area in order to generate extra income for their businesses”.

Agri-tourism from the tourists' view point means:

“Anything that connects tourists with the heritage, natural resource or culinary experiences unique to the agricultural industry or a specific region of the country's rural areas”.

Broad worldwide overview: Agri-tourism is a form of niche tourism that is considered as a growth industry in many parts of the world, including Australia, Canada, the United States, Srilanka, and the Philippines. It often overlaps with Eco-tourism, Geo-tourism, and Heritage-tourism, but retains its exclusive identity.

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

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

10.2. Agri-tourism in India

Agri-tourism has been growing as a niche activity, particularly in the western world over the last century. As a concept, it is therefore not new. In India too, there have been some beginnings, but is yet to blossom as a mature activity. The scope for its growth in India is provided by the following advantages:

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

10.2.1. Agri-tourism Development Corporation, India

The seeds of agri-tourism in India were first sown by formation of Agri-tourism Development Corporation, India (ATDC, India), and is located at Malegaon, Baramati in Maharashtra. It was founded in 2004 by Shri Pandurang Taware, an entrepreneur and descendant of a farming community. ATDC is a company that facilitates agricultural tourism in Maharashtra, and promotes it as a means of diversifying business opportunities and securing a viable livelihood for the farmers. Following a phase of research and an initial pilot programme in a village of Baramati district in 2005, ATDC has grown to a substantive size with 500 number of trained farmers and 152 agri-tourism locations across the state of Maharashtra. Since its inception, farmers across the state have gained a 25 per cent growth in their income.

ATDC offers farmers agri-tourism training programmes which equip them with the technical & professional knowledge needed to establish farm-centric tourism ventures. It advocates a policy of employing local youth at its agri -tourism guides and specifically contracts women for food preparation services through organized Women Self Help Groups. ATDC has established close links with the state government, and has been successful in arranging a preferential loan policy for the agri-tourism farmers from the Pune District Central Cooperative Bank. It has introduced competition and awards for its agri-tourism centres. ATDC itself has won a number of national and international awards.

10.3. Scope to Grow Agri-tourism

Agri-tourism has great scope for growth in the present context of India, on account of the following reasons:

- An inexpensive gateway - The cost of food, accommodation, recreation and travel is minimal and can broaden the tourist base, beyond the rich and monied.
- Curiosity about farming industry and life style - The urban population with earlier or even current roots in villages are drawn to agri-setting characterized by novel sources of food, plants, animals, raw materials like wood, handicrafts, languages, culture, tradition, dresses and lifestyle specific to farmers, villages and agriculture.
- Demand for wholesome family oriented recreation - Villages can provide recreational opportunities to all age groups i.e. children young, middle and old age, male, female, in a wholesome manner and at affordable cost. Rural games, festivals, food, dress and the nature can offer variety of entertainment de-stress environment to the entire family.
- Health consciousness of professional and urban population - Modern lifestyle engenders lot of stress. Hence, many engaged in busy professions and confined to large urban habitats are in constant search of pro-nature outings. Ayurveda which is a nature-centric approach to wellness has roots in villages. Indigenous medical knowledge and organically/naturally grown food articles can be savoured too. These are strong allurements to outside visitors.

- Desire for peace and tranquility - Modern life based on materialism means a disturbance of their life's evenness. Peace and tranquility are inbuilt in Agri-tourism as it offers a different environment where time appears still and quiet.
- Nostalgia for their roots on the farm - Cities are growing at the cost of villages. Villagers are migrating to cities in search of jobs and to seek the comforts of modern life. Hence, yesterday's villagers are today's urbanites. Deep in the heart of urbanites lies the love and respect for their ancestors and villages. Agri-tourism offers them an opportunity to enjoy the nostalgia and connect with their roots.
- Rural recreation - Villages built predominantly around agriculture offer a range of recreation through festivals and handicrafts. Villagers (farmers') lifestyle, dress, languages, culture / traditions are an enriching experience. Agricultural environment around farmers and the entire production process could create curiosity among the city dwellers. Places of agricultural importance like highest crop yielding farm, highest animal yielding farm, processing units, innovative farms etc can provide their own exclusive experience. Agricultural products like farm gate fresh market, processed foods, organic food could lure the urban tourists. This will generate space for developing agri-tourism products like agri-shopping, culinary tourism, pick and own your tree / plot, bed and breakfast, pick and pay, bullock cart riding, camel riding, boating, fishing, herbal walk, rural games and health (ayurvedic) tourism etc.
- Educational value of Agri-tourism – Agri-tourism can create awareness and knowledge about rural life and agriculture science as practised among urban school children. It provides a healthy alternative for school picnics, opportunity for hands-on experience for urban college students in agriculture. In general it will mean education through entertainment. Seeing is believing, doing is learning is the concept of Agri-tourism.

10.4. Business of Agri-tourism

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

i. Have something for visitors to SEE

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

ii. Have something for visitors to DO

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

iii. Have something for visitors to BUY

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

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

10.4.1. Three basic bricks of Agri-tourism

- i. Farmer – Relatively, farmers are less educated, less exposed and innocent. Any outsider is a guest and is treated wholeheartedly in a very simple but warm manner by the rural folk. With some orientation in hospitality and public hygiene, they can become desirable hosts.
- ii. Village – situated far from the madding crowd, rural habitations are blessed with natural resources. Investments are made by nature in the form of water bodies, fields, forest, mountains, deserts and islands. The community structure is more homogenous and treating guests is part of the culture. With good connectivity to the outside world, basic infrastructure inclusive of power and civic amenities, these sylvan settings can attract tourists.
- iii. Agriculture – is an expansive and variegated profession that is worthy of visual and mental experience. Its dimensions comprising land, water, plants and domestic animals tended to by the simple farming community create a picturesque scene. Indigenous knowledge of rural people is a wealth, which can add richness to the tourist experience.

10.4.2. Six basic steps to a business model

An enterprise based agri-tourism is successful when it plans in all aspects including marketing. The following six (6) basic steps are suggested as a guide.

- i. Collection of data, analysis of situation and pre-emptive problem assessment.

This is the basic stage, at which the potential entrepreneur makes an analysis of his farm condition to recognise the opportunities for agri-tourism on his farm, besides identifying the facilities needed, potential problems and solutions.

- ii. Personal and project feasibility evaluation.

Personal evaluation helps a potential entrepreneur determine why he or she is considering an agri-tourism business. It is important to clearly identify and prioritize one's goals for the new venture, as well as the special resources and skills that he/she possesses. Project feasibility

evaluation addresses the technical and the financial viability concerns.

iii. Market & financial evaluation

This includes identification of potential market and the target tourists. The purchasing power varies and one should be clear as to the target visitors. Investments will need to be made accordingly. Unlike traditional agricultural products, agri-tourism includes a service or experience as well as merchandise, and hence calls for different skill sets.

A budget needs to be carefully developed, preferably with the assistance of a production specialist and a business planning specialist. In financial evaluation, a proper outlay of budget is prepared.

iv. Developing a business plan

A clear business plan is what a banker asks for from a loan seeking entrepreneur. The business plan should include detailed information on the personal, market demand, project feasibility, and financial evaluations. It must contain a detailed statement of proposal of Expenditure (establishment and maintenance cost) and Income (admission/tour fee, activity charges, sales of fresh produce, sales of processed products, show charges and halting charges).

v. Regulation, permit and insurance

A permit from State Tourism Department or other line department or from an Apex organization for agri-tourism (if there is one) is a pre-requisite. A permit/registration will make the firm eligible to get insured against any unpredictable calamities.

vi. Marketing strategy

The market mix strategy for the promotion of Agri-tourism concept consists of:

- a. **Product** - The product in Agri-tourism is seeing, believing and ultimately experiencing. This experience can be simple but unique. The experience of climbing a tree, buffalo riding in the pond and enjoying the sugarcane juice in the field is by itself unique to a tourist from a different culture.
- b. **Price**
 - Customer segment pricing – Depending upon the nature of tourist, price differentiation can happen. For example, bullock cart riding might be an entirely new experience to someone from outside the country, while not so for a city dweller in India. Pricing may accordingly be structured.
 - Location pricing – Pricing in Agri-tourism depends upon location and importance. Agri-tourism which offers agriculture and rural life alone without any already additional advantage of a well-known tourist spot in close proximity can charge normal pricing. Whereas, Agri-tourism spots are very close to established tourism hot spots like

temple towns, hill stations, large water bodies, mountains, etc may be able to charge higher. As the price tariff in reputed tourism places is already high, it may work out cheaper for a tourist to stay at on-farm homes and visit the more well-known benefitting himself twice over.

- Time pricing – Agri-tourism units can demand higher chargers in peak season i.e. November to January and around special events like festivals, harvest seasons etc.
- c. Place** – The place where tourists are accommodated also influences the pricing. If a farmer-entrepreneur has created dedicated lodging infrastructure on his farm, even high tariffs will be accepted.
- d. Alliances** – Promotion of Agri-tourism and strategic alliance can take place at two levels:
- Alliance with airlines, tour operators and foreign embassies – It may not be possible for individual farmers to build such alliances. Central and State Tourism departments / corporations or private tour operators can build such alliances and integrate individual service providers into their network after registering them appropriately as ‘home stay facilities’.
 - Alliance with hotel industry – Large number of domestic tourists can be attracted through alliance with hotel industry.
- e. Policies** – Some of the policy initiatives for promotion of Agri-tourism are:
- Policy Guidelines and Capital facilitation
 - Orientation & training in hospitality
 - Training & building a brand of Agri-tourism
 - Building basic infrastructure
 - Ensuring safety & security of the tourists.
 - Product and service quality control

Like any other consumers, tourists visiting farms also demand value for their money. Hence, the importance of meeting the expectations in delivery of services and products. The challenges of agri-tourism in this regard are possible lack of knowledge about the importance of these among the first generation entrepreneurs.

10.4.3. Hypothetical model for Agri-tourism with proposed components.

i. Crop components

Standing crops are a major attraction for the tourists. It should preferably show case perennial crops, fruiting trees, flower crops and annual / seasonal crops, such that farmers can engage the tourists in farming activity.

ii. Activity component

- Includes a conducive site for conducting recreational activities and rural games.
- Showcase cultural and folklore programmes with local flavour in the evenings.

iii. Food

The Agri-tourism centres offering delicious traditional and village style cuisine add to the attraction of the centre. The tourists can be facilitated to prepare their own menu and cook in local style with some help.

iv. Accommodation

The accommodation facilities must be simple, safe, secure and clean. The guest house which accommodates about 15-20 tourists at a time is economical and gets remunerative income. There can be individual accommodations too.

10.5. Recommended Strategies

i) Establish 'Quality Standards' - For agri-tourism in India to be credible, specific efforts are needed in developing a quality standards system. These are standards which should guide general business requirements (i.e. meeting health standards) as well as relate to customer service and products sold. Several of Indian tourism businesses have developed various 'Codes of Conduct', which can be actively promoted.

ii) Encourage use of 'Quality Standards' - The key to ensuring the effectiveness of this initiative is training and awareness of what constitutes a quality product. The apex organization in association with agri-tourism operators should build a consensus around a standard code of conduct and ensure adherence in delivery of agri-tourism products and services. As part of the establishment of quality programs, an industry based assessment program to audit quality of on-site safety and health environment could also be developed.

iii) Develop and promote thematic images of Indian farm experiences - The creation of a world-wide image of Indian agri-tourism experiences will help strengthen growth opportunities and provide new marketing avenues. Such an approach was successful for other tourism sectors including Incredible India, Kerala Tourism, Goa Tourism, etc.; specific to agri-tourism, the Maharashtra region has been successful in increasing the awareness of its farm touring experiences.

iv) Create marketing materials - To support the image of Indian farm experiences, innovative marketing materials will need to be developed for distribution and awareness generation.

v) There are media avenues that individual farmer and agri-tourism associations can use to reach a wider marketplace. Examples include TOURISM DEPARTMENT website, or toll free number or call centre which can be easily accessed by the public; product guide placed at all visitor information centres; and regional tourism association brochures. Similarly, communication channels can be developed between agri-tourism operators and consumers.

vi) Conflict management programmes - While agri-tourism can create business opportunity for the farmers, it can also generate conflict between primary farming pursuits and leisurely travel activities. This has to be handled sensitively. There can be issues of noise, smell, farming practices, annoyance of behaviour, and disease control. In each of these situations, it is important to establish clear communication strategies on what should be expected on-site with respect to the character of the agri-tourism experience. It calls for developing policies and guidelines for agri-tourism that address effective ways of managing public relations associated with such events.

10.6. Conclusion and Recommendations

Agri-tourism is complimentary to traditional agricultural activities. It is an opportunity for farmers to use the available resources in a diversified and innovative way. It holds the potential of creating a win – win situation to farmers as well as tourists. Agri-tourism enables unraveling of the various facets of rural life around farming. The youth in particular can be specially trained and supported to take up agri-tourism as a service enterprise.

Government can set up dedicated wing within the Central and State Tourism Departments / Corporations to promote this enterprise. The eco-tourism being promoted by State Forest Departments and agri-tourism can be promoted in alignment with each other.

Chapter 11

Mushroom Cultivation as an Enterprise

Mushroom cultivation requires less land, utilises waste from other farming activities and provides potential to enhance farming income. As a stand-alone enterprise, it presents opportunity to small or landless farmers. Mushrooms are also a high nutrient and high protein crop with rising market demand.

11.1. Introduction

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

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

Since mushroom cultivation is not capital intensive, farmers with poor financial resources, including those with no land of their own can practise mushroom growing. It is worthwhile to note, that young and aged people are more likely of considering mushroom enterprise as an economic activity. As an enterprise mushroom cultivation is well suited to the educated rural youth. The lean period of agriculture activity in between rice-wheat cropping system offers the farming community a scope to use their labour as well as unutilised crop residue resources to get gainful returns through mushroom cultivation.

Income enhancement for the farmers can be achieved by thinking beyond the conventional methods of monetary returns in agriculture. Mushroom cultivation with its potential for monetisable output by using agricultural wastes can become an important avenue for utilization of a farm family's slack time.

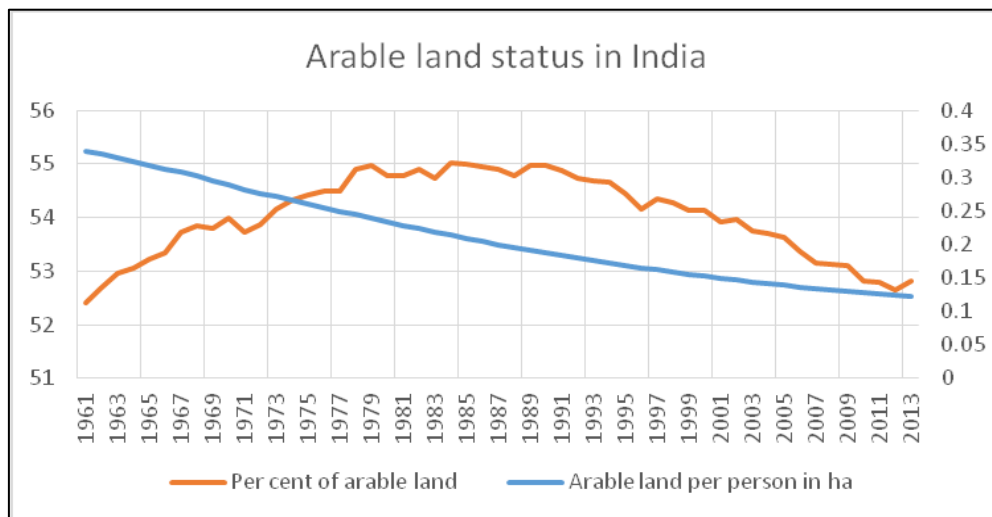
A survey conducted by Indian Standard Market Research Bureau in 2016, showed that protein intake of 88 per cent of people was less than the ideal amount of consumption. The problems of malnutrition and under-nourishment are posing a silent but potent challenge to the nation's

demography. While, the role of pulses has been sufficiently highlighted, the emphasis on potency of mushrooms as a protein rich food is yet to be appreciated.

11.2. Less Pressure on Land for Protein Production

The demand for land by other sectors has led to reduction in the share of arable land to 52.8 per cent (2013) from 55.0 per cent in 1985 (Fig. 11.1). Coupled with increasing pressure of population, the per capita land availability in India has reduced from 0.34 ha in 1961 to 0.20 in 1985 and further down to 0.12 ha in 2013 (World bank report, 2018). The similar trend for few more years will put increasing pressure on land availability which can jeopardize the farmer's income levels. In the context of increasing pressure on land mushroom cultivation as a horti-business entrepreneurship assumes special significance, as it is least dependent on land area but produces highest quality protein per unit area.

Figure 11.1 Per capita land availability (ha) and share of arable land in the total land area.



11.3. Input use efficiency

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

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

Mushrooms cultivation has great relevance at the ecological level. It utilises farming waste to

create value and the remaining substrate is recycled as manure in fields. Not only is the production a marketable item, but the subsequent waste helps improve soil health, and minimises the need to use chemicals in other farming.

11.4. Post-harvest Management and Processing

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

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

The ICAR-Directorate of mushroom research, Solan through its extension and outreach activities has been organizing mushroom consumption fairs and campaigns for popularisation of mushroom recipes and value added products. Similar event organised at ICAR-IARI in February 2018 showcased the untapped possibilities and opportunities in mushroom processing by displaying the diverse mushroom products prepared by ICAR-DMR and many entrepreneurs trained by DMR, Solan. Such kind of events on one side will generate awareness among policy makers about unique benefits of mushroom consumption and on the other hand will spiral new interest among the innovative entrepreneurs to explore social enterprises of providing nutrition security to unprivileged masses and realising additional financial returns.

11.5. Marketing

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

treated as a viable and attractive activity for both rural farmers and peri-urban dwellers.

Compared to consumption level of edible mushrooms at the global level and in many advanced countries, Indians are below par in its consumption. The per capita mushroom consumption (90 g) in India is abysmally low compared to the per capita consumption (3,860 g) in many developed countries (Wakchaure, 2011). Even though, India ranks second in terms of global vegetable production, its mushroom production and consumption do not match many other vegetables. Hence, mushroom is not likely to face any marketing challenges of price risk in the near future, at least for fresh mushrooms. The growing urbanisation and lifestyle related diseases have augmented the importance of mushrooms as health food. Further, the diversity of mushroom varieties will diversify and exhibit the consumers table with respect to taste, aroma and unique medicinal and nutritional properties of each mushroom variety. Demand for, mushroom is growing, and there is ample opportunity for the expansion of its market.

Mushroom production can also be adopted either as an agri-business activity with environment-controlled production unit by the resource rich farmers, or as a livelihood activity in case of small & marginal farmers, as also landless agricultural labour. Production of ready-to-fruit-bags for home cultivation will add an additional dimension in urban horticulture.

Figure 11.2 Edible mushrooms grown commercially in India



Button mushroom Oyster mushroom Shiitake mushroom



Paddy straw mushroom Milky mushroom

11.6. Mushroom cultivation is a round the year activity

Many farmers in Northwestern India have adopted mushroom cultivation as a regular farming activity during winter. The use of low cost mushroom houses made from bamboo, paddy straw and other cheap raw materials has made huge difference to their income levels. In recent times, the practice of adopting tropical mushrooms like *Pleurotus* spp. and *Calocybe indica* adjusting

to the prevailing climate and using the same facilities has helped the farmers in getting round the year returns, compared to the earlier times, when it was a mere seasonal activity in the earlier days. Extending mushroom cultivation beyond winter has turned its growing as a round the year activity. Earlier it used to be a four months activity limited to growing white button mushroom alone. However, still mushroom industry is dominated by the production of white button mushroom and it is contributing upto 73 per cent of total mushroom produced in India (Sharma, 2017).

Tropical and subtropical mushrooms such as oyster, paddy straw mushroom, milky mushroom, etc. are not cultivated on a larger scale. It is a fact that, due to the varied agro climatic conditions prevailing across the vast geographical location of the country, all mushrooms can't be grown in every region. The practice of multiple cropping, using the principles of crop rotation can also be practised in case of mushroom cultivation by understanding its temperature requirements.

Table 11.1 Temperature requirement of major edible mushrooms under cultivation in India

SN	Type of mushroom	Substrate	Temperature (Vegetative phase)	Temperature (Reproductive phase)
1	White button mushroom	Composted substrate	24-26 °C	16-18°C
2	Oyster mushroom	Pasteurised paddy straw/ wheat straw	24-26°C	16-28°C
3	Paddy straw mushroom	Pasteurised paddy straw/ cotton waste	30-32°C	32-35°C
4	Milky mushroom	Pasteurised paddy straw/ wheat straw	30-32°C	32-35°C
5	Shiitake mushroom	Sterilised sawdust enriched with cereal bran	24-26°C	18-20°C

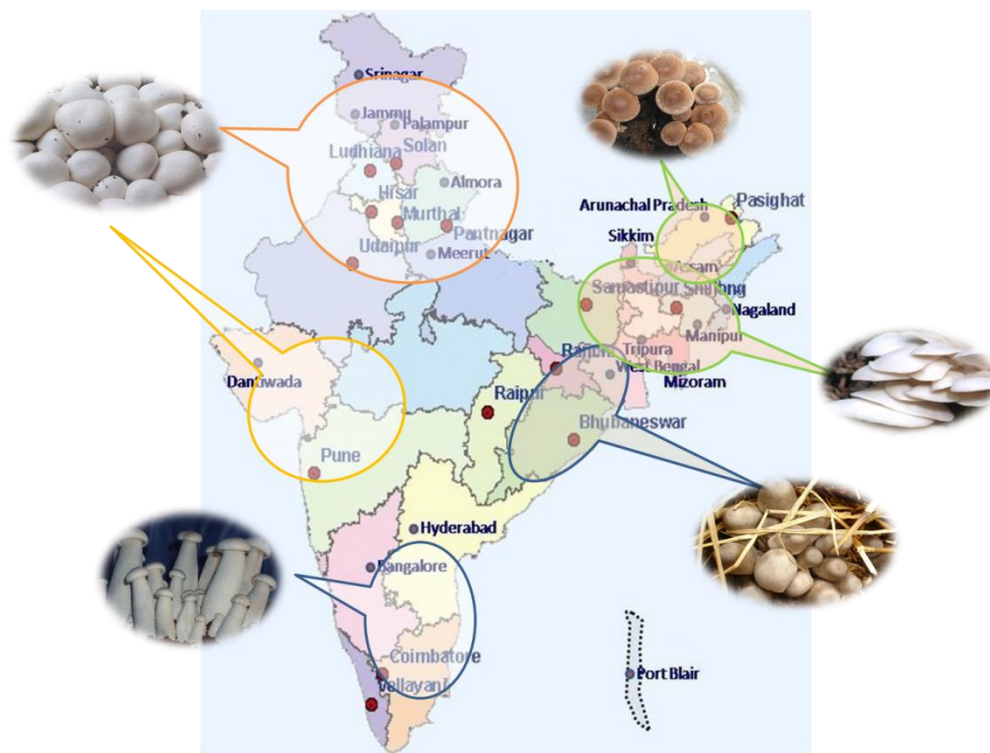
The temperature profile of the edible mushrooms in Table 11.1 indicates the suitability of different regions of the country to grow particular mushrooms in different seasons. Based on this wisdom, a model to recommend region-specific mushroom cultivation has been worked out along with the cost of cultivation and financial returns. Five prime edible mushrooms requiring different temperature have been proposed for adoption by farmers with minimum inputs in different regions of the country as mentioned in Fig 11.3.

11.7. Cost of Cultivation of different Mushrooms

Mushroom cultivation is a highly skilled and capital-intensive activity under controlled conditions. It involves investment depending on the size of the unit/production targets. However, by introducing tropical and sub topical mushrooms in the production cycle, the year-round mushroom production can be achieved successfully with high monetary returns. In Haryana and Punjab region, mushroom growing is a seasonal activity for marginal and small farmers around cities. These farmers prepare compost either through a long drawn process or purchasing from composting units and sell the fresh mushrooms in nearby market. The temporary structures after cultivation of white button mushroom are lie vacant and remain

unproductive. These can be used for cultivation of tropical mushrooms during the warm seasons. Hence, the calculations on cost of cultivation were done on the premise of growing mushrooms in temporary structures (two cropping crops) as per the prevailing climatic conditions. Even in the prevailing circumstances where farmers take just one crop of button mushroom in the huts in the winter months, a farmer earns on an average Rs 50,000 per hut and an acre of land can accommodate 8-10 huts including area for compost preparation. Within four months, the farmer can earn Rs 4-5 lakh per acre, which is much higher than any other crop. The substrate left after growing mushrooms is ploughed back to the fields and it adds to soil health and better production of vegetables and other crops. Chang, 2015 reports, that in China, the economy of villages was totally transformed within few years by adopting better techniques of mushroom cultivation; and that there was 5.5 times increase in the income of farmers between 1991 to 1997 in Biyang region of Henan province, China.

Figure 11.3 Region-wise suitability of different mushroom species



11.8. Cost of Cultivation using Low Cost Sheds

Sheds can be used for the cultivation of different types of mushrooms and more than one mushroom can be cultivated in the same shed and the choice of species will vary as per location.

Technical parameters considered for calculation of economics

- i. The cost of cultivation is proposed for the cultivation of different mushrooms using the same infrastructure facilities (huts) as per the seasonal variations.
- ii. A minimum of two cropping rooms are proposed for cultivation of different mushrooms by considering the technical and economic feasibility.

iii. Depreciation of 20 per cent on temporary sheds and 12 per cent interest rate has been taken into consideration while calculating the non-recurring costs. The value of depreciation and interest rates are deducted from the net profit while projecting the returns.

iv. Additional depreciation of 10 per cent have been calculated for the machinery requirement for cultivation of shiitake mushrooms and deducted from the gross profits while projecting the returns.

v. The amount of substrate that can be accommodated in a hut varies from species to species. The calculations of raw materials has been done accordingly. For example compost made from 10 ton straw can be accommodated in two sheds while growing button, but substrate made from only four ton straw can be accommodated while growing oyster mushroom.

vi. The cost of emptying, repair of sheds after cultivation of one mushroom has been included in the recurring cost as miscellaneous expenses.

11.8.1. Non-recurring cost for construction of the low-cost sheds

Item	Quantity	Cost Rs. (approx)
Composting yard @ Rs. 60/ sq ft	1000 sq ft	60000
Straw soaking tank (10000 lit capacity)	1	15000
Cropping sheds (50'x 20')	2	150000
Sprayers	2	10000
Bamboo for racks	-	25000
Total		260000

Depreciation (@ 20%) and interest rates (@12%) - Rs. 83200

11.8.2. Recurring cost

i. Cost of cultivation for oyster mushroom (*Pleurotus spp.*) –one cropping cycle

A. Cost of labour (Rs. 9000/-month) - 2 No. for three months: Rs. 54000

B. Raw Materials:

Item	Quantity	Cost Rs. (approx.)
Paddy straw/ wheat straw @ 5000 per ton	4 T	20000
Spawn @ Rs. 7000 per q (10% on dry wt)	4 q	28000
PP bags for growing	50 kg	7500
PP bags for packing	30 kg	5000
Formaldehyde	5 litres	1000
Bleaching powder	10 kg	2000
Miscellaneous expenditure		10000
Fuel and electricity		25000
Total		98500

Total cost of cultivation (A+B) : Rs. 152500.00

Returns (excluding cost of shed)

Total mushroom produced @ 70% conversion (In four cropping cycles in a year)	28 q
Gross Income (@ Rs. 10000 per quintal)	280000
Net returns per year (Gross income – Total production cost)	127500

ii. Cost of cultivation for milky mushroom (*Calocybe indica*) –one cropping cycle

A. Cost of labour (Rs. 9000/-month) - 2 No. For three months: Rs. 54000

B. Raw Materials:

Item	Quantity	Cost Rs. (approx.)
Paddy straw/ wheat straw @ 5000 per ton	4 T	20000
Spawn @ Rs. 7000 per q (5% on wet wt)	5 q	35000
PP bags for growing	50 kg	7500
PP bags for packing	30 kg	5000
Casing material	--	7500
Formaldehyde	5 litres	1000
Bleaching powder	10 kg	2000
Miscellaneous expenditure		10000
Fuel and electricity		25000
Total		113000

Total cost of cultivation (A+B) : Rs. 167000.00

Returns (excluding cost of shed)

Total mushroom produced @ 80% conversion	32 q
Income (@ Rs. 10000 per quintal)	320000
Net returns per year (Gross income – Total production cost)	153000

iii. Cost of cultivation for button mushroom (*Agaricus bisporus*) –one cropping cycle

A. Cost of labour (Rs.9000/-month) - 2 No. For three months : Rs.54000

B. Raw Materials:

Item	Quantity	Cost Rs. (approx.)
Wheat straw @ Rs. 5000 per ton	10 T	50000
Spawn @ Rs. 7000 per q (0.75% on wet wt)	1.5 q	10500
Casing material	--	10000
Formaldehyde	50 litres	10000
Bleaching powder	10 kg	2000
Miscellaneous expenditure		10000
Fuel and electricity		15000
Total		107500

Total cost of cultivation (A+B) : Rs. 161500.00

Returns (excluding cost of shed)

Total mushroom produced (20 T compost * 14% conversion = 5.6 T)	2.8 T
Income (@ Rs. 100000 per ton)	280000
Net returns per year (Gross income – Total production cost)	118500

iv. Cost of cultivation for shiitake mushroom (*Lentinula edodes*) –one cropping cycle

Fixed costs

Item	Quantity	Cost Rs. (approx)
Autoclave (manual)	1	350000
Laminar flow chamber	1	50000
Total		550000

A. Cost of labour (Rs.9000/-month) - 2 No. For three months : Rs.54000

B. Raw Materials:

Item	Quantity	Cost Rs. (approx.)
Sawdust @ Rs. 7500 per ton	2 T	15000
Wheat bran @ 1500 per q	6.4 q	9600
Calcium carbonate @ 2000 q	1 q	2000
Spawn @ Rs. 7000 per q (4% on wet wt)	1.6 q	11200
Non-absorbent cotton	50 kg	12500
PP bags	30 kg	10000
PP rings	10 kg	5000
Miscellaneous expenditure		10000
Fuel and electricity		40000
Total		115300

Depreciation and interest (@ 10per cent and interest @ 12%) - Rs. 121000.00

Returns (excluding cost of shed)

Total mushroom produced (2 T substrate * 80 % conversion)	1.6 T
Income (@ Rs. 300000 per ton)	480000
Net returns per year (Gross income – Total production cost)	189700

v. Cost of cultivation for paddy straw mushroom (*Volvariella volvacea*) – one cropping cycle

A. Cost of labour (Rs.9000/-month) - 2 No. for one month: Rs.18000

B. Raw Materials:

Item	Quantity	Cost Rs. (approx.)
Paddy straw @ 5000 per ton	4 T	20000
Spawn @ Rs. 7000 per q (4% on dry wt.)	1.6 q	11200
Calcium carbonate	2 q	3000
Miscellaneous expenditure		3000
Fuel and electricity		5000
Total		42200

Total cost of cultivation (A+B) : Rs.60,200.00

Returns (excluding cost of shed)

Total mushroom produced @ 20% conversion	8 q
Income (@ Rs. 10000 per quintal)	80000
Net returns per year (Gross income – Total production cost)	19800

Mushroom farmers can reutilise the same shed by shifting into cultivating of the mushroom most suited for a particular season or market. Therefore, the farmers have opportunity to diversify within mushrooms to suit prevailing seasonal conditions and market conditions, and sustain a year around source of income.

Projected income levels of farmers in different regions by growing the mushrooms as per the seasonal conditions considering that same shed is used to grow more than one type of mushroom

SN	Region/ States covered	Type of mushroom recommended	No. of crops per year	Growing season	Total net income (lakhs /annum)
1	North Western India (Punjab, Haryana, Parts of HP, UK and JK)	White button mushroom,	One	Nov - Feb	$(1.18 + 1.27*2) - 0.83 = 2.89L$
		Oyster mushroom	Two	Feb-April Aug-Oct	
2	Northeast India (Assam, Manipur, Sikkim, Meghalaya, Nagaland, Tripura, Mizoram)	Shiitake mushroom	Two	Sep-Feb	$(1.90*2 + 1.27*2) - 0.83 = 5.51L$
		Oyster mushroom	Two	Feb-April & July-Sep	
3	Central India (MP, UP and MH)	Oyster mushroom	Two	Sep-Feb	$(1.27*2 + 1.53) - 0.83 = 3.24L$
		Milky mushroom	One	Mid Feb-April	
4	South India (Kerala, TN, Karnataka, AP, Telangana)	Oyster mushroom	One	Nov-Jan	$(1.27 + 1.53 + 0.20) - 0.83 = 2.17L$
		Milky mushroom	Two	Jan-April	
		Paddy straw mushroom	One	July-Aug	
5	East coastal area (Odisha, WB, parts of Chhattisgarh)	Paddy straw mushroom	Four	July-Nov	$(0.20*4 + 1.53*2) - 0.83 = 3.03$
		Milky mushroom	Two	Feb-April	

11.9. Mushroom Spawn Production as an Agribusiness Activity

Spawn is a critical input, without which mushroom production is not possible. The mushroom units must either have their own spawn production facility or purchase from other commercial suppliers of spawn or Government institutes. Own spawn production normally makes economic sense when the average mushroom production is more than a ton per day (Singh and Shirur, 2016). However, majority of the mushroom growers in India are/will be small scale growers relying on purchased spawn. Moreover, spawn production is an investment intensive activity requiring technical skill of handling scientific equipments and good laboratory practices. This presents an opportunity for the educated rural youth set up spawn production centres on commercial scale as an independent agri-business activity with additional source of revenue.

An ideal spawn production unit can be started with an investment of about Rs.12-15 lakh. On an average 150-200 kg of spawns can be produced every day to earn an average monthly income of Rs.75,000-100,000. There is keenness among the academically well qualified youth to undertake mushroom cultivation, spawn production and processing. The ICAR has found it to be one of the preferred options that can target youth entrepreneur under the central scheme of “Attracting and Retaining Youth in Agriculture (ARYA)”.

On the technological front, the ICAR-DMR through the development of improved varieties,

production technology, integrated crop protection measures, value addition, spent substrate utilization, capacity development through training and extension activities, etc. has played the role of an active enabler. These research interventions and extension initiatives have either aimed at reducing the cost of cultivation or in augmenting the financial returns, effectively contributing thereby to enhancing the farmers' income. Mushroom cultivation as a single enterprise in itself can be a potent tool in each of the strategy framework delineated for doubling farmers' income. Hence, the policy framework of Indian agriculture must accommodate farmer friendly, region specific incentives to usher in the growth of region and climate specific mushroom enterprises in India.

11.10. Measures to Promote Mushroom Entrepreneurship

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

- Mushroom entrepreneurship must be treated as an agriculture activity for all purposes.
- Two to three KVKs in each state must be identified and strengthened through capacity development and necessary infrastructure to serve as the Centre of Excellence (CoE). It should also be centre for production of spawns.
- Commercial spawn production centres must be incubated, at SAUs, KVKs and public private partnership (PPP) establishments.
- Start-up entrepreneurs must be promoted with right incentives to venture into post-harvest technology and value addition in mushroom sector.
- Supply chain management should incentivise the supply of fresh mushroom producers and attract investments in mushroom products through financial support.
- Mushroom as part of the integrated farming system should be encouraged through input supply and subsidies by the development departments.
- Farmer producer associations (FPOs) and cooperative farming must be promoted by bringing the stakeholders associated with mushroom cultivation, marketing and processing.

Chapter 13

Recommendations and Policies

Given the DFI strategy of making agriculture more professional and viable across the land holding structure, it has to aim at raising the size of farm incomes, as also changing the ratio of farm to non-farm income, in favour of the farmer. Towards this objective, Secondary Agriculture can play a critical role and therefore needs to be recognized as an independent mandate of the Government.

In the light of the understanding gained of the meaning of secondary agriculture, scope for avenues and types of avenues, the following strategies and recommendations are made.

1. Secondary Agriculture is not a Secondary Sector economic activity, as generally perceived. It has so far been largely defined as a processing activity, and when defined on this test stone, secondary agriculture will broadly come to mean agro-processing (food and non-food), within the all enterprise classes of small or medium or large scale industry, wherein farmers become labour/employee depending upon their level of skill and education.

2. Secondary Agriculture in the view of DFI Committee is an elevated level of agricultural operations or those linked to agricultural activities, undertaken by the agricultural community, whose primary aim is generation of additional income, on-farm or near-farm. The approach of secondary agriculture in this regards is 'value capture' through multiple activities, using slack time or manpower, thereby offering vertical elasticity to a farmer's land, which is intrinsically inelastic (horizontally though).

3. Land and manpower are the two basic assets of a farmer, and the latter remains slack for large periods, in particular during the inter-crop seasons, which can be used gainfully. The best way to use this slack/idle man-days of the farm-family is to enable them to make use of the farm generated resources (products and by-products), as also biological resources in their environment (eg. forest produce) for value addition through micro-enterprises.

4. There is need to promote secondary agriculture activities whose outputs can be in the nature of either value added goods or services, that help the primary sector actors to capture more value from its primary produce (grain, fruit, vegetable, milk, fish, fibre etc.) and/or from the by-products (straw, stalk, bio-mass etc.).

5. Set up an institutional mechanism, that will facilitate advocacy and promotion of micro-enterprises; and linkages to the larger secondary & tertiary sector enterprises. In case of the latter, the families (and youth in particular) can set up aggregation and supply services, to provide the raw material from dispersed farm origins.

6. Develop a compendium of Secondary Agriculture avenues under different Types:

Type A: Value addition to secondary agriculture production system

Type B: Alternative enterprises

Type C: Enterprises based on the concept of 'agricultural waste to wealth'.

The compendium preparation should be decentralised, so that agro-climatic specific activities

are identified for conversion into micro-enterprises.

7. Simultaneously, the scope of Secondary Agriculture can be enhanced by promoting secondary and tertiary sector enterprises, that are principally based on sourcing farm-generated primary products and by-products. However, unlike in case of secondary and tertiary sector enterprises where they engage as employees, in the secondary agriculture micro-enterprises the farm family members would retain the ownership and are thus 'self-employees'.

8. The potential list of micro-enterprises may be converted into bankable projects, so that subsidy and credit linked support can be given to the farm families.

9. In compiling such potential avenues, the gender-specific needs and strengths should be kept in mind. The women have innate knowledge of value addition, and micro-enterprises based on this can be easily promoted.

10. The institutional mechanism should address all aspects of promoting a first-generation entrepreneur class at the farm household level. Hence a 'package of facilitation' may be thought through and customised for easy adoption by the field level Promotion / Extension Officer, with suitable modification for location-specificity. The knowledge & skill set include building enterprise competence, bank transactions, marketing skills, communication skills etc. apart from project knowledge itself. While doing so, the special needs of the women must be appreciated and catered to.

11. Marketing would be the most critical factor in promoting and sustaining such micro-enterprises. A market study would be required, so that the farm families are advised and supported to produce marketable products. The target market can be local or regional or even national/international in reach.

12. In order to undertake distant marketing, the products will need to be branded and quality standards defined and adhered to. The concerned / mandated organisations should build these systems in aid of such secondary agriculture activities.

13. The private sector and NGOs can play an important role in building market strategies; and individual value chains and their integration into supply chains for market integration of micro-enterprise products.

There may also be scope for promoting both downstream and ancillary micro-enterprises linked to secondary & tertiary sector enterprises in their hinterland.

14. The marketing strategy should be clear about the marketing zone – near or far – as well as the type of demand, so that the products are developed in consonance with the nature of demand, e.g., tastes and preferences in case of food items.

It should be remembered, that there are many Indias within India, such is the diversity. Even consumer goods MNCs are pushing for localisation of their branded products (soft drinks, biscuits, ketchup, tea & coffee powder etc.) to counter the regional brands, by catering to the

varied tastes & preferences of people in different parts of India. Home-grown brands have the advantage of better appreciation of local tastes and therefore manage to beat even global companies in food space. On the lines of home-grown brands, that understand the regional nuances better, the micro-enterprises can possibly compete with them by meeting the locally differentiated needs of the consumers. The first market approach of the secondary agriculture enterprises should be to sell their output in the local market.

15. Promotion of Secondary Agriculture cannot happen without recognising it as an independent mandate, working to create additional job opportunities for income generation and to enhance farm incomes. In this context, it requires:

- a. special emphasis, mention and budget allocation to be made for the avenues of secondary agriculture, independently as also under various ongoing schemes. A budget head may be created for this purpose.
- b. recognition of Secondary Agriculture activities as priority sector and as sunrise sector of rural industrialisation
- c. convergence with enterprise promotion, incubation facilities and credit linkage
- d. consideration of incomes thereof as farm income and exemption from income tax.

16. It would be necessary to create a 'Division of Secondary Agriculture and Entrepreneurship' in all the three departments of the Ministry, which include DAC&FW, DAHD&F and DARE/ICAR. A common platform of these 3 led by the DAC&FW and supported by various institutions under these departments (NIPHM, MANAGE, KVIC (Khadi & Village Industries Commission), NIAM, ICAR institutes, etc. will also need to be created with a mandate to roll out policies and implement the programmes. A Mission Mode approach will be needed.

17. State and District level committees may be created for consideration and monitoring.

18. At the field level, the farm families will require handholding. Hence, dedicated extension will be necessary. At the block level, a team of Extension Officer (from the departments of agriculture, animal husbandry, fisheries etc.) and Industrial Promotion Officer-IPO (from the department of industries) will need to be created with responsibility for promotion of secondary agriculture and outcome based targets.

This team should get technical backstopping from State Agricultural Universities (SAUs), ICAR institutes, KVKs, District Industry Centres (DICs), State Khadi and Village Industries Boards (KVIBs), Textile and Sericulture departments etc.

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Annexures

Agri-Tourism Case Studies

STRENGTHS

- Strong supplementary source of income for farmers
- Employment generation
- Rural development

WEAKNESS

- Growth of agri tourism is slow.
- Farmers need varied training.
- Lack of government subsidies
- Insufficient agri tourism training centres in India
- Lack of publicity

SWOT Analysis for Agri-Tourism

THREATS

- Climatic conditions
- Rampant migration from farming to other sectors

OPPORTUNITIES

- As a new branch of tourism has immense scope for growth
- More farmers can be the beneficiaries
- Government support can increase the outreach of this tourism
- State owned land can be used to facilitate agritourism

Case Study – 1

Socio-Economic Implications of Agri Tourism in India (2012, Deepika Chadda and Sharayu Bhakare)

In this paper the researchers have critically reviewed the experience of agricultural transformation by complimenting it with agro based tourism through a SWOT analysis and substantiating it with case studies from the state of Maharashtra, India. The primary data has been collected by an in-depth personal interview of Mr.Pandurang Taware, Director Sales and Marketing, Agri-tourism Development Corporation and the brain behind initiating agri-tourism concept in India. The authors have also conducted a field study to the agri-tourism project in Malegaon-Maharashtra to understand its set up and management.

Case study of Agri-tourism in Malegon Village Maharashtra:

The researchers have selected this case because it is a novel unique project- first of its kind in India - Malegaon - Maharashtra and can be emulated over various states in totality. The Agri-Development Trust a Non-Governmental Organisation (NGO) which was formed with the intention of training farmers on farming techniques awareness. The major objective of the trust was to increase farm productivity after deployment of advanced farming techniques.

In 2004, the agri-Tourism Development Corporation started agri tourism, as totally new idea

over an area of 110 acres owned by agri development trust. After year 2002, tourism activities in India gained momentum due to government endeavours. Agri tourism was conceptualised by an enterprising individual Mr. Pandurang Taware and started as a pilot project under the aegis of Agri-Development Trust on 110 acres of cultivated land. The operation of the project was critically monitored over 2004-2006 which was considered to be the gestation period. The vast span of land was developed for agri-tourism with unique irrigation methods to run projects of tourist interest like horticulture, floriculture, sericulture, winery, cattle breeding, animal husbandry, jaggery processing unit and dairy farming.

Agri-tourism is developed as a viable business model by Mr. Taware. This business model of agri-tourism was worked out on the premise that urban population is leaning towards nature and has a strong desire for family oriented recreational activities in a radius of 150 kms in a rural setup having a travel time of just 2-3 hours. This project is carefully carved considering the requirements of an urban population and the boost in tourist trade. This project is operating successfully from the year 2006 and at present is thriving in providing an inexpensive get away to a large majority. The feasibility of this project increases as it translates into attracting large number of tourists. Maharashtra, one of the largest states in India has a high rate (53 %) of urbanisation, thereby leveraging demand for agri-tourism. This specific project of agri-tourism generates annual revenues of about Rs. 4,000,000 to Rs. 4,500,000 which is mainly from three sources:

Primary source	Secondary Source	Third Source
Day and Night Camp Rs. 600-1000/person	Summer Camp for 3 days Rs. 2,500-4,000/person	Farmers Training for 7 days Rs. 10,000/person

This project was implemented with the involvement of farmers from the vicinity. Therefore farmers are given 70per cent of the revenue generated. This keeps them motivated and attached to the project. The farmers also benefit as they can market their products to the tourists. The women who have formed self-help groups are benefited as they get ready customers for their handicrafts leaving high profit margins.

In order to widen the horizon of agri tourism, since the year 2007 concerted efforts are made by the trust to provide training to farmers from all of the country for which National agri tourism training centre has been established. At its inception 350 farmers had applied out of which 52 farmers were selected and trained. These farmers have successfully ventured out into agri tourism. The World Travel and Tourism council has recognised the efforts made on this front by Mr. Pandurang Taware and applauded his work. He is also the recipient of Global Responsible Tourism award for his innovative and pioneering agri-tourism concept.

Case Study – 2

Impact of agro-tourism on local agricultural occupation: A case study of Chang Klang district, southern Thailand

(2012, Na Songkhla, T. and Somboonsuke, B.)

The study was conducted in Chang Klang district of owing to its well-known agro-tourism destination in southern Thailand. This area was examined by the researchers to study the impacts of agro-tourism on local agricultural occupation due to its implementation of agro-tourism activities at least 10 years, expanding a number of tourism activities and tourists, conducted by villagers. To investigate the impacts on local agricultural occupation, agricultural management on agro-tourism farms was analysed how it relates to local agricultural occupation. The research was conducted considering seven farms that were active during the period of study.

The background of local farms especially agricultural products and resources use was a basis of the features of agro-tourism activities. Farms which promoted as agro-tourisms activities were agricultural occupation of mushroom cultivation, apiculture, and organic farming. These farms operated tourist activities with a variety of features:

1. Apiculture
 - a. They were distributing honey and apiculture equipments.
 - b. They helped to study productivity of orchard improved by apiculture.
 - c. They also demonstrated the processing and equipment use of apiculture.
2. Mushroom Cultivation
 - a. They sold many kinds of mushroom products.
 - b. They helped to study the procedure of mushroom cultivation.
 - c. They also conducted Demonstration on procedures of mushroom cultivation.
 - d. They were rendering advisory services on mushroom business.
3. Organic Farming
 - a. They study the organic farming and sufficiency economy.

They conducted demonstration on organic fertilizer producing.

All tourist farms operated various agro-tourism activities. These activities offer on the farm were sequenced to make income from visitors. The agro-tourism package included first providing with knowledge of farming. The next activity was agricultural process

demonstration, and last activity was agricultural production distribution and agri-business guidance. As this condition, apicultural farm focused on activity of demonstration because the method of apiculture was very complex and interesting. Unlike the farm of mushroom cultivation, it mainly shown a diver of mushroom production, distributed production, and advised mushroom business because this production was easy to produce by visitors themselves. Whereas the organic farm concentrated on activity of organic planting study because of the boom of green agriculture.

This research considered the changes of local agricultural occupation during the past 10 years of agro-tourism promotion. This study found that the change can be defined into 3 characteristics: Conservation of agricultural resources, Expansion of agricultural career, and Value adding of agricultural resources.

1. Agricultural Resource Conservation

Mixed farming or diversity farming has been encouraged. More than 20 farms within Chang Klang district has switched from their monoculture farms (such as durian, mangosteen, and rambutan) to mixed farms. Besides, after the past five years of activities of organic farming study, it was found that a number of chemical fertilizers use in Chang Klang district was decreased significantly compared to in the past. According to the boom of such agricultural resource conservation, residents in Chang Klang district continued their agricultural activity but most of them tried to operate as small scale (less than 1 ha) in the sense that green agricultural products were used for them where as the main incomes were generated from tourism activities and rubber plantation.

2. Agricultural Activities Expansion

Activities of agri-business guidance of mushroom cultivation have encouraged the new farms of such business due to its low investment, less operating areas, and enough local materials. During this study, the researchers found that about 90 farmers in Chang Klang district had operated this business as a part of their farms. Besides, activities of organic farming study have encouraged more than 70 local farmers to conduct organic farming in order to reduce farming cost. Furthermore, activities of apiculture study have motivated many orchards to adopt apiculture.

3. Value Adding Of Agricultural Resources

The local products distribution has resulted in the value adding of certain agricultural resources such as traditional rice farming, and local plants were modified as a wide range of local products. It not only increased the income but also attracted a wide spectrum of tourists due to its unique characters.

Case Study – 3**“Management Approach towards Agro Tourism” (With Special reference to potentials, Challenges Development and Growth in Western Maharashtra)**
(2012, Dr. Deepak. J. Tilak)

The present case study was conducted to gather information and understand the scope and nature of agri-tourism development in Maharashtra. The researcher conducted case studies of 20 such agri-tourism destinations in Maharashtra. One of the finest and important case is from Neral Village, Raighad, Maharashtra. It is named as Nisarg Niketan - Saguna Baug

Peak Season Turnover (Saguna Baug)

Type of accommodation	Food charges B/f/Lunch/Dinner	Accommodation Charges	Total
Dormitories	@ Rs. 240 per head per day X 14 pax / dorm = Rs. 3360/-	Rs. 700/-	Rs. 38,97,600/-
	Rs. 3360 Food + Rs. 700 Accommodation = Rs. 4060 X No. of dorms 4 = Rs. 16,240 per day X 240 days		
Cottage	@Rs. 240 per head per day X 4 pax / Cottage = Rs. 960/-	Rs. 800/-	Rs. 16,89,600/-
	Rs. 960 + Rs. 800 Accommodation = Rs. 1760 per cottage per day X 4 Cottage = Rs. 7040 per day X 240 days		
Pond House	@ Rs. 240 per head per day X 4 pax = Rs. 960/-	Rs. 1200/-	Rs. 5,18,400/-
	Food Rs. 960 + Rs. 1200 Accommodation = Rs. 2160 per day X 240 Days		

Day visitors

50 pax @ Rs. 350/- = Rs. 17,500/- per day X 240 days = 42,00,000/-

Total revenue earned in peak season on from agro-tourism

Dormitories Rs. 38,97,600/-

Cottages Rs. 16,89,600/-

Pond House Rs. 5,18,400/-

Day visitors Rs. 42,00,000/-

Total Rs. 1,48,61,200/-

Economic Implications: This has generated lot of employment opportunities for local people.

Around 35 - 40 people are working on the farm. Also locally made bamboo products are sold at the farm. There is certainly addition in the farm revenue and it is considerable but major source remains agriculture.

Seasonality: Peak and low seasons for tourism are observed. Peak season from November to July and low season from August to October. But in every season there is something for the guest to enjoy. As main income source is agriculture seasonality does not affect much.

Guest Facilities: Homemade food is served. Accommodation ranges from dormitories to Pond house which is a luxury accommodation. Around 25 people can be accommodated for overnight stay. Water buffalo ride, dairy, fishery, swimming, trekking, adivasi folk dance, camp fires, bird watching can be enjoyed at the farm. Of course farm activities are major attraction.

Marketing Strategy: Word of mouth publicity through good service. He is a member of ATDC has an advantage as the well-established project of agro tourism and is well established. They aimed at attracting Ladies, urban families, senior citizens, school and college children.

Major Motto behind Starting the Project: He wanted farming profession and farmers respect and recognition in the society. He wanted people to come and see the rural life and devotion of farmers towards their work. Interaction with the guests develops confidence and cultural exchange of rural and urban people is possible.
