

LITCHI VALUE CHAIN ANALYSIS AND MARKET ASSESSMENT FOR MUZAFARPUR DISTRICT, BIHAR



Submitted to:

*Mission for Integrated Development of Horticulture
MoA&FW, Govt. of India*



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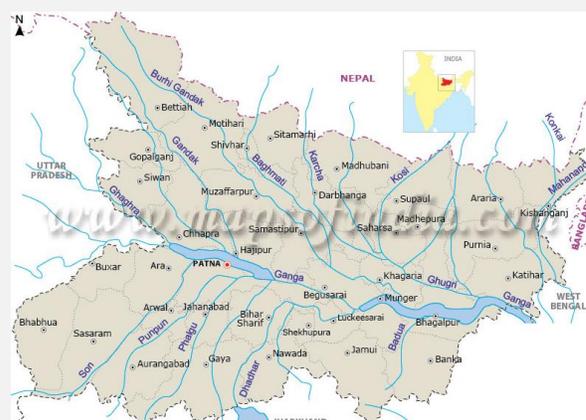
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1. INTRODUCTION

FIGURE 1. MAP OF BIHAR



1.1. Bihar at a glance

Land-locked on all sides, the State shares international borders with Nepal in the north, and regional borders with Uttar Pradesh in the west, West Bengal in the east and Jharkhand in the South. River Ganges flows west to east through the middle of the state, dividing the fertile alluvial plains into two unequal halves viz. North of Ganges River and South of Ganges River, North Bihar in general being highly flood-prone, and South Bihar being highly drought prone.

In recent year, there have been increased investments in the State. Bihar is one of the fastest growing states in India. The GSDP of Bihar at constant (2011-12) prices in 2015-16 was Rs. 3.27 lakh crore, yielding a per capita income of Rs. 29,190. The estimated GSDP at current prices in 2015-16 is Rs. 4.14 lakh crore, implying a per capita income of Rs. 36,964.¹ During the last decade (2004-05 to 2014-15), the state income at constant prices grew annually at 10.1 percent. In the immediate past (2011-12 to 2015-16), the growth rate of GSDP in Bihar was 7.6 percent. It is notable that the State has undergone a structural change moving away from agriculture towards industry and service sector. In 2016-17, the share of the primary sector (agriculture and allied) in total GSDP was 18.3 percent, secondary sector contributed 18.1 percent and tertiary 59.9 percent.² Despite the declining share in total GSDP, agriculture continues to remain a critical contributor to overall socio-economic and inclusive development of the State, as more than 80 percent of the State population depends on the sector for livelihood.³

TABLE 1: SUMMARY OF STATE PROFILE

1	Date of Formation	15 Aug., 1947
2	Capital	Patna
3	Longitude	82°-19' to 88°-17' E
4	Latitude	24°-20' to 27°-31' N
5	Area	94,163 Sq.Km. (2.86% of India)
6	Population (2011)	104.1 million
7	Population (%)	8.58% (3rd Rank)
8	Population Density	1106 (Highest among Indian States)
9	Sex Ratio	918
10	Literacy Rate*	63.82% with 73.39% Male & 53.33% Females
11	No. of Districts	38 (Divisions = 9, Sub-Divisions = 101)
12	Neighbouring States	UP, West Bengal, Jharkhand
13	International Borders	Nepal – 625 km

Source: Economic Survey, 2016-17, Government of Bihar

1.1.1. Demographic profile of the State

As per 2011 Census of India, Bihar is third most populated state of India (after Uttar Pradesh & Maharashtra) with total population of about 104.1 million. The state has a very high population density of 1106 persons/sq km compared to the national average of 396 per sq km, increasing the pressure on land and compounding the problem of rural poverty. Around 88.5 per cent of the population lives in rural areas as compared to the national average of 68.8 per cent, thereby making Bihar largely a rural economy.

1.1.2. Agriculture Profile

Agriculture remains vital source of wealth for the State. Bihar is one of the largest producers of vegetables and third largest producer of fruits in India.⁴ Food processing, dairy, manufacturing, healthcare are some of the fastest growing industries in the state.

¹ Source: Bihar Economic Survey 2016-17 (<http://finance.bih.nic.in/Documents/Reports/Economic-Survey-2017-EN.pdf>)

² Source: Bihar Economic Survey 2016-17 (<http://finance.bih.nic.in/Documents/Reports/Economic-Survey-2017-EN.pdf>)

³ Source: Distribution of workforce by category, Census India (http://censusindia.gov.in/Tables_Published/A-Series/A-Series_links/t_00_009.aspx)

⁴ Source: IBEF, 2017 (<https://www.ibef.org/download/Bihar-January-2017.pdf>)

As majority of the area falls in the rich and fertile riverine plains of Ganga basin, the share of total land put to agricultural use is high in Bihar. About 56 percent of the total geographic area is net sown area (52.25 lakh hectares). Gross cropped area (GCA) in Bihar is 75.8 lakh hectares. The pattern has remained nearly the same over the years. However, with increasing high density of rural population, recurring floods and drought situation across certain region, have contributed to relatively scarce land availability for agricultural purpose in the State. Thus, number of individuals are reliant on a small amount of land for farming in the State (table 3)

TABLE 2: LAND USE CLASIFICATION BIHAR

#	Land Use	Area ('000 hectares)	
A.	Total Geographic Area (As per village papers)	9360	100%
B.	Land not available for cultivation		
	a) Forest	622	6.6%
	b) Barren Land	432	4.6%
	c) Land put to non-agricultural uses	1708	18.3%
C	Cultivable Waste Land		
	a) Permanent Pasture and other grazing Land	15	0.2%
	b) Culturable waste other than fallow Land	45	0.5%
	c) Miscellaneous tree Crops and groves	247	2.6%
	d) Current fallow	913	9.8%
	e) Other fallow	120	1.3%
D	Area Sown		
	a) Net area sown	5252	56.1%
	b) Gross cropped area	7580	
	c) Cropping Intensity	1.44	

Source: Economic Survey, 2016-17, Government of Bihar

About 90 percent of the farmers in the State are marginal farmers holding approximately 57% of the total operational holding. High proportion of marginal farmers has led to low farm level investments, adversely affecting the overall productivity particularly in case of horticulture crops (including litchi).

TABLE 3: CATEGORY OF FARMERS

Category of farmers	No. of Holdings	Operational holding (In Ha.)
Marginal (0-1Ha.)	1,47,44,098 (91.06%)	36,68,727.64 (57.43%)
Small (1-2 Ha.)	9,48,016 (5.85%)	11,85,695.24 (18.56%)
Semi medium (2-4 Ha.)	4,14,664 (2.56%)	10,72,969.00 (16.80%)
Medium (4-10 Ha.)	81,484 (0.50%)	4,14,941.12 (6.50%)
Large (10-above Ha.)	3129 (0.03%)	45,227.71 (0.71%)
Total	1,61,91,391 (100%)	63,87,560.71 (100%) ⁵

Source: Website of Dept. of Agriculture, Govt. Bihar

1.1.3. General Infrastructure

General infrastructure connectivity is important for integrated development of any sector in the State and is critical to amplify the overall economic growth. Specific to agriculture sector, connectivity through road infrastructure is one of the major factors for enhancing the investment in the agricultural marketing, distribution and processing. Poor road infrastructure availability limits farmers access to markets, increase time and cost of transport which result in deterioration of produce quality.

⁵ Source: Agriculture Census, Ministry of Agriculture

1.3. Horticultural crop Production in Bihar

Although the horticulture crops occupy only about 15 percent (1178 thousand hectares) of the total geographical area of the State, yet the State contributes largest production of fruits and vegetables in the country. Bihar ranks 3rd in vegetable production & 9th in fruit crop production in India. The average productivity of horticultural crops in the State is also higher than the national average.

In 2015-16, the State production of vegetables was about 14.4 million tonnes from an area of 837 thousand hectares, which is approximately about 8.5 percent of the total vegetable production in the country⁸. Potato (63.46 lakh tonnes), onion (12.47 lakh tonnes), tomato (10.01 lakh tonnes), cauliflower (10.04 lakh tonnes), cabbage (7.20 lakh tonnes), brinjal (11.38 lakh tonnes) bottle gourd (6.32 lakh tonnes) and radish (2.47 lakh tonnes) are among the major contributors to the vegetable production in the State. Bihar is also among the leading fruit crop producer. In 2015-16, the fruit crop production in the State was reportedly about 4.23 million tonnes from an area of 308 thousand hectare, contributing 4.5% of the total fruit production in India. Mango (1465 thousand tonnes), guava (370 thousand tonnes), litchi (198 thousand tonnes), banana (1535 thousand tonnes), pineapple (116 thousand tonnes), papaya (53 thousand tonnes) and amla (14 thousand tonnes).

TABLE 5: AREA & PRODUCTION OF HORTICULTURE CROPS IN BIHAR (IN '000 HECTARE, '000 MT)

Crop	2011-12		2012-13		2013-14		2014-15		2015-16		2016-17	
	Area	Prod.										
Fruits	299	3946	302	4249	302	4014	301	3990	306	4231	308	4235
Vegetable	857	15552	862	16326	809	15098	842	14467	838	14400	842	14521

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India. (ON1549)

1.4. Litchi Production in Bihar

Bihar is known all over India for its litchi and mango. In litchi season, production from Bihar can be found in all the major markets of India. Litchi produced in Muzaffarpur region especially, particularly 'shahi' litchi, is famous for its taste and flavour. Bihar is the largest producer of Litchi in the country and accounts for 35% of the total production and area in the State.

TABLE 6: COMPARATIVE ANALYSIS OF LITCHI PRODUCTION IN INDIA (AREA IN '000 HECTARE, PRODUCTION IN '000 MT, PRODUCTIVITY IN MT/HECTARE)

States/UTs	Bihar	Uttarakhand	West Bengal	Chhattisgarh	Assam	Jharkhand	Punjab	Odisha	Uttar Pradesh	Tripura	All India	
2012-13	Area	31.3	9.5	9.2	5.0	5.6	5.3	1.8	4.5	0.3	3.5	82.9
	Production	256.4	19.2	90.0	30.9	49.6	58.2	26.5	20.3	1.6	18.0	580.1
	Productivity	8.2	2.0	9.8	6.2	8.9	11.0	14.7	4.5	5.3	5.1	7.0
2013-14	Area	31.5	9.4	9.3	5.4	5.4	5.3	1.9	4.5	0.4	3.9	84.4
	Production	234.2	30.7	93.9	37.6	48.1	58.2	28.0	20.3	2.0	20.2	585.3
	Productivity	7.4	3.3	10.1	7.0	8.9	11.0	14.7	4.5	5.0	5.2	6.9
2014-15	Area	32.0	9.7	9.4	5.6	5.4	5.3	2.0	4.5	-	3.9	85.0
	Production	198.0	19.7	76.8	39.2	48.7	58.8	32.1	20.3	-	20.6	528.3
	Productivity	6.2	2.0	8.2	7.0	9.0	11.1	16.1	4.5	-	5.3	6.2
2015-16	Area	32.1	10.3	9.5	6.6	5.5	3.5	2.2	4.5	4.2	4.0	90.0
	Production	198.0	23.9	75.3	45.4	49.6	40.0	34.9	20.3	35.9	20.3	558.9
	Productivity	6.2	2.3	7.9	6.9	9.0	11.6	16.2	4.6	8.6	5.1	6.2
2016-17*	Area	32.1	10.3	9.7	6.6	5.8	3.5	2.2	4.5	4.2	4.0	90.7
	Production	198.0	23.7	76.6	45.4	55.6	40.0	34.9	20.3	36.0	20.3	566.5
	Productivity	6.2	2.3	7.9	6.9	9.5	11.6	16.2	4.6	8.6	5.1	6.2

⁸Source : Ministry of Agriculture and Farmers Welfare, Govt. of India.

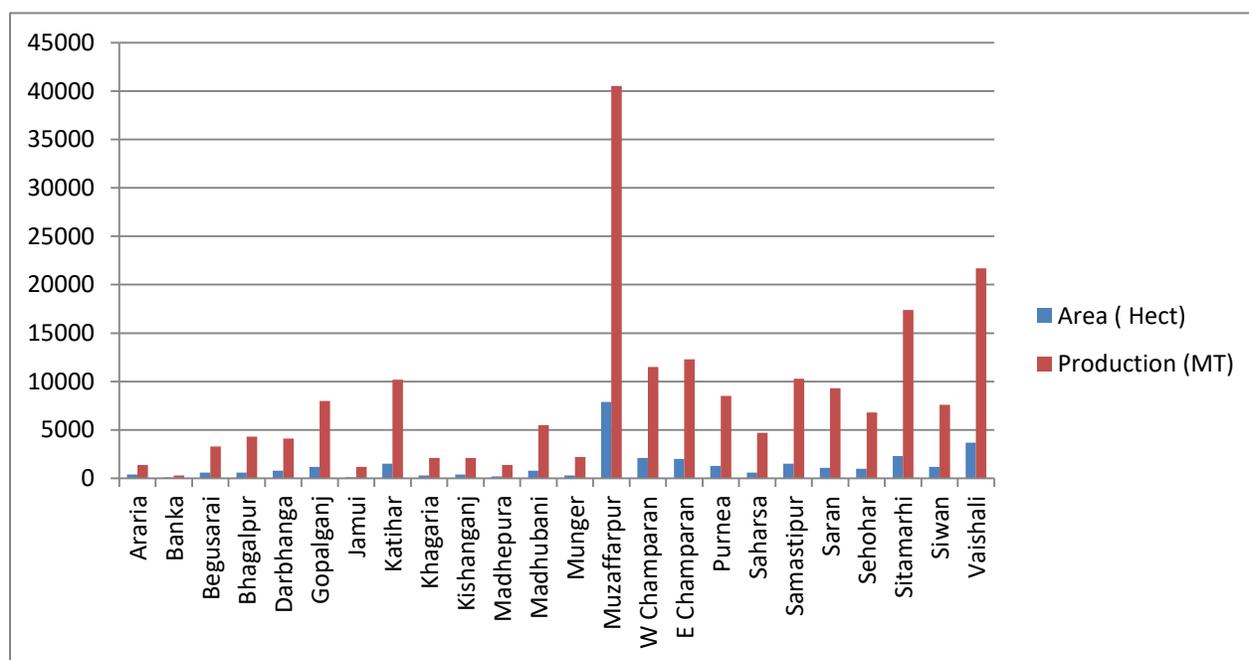
Source: Ministry of Agriculture and Farmers Welfare, Govt. of India. (ON1549); * 3rd Advance Estimates

Based on the comparative data analysis, it is notable that while the total area and production of Litchi in the country has increased in last three years by over 7 per cent (2014 to 2017), the production of litchi in Bihar has registered a negative growth. Owing to adverse agro-climatic conditions, the average productivity of the State is declining and is only marginally higher than the national average (of 6.2 mt/ha). The State productivity infact lags behind other emerging litchi producing States as Jharkhand, West Bengal, Assam and Chhattisgarh. While West Bengal is focusing both on area expansion and productivity enhancement states like Tripura, Jharkhand and Chhattisgarh are looking at area expansion even while agro-climatic conditions are hindering productivity enhancement. As far as productivity is concerned, Punjab has registered a productivity of 16.2 tonnes per hectare which is more than twice that of the all India average and litchi productivity in Bihar. As more number of other States in India are showing interest to adopt this fruit crop, Bihar is loosing the market share.

1.4.1. District wise production of Litchi in Bihar

Litchi in Bihar is produced in around 25 districts mostly in the northern Bihar. While Muzaffarpur ranks one in Litchi production other prominent districts include Vaishali, Sitamarhi, East and West Champaran. District wise litchi production for the year 2015-16 is given below:

FIGURE 3: DISTRICT WISE LITCHI PRODUCTION IN BIHAR 2015-16



Source: State Horticulture Development Society

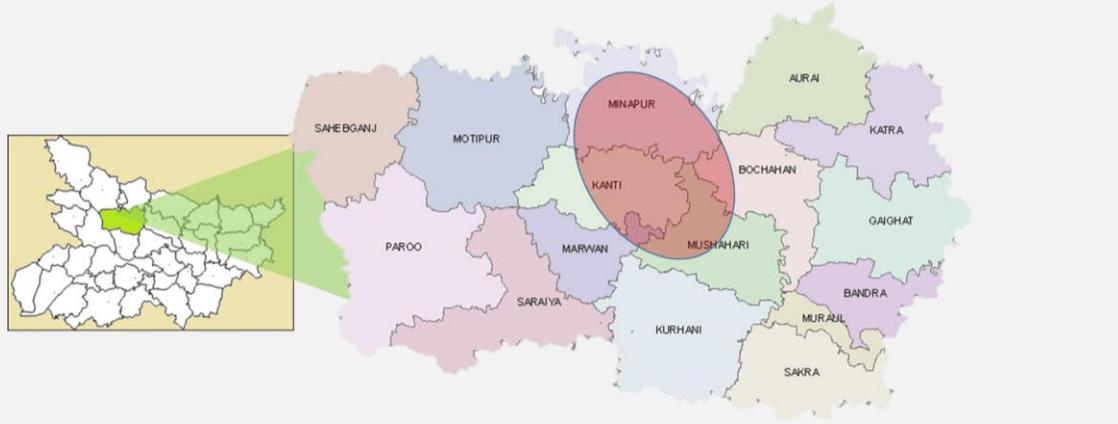
2. APPROACH & METHODOLOGY

2.1. Study Area

During the inception stage it was proposed to include Minapur and Musahari blocks of Muzaffarpur district as the study area. However, post discussion with State Govt. officials and after due assessment of ground realities three blocks were selected for primary survey – Minapur, Kanti&Musaharilt may be noted that the following blocks were selected in a purposive manner so as to cover

1. Various Categories of farmers
2. Various categories of orchards
3. Availability of support structures

FIGURE 4. STUDY AREA



2.2. Sample Size

The sample selected for the interview and discussion included all the major stakeholders including grower, traders, processors and local retailers so as to develop a clear understanding of their roles/contribution. Discussion and consultations were also carried out with State and district level officials to understand the overall scenario and seek suggestions.

The sample of litchi growers for field survey were identified and mobilized at different selected locations with assistance of District Horticulture Office, Muzzafarpur. Group discussion& individual farmer interview were conducted with 41 farmers in each of the selected clusters using structured questionnaire to collect information on value chain activities undertaken by the farmers, package of production practices, cost of cultivation, value addition at farm level, marketing of produce and associated costs, access to services for procurement of inputs, technical guidance, transport, market information and infrastructure access, constraints in production and marketing etc. On the market side of the value chain, wholesalers, retailers dealing with marketing of litchiwere also interviewed to understand the goods movement upto end consumer including marketing cost, margins and efficiency. Primary data was collected using structured questionnaires. Secondary data and information was collected by referring to published reports, information and data base of various relevant sources and their website.

3. PRIMARY SURVEY: RESULT AND DISCUSSION

3.1. Socio-Economic Profile of Respondents/Growers

The primary survey in Muzaffarpur district suggests the followings:

3.1.1. Land Holding

The average landholding size of litchi grower in the study area is estimated about 2.18 acre. Of the surveyed farmers, 76% were reportedly marginal farmers (less than 1 ha or 2.5 acres); 20% small (1-2 ha), 4% semi-medium (2-4 ha). None of the surveyed farmers had more than 4 ha of land. The proportion of larger land parcels was found to be higher in Kanti Block

S.No	Category	Operated Area	% of Farmers from Sample	As per overall State Statistics
1	Marginal	Less than 1 ha.	76%	91.06%
2	Small	1 - 2 ha.	20%	5.85%
3	Semi-medium & medium	2 - 4 ha. 4 -10 ha	4% -	3.06%
4	Large	More than 10 ha.	-	0.03%

3.1.2. Education

Majority of the farmers (25 out of 41 respondents) have completed their school level education. While almost 35% have education level till 12th. Only one respondent farmer was found to have a post graduate level of education. Three respondents did not divulge their educational details.

3.1.3. Income Level

Farmers of the studied region depend mostly on agriculture and related activities for generating their livelihood. Some of them are also into salaried occupation both in public as well as private sector. While discussion related to income level is a sensitive issue in the studied region various proxies were used to assess the same.

Majority of the farmers (22 respondents out of 41) were found to be in the income bracket of Rs.2-3 lakhs/annum. While about 10% of the respondents suggested to have an income level of more than Rs.5 Lakh/annum. About 20% respondents indicated to have an income level of Rs.3-5 lakh/annum

It may be noted that the combined effect of small landholding, low level of education and low income level has affected the overall value chain development of litchi in the region.

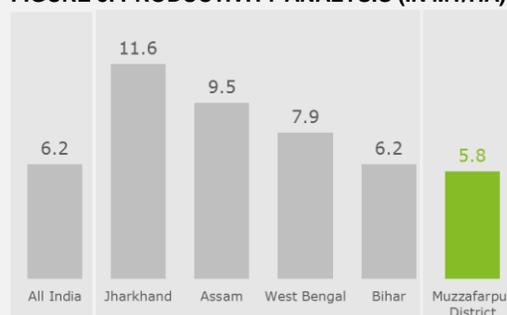
3.2. Focus Crop Area, Production and Productivity in Muzaffarpur District

Muzaffarpur district is the Hub for litchi production in the State. The agro-climatic condition of North Bihar particularly that of Muzaffarpur region is very congenial for commercial litchi production. In addition to this, the region is also endowed with rich fertile calcareous soil that is very suitable for cultivation of high quality litchi. Muzaffarpur ranks **first** among the districts in Litchi production. About 7900 ha of area is under litchi

cultivation in Muzaffarpur with production on 40500 MT. The district, thus, accounts approximately 20.5% of the State production and 24.6% of the total area under litchi cultivation Muzaffarpur.

Over the last 3-5 years the production of Litchi in the cluster has decreased marginally mainly owing to unfavorable weather conditions and inappropriate management practices. The area under the crop has also decreased marginally especially in the semi-urban blocks.

FIGURE 5. PRODUCTIVITY ANALYSIS (IN MT/HA)



3.2.1. Major Litchi producing clusters in the District

Litchi is grown in almost all the parts of Muzaffarpur district/.Mushahari, Minapur, Kanti and Saraiya block together account for about 50% of the district production.tc. While Mushahri block used to be one of the high producing zones over the years its contribution towards production has come down. Urbanisation and use of land towards other commercial activities are the major reason behind declining area under litchi.

As per the latest available statistical data provided by the State department of Horticulture, the block-wise area and production of Litchi in Muzaffarpur is as under:

TABLE 7: BLOCK WISE PRODUCTION OF LITCHI IN MUZAFFARPUR⁹

Block	Area (ha)	Production (MT)
Mushahari	1002	6098
Minapur	895	5442
Bochahan	420	2425
Aurai	264	1527
Katra	283	1658
Gaighat	491	2930
Muraul	413	2325
Sakra	367	2120
Kurhani	500	2948
Kanti	1053	5372
Saraiya	648	4232
Paroo	456	2776
Sahebganj	319	1902
Motipur	317	2000
Total	7428	43755

Source: District Horticulture Office, Muzaffarpur

3.3. Crop Seasonality and Varieties Grown

3.3.1. Major varieties

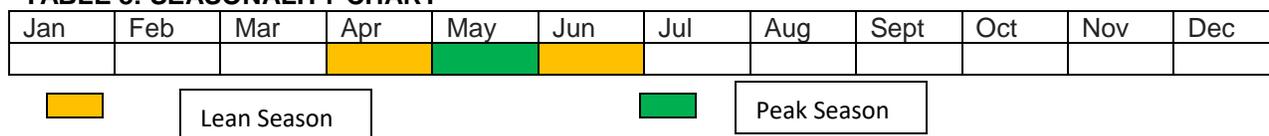
⁹ It may be noted that the block wise data as available in the public domain is a bit dated and thus can be considered indicative only. During the field visits it was found out that the production of Litchi in Mushahari has come down.

Major varieties of Litchi grown in Muzaffarpur include China, Shahi and Rose Scented. While China variety accounts for the majority of the crop in the district, in Kanti block significant quantum of Shahi litchi is cultivated. Recently rose scented variety is also being adopted by the farmers. It may be noted that each of these varieties have their own distinct advantages. While china litchi is more resistant to harsh climatic conditions (which result in fruit splitting) Shahi commands premium price because of its flavor. Rose scented is a late variety crop and thus gives the farmer an additional window of about week for marketing the produce.

3.3.2. Seasonality of production

Litchi has a relatively smaller harvesting period. The harvesting of the crop in Bihar starts towards the end of April, picks up during the 2nd /3rd week of May and ends around 1st week of June. The same is depicted below:

TABLE 8: SEASONALITY CHART

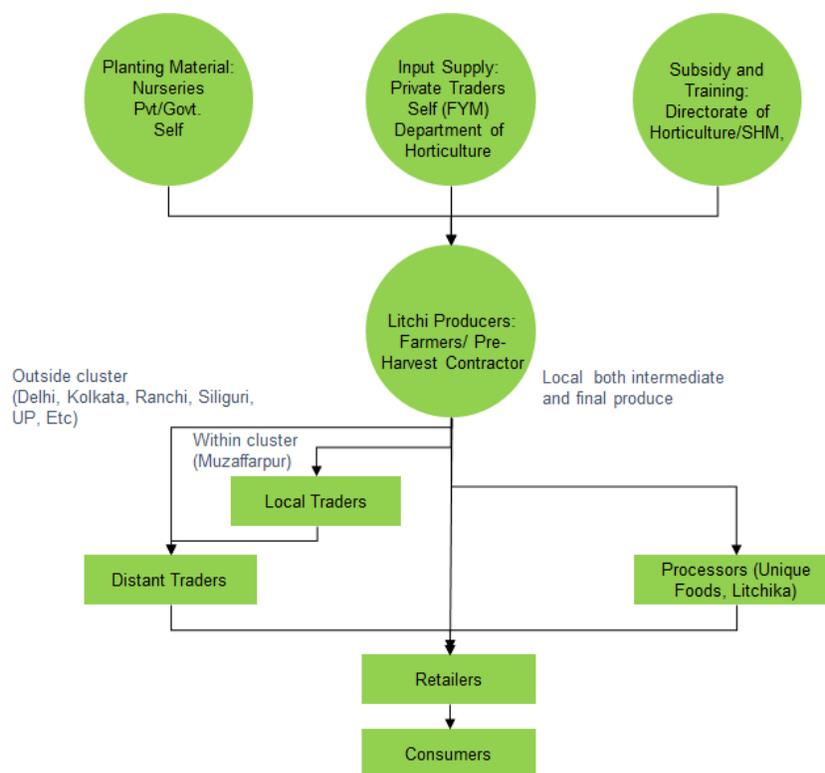


3.4. Litchi Value Chain in Muzaffarpur District

3.4.1. Structural Analysis

The value chain for litchi in the district starts with farmers and pre-harvest contractors who are responsible for production and harvesting of the produce. The product then flows to the local and distant traders who procure and transport fresh litchi from farmers/ pre-harvest contractor directly. Very small quantity also goes into processing. The litchi from traders reach to retailers, who sell it to the consumers in fresh form

FIGURE 6. STRUCTURE OF LITCHI VALUE CHAIN IN THE DISTRICT



3.4.2. Functional Analysis

The role played by various members of the value chain is as follows:

- Growers:** Aforementioned the farmers cultivating litchi in the region are mostly small and marginal with average landholding size upto 2.18 acres. The litchi growers are responsible for establishment and maintenance of the orchards including farm operations as soil preparation, planting, nutrition management, irrigation, etc.. Majority of surveyed farmers in the district lease out their orchards to contractors at the time of flowering or early fruiting stage in month of January/ February, who then carrier out the remaining operations including harvesting and post harvest activities such as sorting, grading, packing and transportation. The cost of these operation in such case is borne by the contractor. Some of the farmers in the region also tend to directly sell the produce themselves into the local market, in such a scenario growers also carry out other farm operations including harvesting and post harvest management. However, this practice is relatively less prevalent practice in the cluster. Some of the farmers also reportedly supply to the processors operating in the region.

In context to the growers, it was observed that there is no association of Litchi growers in the studied region. However, various state Govt. Agencies are promoting FPOs in the studied region under rural livelihood promotion schemes.

- Pre-harvest Contractor:** Pre-harvest contractors (PHC) are the most important players in the existing marketing channel of litchi. Historically, the PHC came into existence to aid large farmers in managing and marketing of litchi orchards. Their role was later strengthened by the absence of proper marketing infrastructure and appropriate input (including finance) supply. Today the PHCs are advising on the use of inputs; providing farm advances to meet the working capital needs and

are absorbing the risk associated with markets. They are also providing their services, as procurement persons, to processors or marketers based out of large consumption centers. PHCs thus, act as interface between the farmer and other stakeholders in the chain. They therefore play a very important role in the value chain of litchi.

The PHCs operating in the region can be categorized as small, medium and large based on the volume handled and location. Smaller PHC's are mostly operational in interior villages, take smaller orchard on contract and for a longer period while the medium ones are relatively closer to mandis, and take medium orchards on contract. Most of the large PHCs play multiple roles as farmers, PHC's and as traders.

PHCs start surveying the litchi orchards from December every year and start purchasing the orchards on lease which is usually informal (no legal documents are signed by the associated parties) at the time of flowering season (February-March). At the time of purchase, the contractors make an on-the-spot assessment of the expected produce from the orchard on the basis of the size of orchard, location, average age of plants and quality of flowering. The lease amount is then mutually agreed upon by the contractor and the farm owner and an advance is given to the owner as an agreement. When fruits attain maturity, the contractors hire local labourers for plucking, pooling, grading and packaging and its cost is borne by the contractor. Generally such lease is for one year but in some cases, the lease duration could be up to five years. In case of contract period of more than one year, the contract prices is negotiated every year. The cost of maintenance, as mentioned above, is borne by the farmer.

PHCs enjoy an advantage as majority of the farmers do not want to go into hassles of marketing due to perishable nature of the produce and risk associated with it. Even if the farmers would like to market the produce they don't have necessary resources including infrastructure for the same.

- **Traders/Aggregators:** These play an important role in distribution of produce to various locations in the country. Generally the traders/ aggregators deal with large volumes of produce. Considering the high perishability of litchi and lacking market infrastructure in the region, the traders/ aggregators operating along the litchi value chain are assessed to be bear of greater marketing risk.
- **Packhouse Operators/Processors:** Currently, there are 3 pack houses/ litchi processors in the cluster. The total installed capacity of these pack houses is only about 5000 MT, which is only 12 per cent of the regional production of litchi. Two of these pack houses are also integrated with processing operations such as pulping. These pack-houses are mostly operated by private Litchi processing companies and are for captive use only. Prominent pack house operators include Unique Foods and Amrapali. These pack house operator mostly procure litchi directly through farmers and sometimes through pre-harvest contractors. At the pack-house the litchi is sorted and graded into various grades manually. As a practice, red color fruit weighing 25-30 gm is graded as Grade A, less than 25 gm weight as Grade B, and discolored ones as Grade C. The total installed capacity of these pack houses is only about 5000 MT, which is only 12 per cent of the regional production of litchi.

Besides the above stakeholder, the State department of Horticulture is responsible for provides extension services to the farmer including technical guidance, input support, support for creation of infrastructure, etc.

National Litchi Resource Center, based out of Muzzafarpur, is also working towards improvement in litchi crop. They have undertaken various activities/action research towards productivity improvement, better nutrient and pest management. Recently they are also working towards bringing in new technologies to the cluster to improve the shelf life. Such technologies include solar powered cold rooms and dip technology (developed in in collaboration with BARC) for retaining fruit quality and color during prolonged storage. National Litchi Resource Center also has pack house in its campus which is available to farmers for use

Activities of stakeholders are depicted below

TABLE 9: FUNCTIONAL ANALYSIS OF VALUE CHAIN

Activity	Agent	Output
Input Supply	Planting Material: Private /Govt Nurseries Self	Planting Material
	Farm Yard Manure/Fertilizer/Pesticides Private Traders Self	Farm Yard Manure/Fertilizer/Pesticides
Training	Department of Horticulture, National Litchi Resource Center	Training on litchi orchard development and maintenance , post harvest management
Production/ Litchi supply	Orchard owners	Litchi
Secondary Processing	Unique Foods Litchika International Unit of Amrapali Foods	Sorted, graded sulphited litchi Pulp RTE products
Trading	Traders (within and outside the cluster) Retailers	Fresh litchi (sorted, graded and packed)

3.4.3. Commodity Flow Analysis

The field surveys in the cluster revealed that the supply chain of Litchi in the District involves multiple intermediaries depending on the point of sale and the destination market. The key players involved in the supply chain of litchi are:

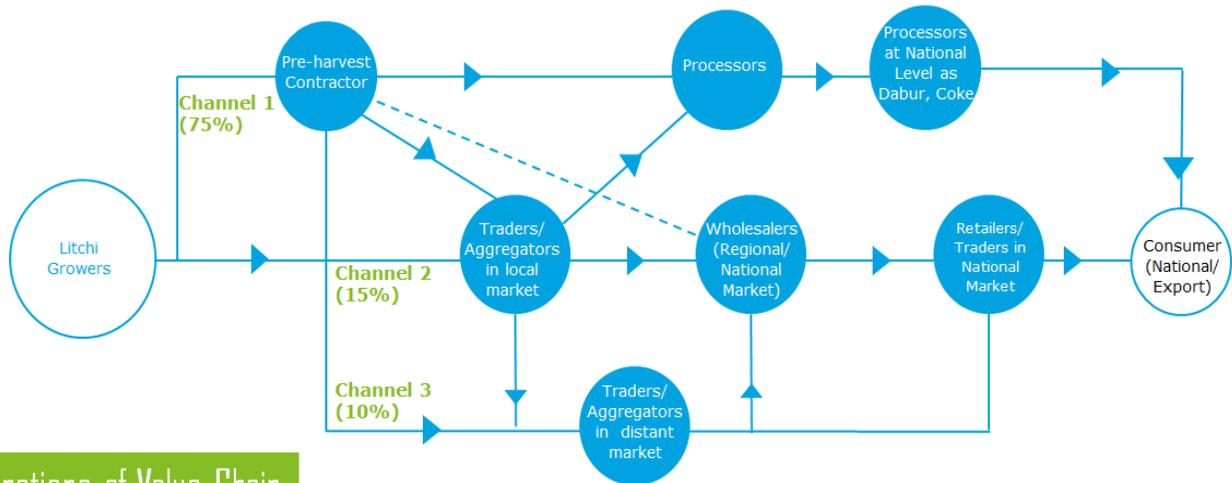
- Growers
- Pre-harvest contractors
- Wholesalers/ Traders at different destinations (local, regional, national level)
- Processor (including pack houses)
- Retailers

Marketing of Litchi in the district to local as well as distant markets is predominantly observed to be carried out through three different marketing channels. Some of the factors which affect the selection of channel include the scale of production, distance from major markets and above all the financial condition of the farmer. It has been observed that in cases where the land owner has other professional interests PHCs emerge as the preferred marketing partner. Pre harvest Contractors are the key players in one such channel and direct selling being the other marketing channel.

The below figure illustrates the different channels in Litchi value chain in Muzaffarpur

FIGURE 7. COMMODITY FLOW

Primary Actor



Functions of Value Chain



Channel 1. Selling to Pre-harvest Contractor

More than 75% of the litchi is marketed through Pre-harvest Contractors. Aforementioned, the pre-harvest contractors contact the farmers, inspect the orchard and fix a price during the flowering or early fruiting stage. The contractors become responsible for all risks and expenses related to undertaking the remaining farm operations including harvesting, sorting, grading, packing, transportation and marketing of produce. The contractor then arranges for the onward sale of fresh produce to the traders and aggregators. Mostly the small PHCs sell to trader/ aggregators in the market in Patna. Whereas many of the medium and large PHCs work with traders located in distant cities like, Delhi, Mumbai, Kanpur, Gorakhpur, Chennai, Lucknow. Some of the PHCs also supply to the processing unit operating in the area

PHCs enjoy an advantage as majority of the farmers do not want to go into hassles of marketing due to perishable nature of the produce and risk associated with it. Even if the farmers would like to market the produce they don't have necessary resources including infrastructure for the same.

Channel 2. Direct Selling in local markets to distant buyers

Other methods used by the litchi growers include direct selling to outside buyers from places such as Ranchi, Rourkela, Kolkata, Siliguri etc, or supplying to local processing units and retail. After APMC act was repealed in the State, many private mandis have come up in different districts, especially in Vaishali and Muzaffarpur, and are emerging as preferred choice of farmers for marketing of litchi. This has mostly affected one year contracts where farmers who take high risk are finding alternative channels to sell their

produce. Though the PHC's are here to stay for their different roles and benefits, their extent of control on litchi marketing may reduce in the new system.

In last 10 years or so after repealing APMC act, private markets in Katarmala, Lalganj, Vaishali, Belsar etc (rural market) and are attracting traders from outside the state during litchi season. Farmers have also found an alternative channel and they get better price by selling in these markets.

Channel 3. Direct Selling to the processors

Some of the farmers are also supplying the produce to the processors operating in the region. Aforementioned, there are about five litchi processors in the cluster including 2 pack houses cum processors (Unique Foods & Litchica), 1 pack house (Amarpali), 2 small scale processors. Reputed processors prefer to buy Shahi litchi of the premium quality, which is known for its flavor and relatively higher pulping percentage. While some processors are also buying china variety of litchi. The procurement price varies between Rs.37-40/Kg depending on the variety and grade.

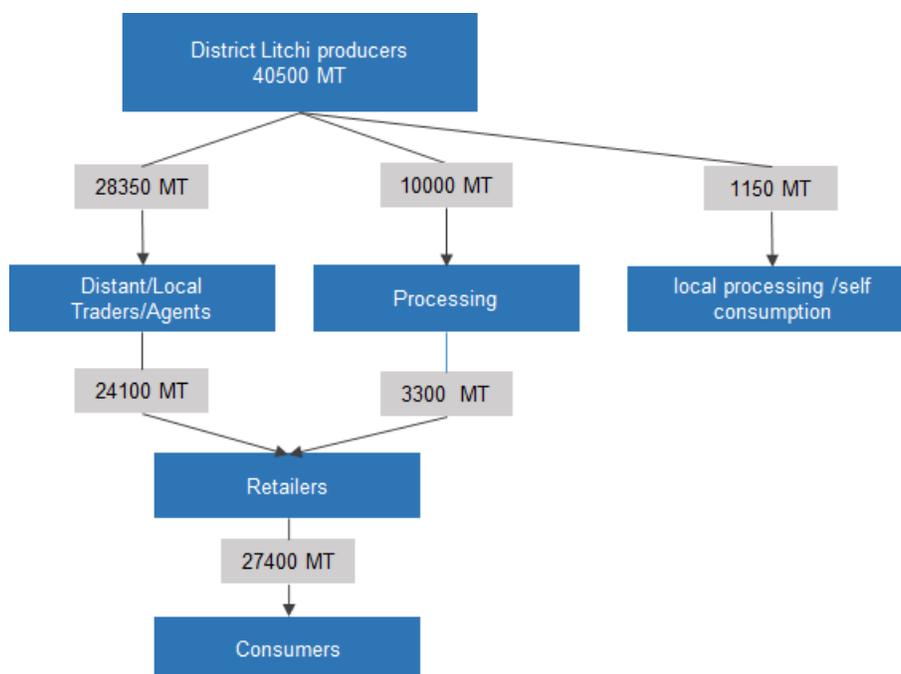
Channel 4. Direct Selling in distant market

According to the field survey estimates, about 80% of litchi produced in the State is assessed to be marketed out of the state. Major markets are Delhi, Lucknow, Kanpur, Varanasi, Mumbai, Chandigarh, Kolkata and Bangalore. In such scenario regional aggregators/PHCs sell the produce through the commission agents based out of these markets. The transportation cost till the produce arrives at the commission agents is borne by the aggregator. Associated risk is also borne by the aggregator.

3.4.4. Quantification of Physical Flow of Litchi along different channels

Based on the commodity flow assessment, the district level physical flow of overall production may be quantified as represented below:

FIGURE 8. QUANTIFICATION OF PHYSICAL FLOW OF PRODUCE



It is notable that only about 25% of the production goes for secondary and tertiary processing. Majority of the produce is directly sold in the market for fresh consumption. Thus, there is a presence of potential opportunity for to link processing sector with farmers for better value addition

3.4.5. Technical Analysis of Various Functions

Production

Farm management in case of Litchi includes orchard development, maintenance and use of appropriate inputs to optimize the production. Orchard development is influenced by certain activities such as soil preparation and plant spacing while maintenance includes mulching and pruning etc. Farm management also includes use of appropriate inputs including fertilizer, pesticides and irrigation.

Pre harvest phase practices affect the overall output of litchi. A fully grown, healthy litchi plant can yield about 100 -120Kgs of litchi. However, during the field survey it was observed that the yield is on an average 70Kg/tree and goes up to 85kg/tree. While there may be extraneous factors (such as bad weather and climatic conditions) behind such low productivity however, the effect of pre-harvest practices may not be negated. Some of the main management practices which have been analyzed in detail under this section include, plant spacing, soil & leaf analysis, ploughing and tillage operations, irrigation and nutrition management.

3.4.5.1. Plant spacing

Proper plant spacing is one of the important factors for optimising returns from litchi orchards. The recommended number of plants in a hectare is 200 (i.e. 80 plants per acre)¹⁰. However, it was observed that farmers in the studied region are planting up to 120 plants per acre (which is almost 150% of the recommended number). Higher number of plants is affecting the plant growth and in turn, the productivity is also hampered.

¹⁰ NHB model report

3.4.5.2. Analysis of soil and leaf

Soil characteristic is one of the most important factors in determining Litchi productivity. Understanding of soil helps in optimum use of nutrients. This can be found out through basic soil testing. However, during the field survey it was understood that none of the farmers in the studied region has undertaken soil testing. While it is understood that basic soil testing facilities are available in Saraiya (neighboring block of the studied region) farmers have not used the facility mainly because of lacking awareness and door step inaccessibility.

It was observed that, in the absence of appropriate soil analysis, farmers tend to apply manure and other nutrients in unscientific way. Mostly, it was observed that they follow the old practices or get influenced by the various options available in the market without realizing the suitability of those particular nutrients for their orchard. It was observed that almost all the farmers are using DAP and urea in the orchards along with farm yard manure.

As a result plants don't get desired type and level of nutrients restricting proper growth of the plant. Most of the deficiency in the soil can be easily identified by the analysis of litchi leaf. However, in the survey, it was observed that farmers' awareness is quite low in this regard.

3.4.5.3. Ploughing (inter-cultural activity) & Mulching

Proper ploughing is a must for ensuring proper growth of the plants and maintaining its health. This also helps in removing the unwanted weeds. This practice is being followed by most of the farmers.

Mulching of soil helps in maintaining good sanitary conditions at orchard level, which is a must for keeping the orchard healthy, and in disease free condition. Besides this it also helps plants in taking nutrients from soil effectively and efficiently. Majority of farmers covered during the survey undertake ploughing at least once a year between August and December, while some do it as late as January.

3.4.5.4. Irrigation

Litchi being an evergreen plant requires optimum soil moisture for growth and development of the plants and fruit production. Frequent irrigation is necessary during early plant growth up to 3-4 years of age to favour rapid vegetative growth. During non-fruit bearing stage, it is recommended to schedule irrigation at an interval of 15 days during Oct-Nov and at one month interval during Dec- Feb, and at one week interval during March-July. The schedule changes when trees come into bearing stage and the trees don't require water till flowering stage and fruits setting, i.e. from Nov to March. Thereafter, trees need regular watering up to harvesting stage, i.e. May-June. It was observed that bore-wells/dug wells are the most used source of irrigation. Availability of electricity was not found to be an obstacle for irrigation.

In the cluster, it was found out that farmers are following regular irrigation practice for young plants but don't irrigate the mature plants as required. However, farmers from Kanti Block are more aware of the requirement and are trying to follow the recommended practices as far as irrigation is concerned. Some farmers off late have also adopted drip irrigation with support from State Horticulture Mission.

3.4.5.5. Use of Fertilizer and Pesticides

An average of 20 Kg of FYM per mature tree was applied by most of the farmers. Oil cake of Neem and Castor are also applied but is generally done in alternate years or in a gap of 2 to 3 years. Urea is the most common chemical fertilizer used by the farmers. About 200 to 500 grams of urea per mature tree is usually applied by the farmers after the first irrigation. Many farmers repeat the dosage of urea after the irrigation. Around 1 to 1.5 Kg of DAP per plant mixed with 0.5 Kg of MoP is applied in Sep-Oct.

There is also practice of spraying the plants with insecticides like Dicofol and NKSE at the time of flowering and when the fruits matured but not ripened. Use of organic pesticides/insecticides was not observed during the study.

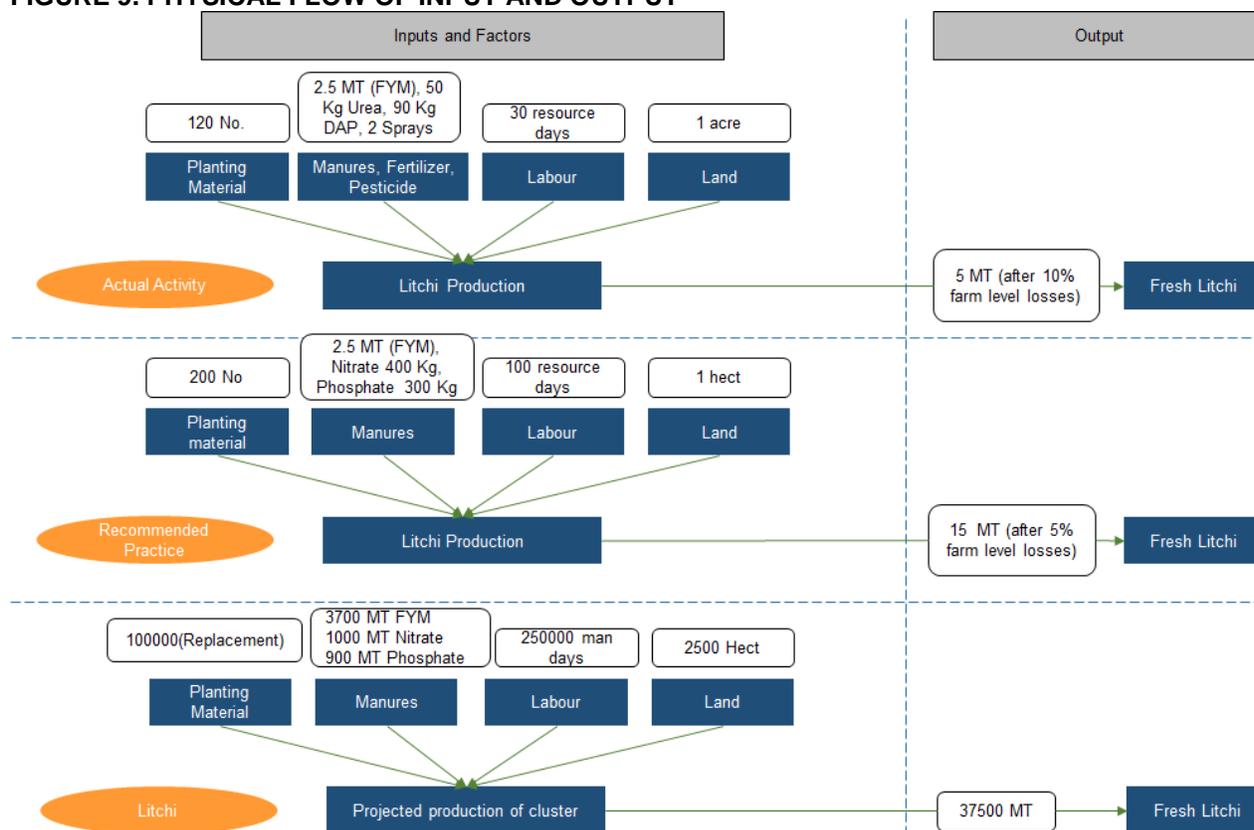
3.4.5.6. Some other Practices

Intercropping: Litchi is a slow-growing tree and takes at least six years for initial flowering and fruiting. Intercropping ensures an adequate return from the orchard in pre-bearing phase and also provides a supplementary source of income to the farmers even at the later stage. This practice was mainly in the small and medium level farmers whereas it was not observed in the large orchards. Turmeric was observed as the intercrop. It was also understood that maize is also used as inter-crop

Apiculture: It has developed in last few years in the cluster and surrounding areas/districts where mainly four types of honey are produced– litchi, karanj, mustard and sarguja are produced. While it may have a positive role in pollination, farmers are using this as a secondary income generating activity from the farming.

Based on the above technical analysis of production practices, it is assessed that if recommended package of practices are followed, the current yields may be increased by 20% per unit area.

FIGURE 9. PHYSICAL FLOW OF INPUT AND OUTPUT



Harvesting & Post Harvest Management

It was observed that harvesting and post harvest management activities in the cluster are influenced by the marketing channel being adopted by the farmers. In case of PHC, the harvesting and post harvesting activities are the responsibility of the PHC. Whereas, in case farmer is selling produce on their own through middlemen/aggregator, then these activities are the responsibility of the farmer.

3.4.5.7. Harvesting

As mentioned earlier, PHC was found to be the dominant marketing channel and thus it was observed that harvesting and post harvest activities are predominantly managed by pre-harvest contractors. Once the deal between farmers and pre-harvest contractors is finalized the litchi orchards are given away to

these contractors who are then fully responsible for management of the orchards. These pre-harvest contractors agree on pre-determined terms and a price per tree is arrived at and settled at the time of plucking, grading, packaging, storage and the transportation. The farmers have a very little or no say in this process.

Litchi being a non-climacteric fruit, it is critical to rightly determine the quality, color and flavor at the time of harvesting. Typically, the PHC deployed labors for fruit harvesting. Often the employed labour employed is unskilled and are professionally untrained on proper harvesting practices. This often results in damaging the tree and in some cases the fruit also.

3.4.5.8. Primary processing (Sorting, Grading and Packing)

Grading of fruits is mostly done based on fruit colour and size and for any damage /injury to the fruit. Generally, damaged and cracked fruits are sorted and rest are packed as a bunch along with twigs and leaves. The type and size of packaging depends on market preferences and availability. As a usual practice, Litchi is mostly packed in bamboo baskets or wooden crates lined with dried litchi leaves cushioning the produce. Some growers also use plastic crates. The required packing material is usually supplied by the traders, except the bamboo baskets which are manufactured locally. In case of pack-houses, which supply to premium markets, the packing material is usually procured from suppliers based out of Delhi and Kolkata on made to order basis and is usually branded as per traders/processors requirement. Per box of litchi packed in wooden boxes or bamboo basket weighs about 4-5 Kg. In case of supply to premium markets, the produce is sometimes packed into cardboard boxes at 2 kg per box weigh.

3.4.5.9. Secondary Processing

Processing of Litchi in the cluster is limited mostly to two units Unique Foods (RK Agribiz) and Litchika International. The combined installed litchi crushing capacity of these two units would be approximately 25000 MTs/annum. Another processing unit Amrapali foods is operational in the neighbouring district of Vaishali.

It is to be noted that these units are consuming about 10000 MTs of Litchi from the cluster and adjoining areas for their processing purpose. It may also be noted that Unique Foods is supplying litchi pulp, etc, to branded processors such as Coca Cola and Dabur whereas Litchika has its manufacturing facilities in Mumbai and Delhi where the Litchi pulp is being used further for processing products such as juices.

Unique Foods and a sister concern of Amrapali Foods are also marketing fresh litchi through their pack house operations.

Transportation and logistic

Litchi fruit is sensitive to temperature and humidity variation. Thus, it is highly perishable and cannot be stored at farm level for more than few days after harvest. Prolonged storage requires appropriate pre-cooling infrastructure. In order to retain the desired colour and quality of produce, is important for produce to reach the market locations at ambient temperature within 24-36 hours after plucking. As the adequate cooling facilities are absent for direct use by the farmer, they generally tend to immediately sell the produce after sorting and grading to the local traders/processors/ buyers from distant markets. Further up the value chain, very few traders (except the processors) own or have access to cold chain infrastructure and required refrigerated vans for selling the produce in distant bigger markets as Delhi, Mumbai, Chennai etc, that offers premium price. Thus, lack of proximal cold stores, refrigerated vans/ trucks are among major bottlenecks

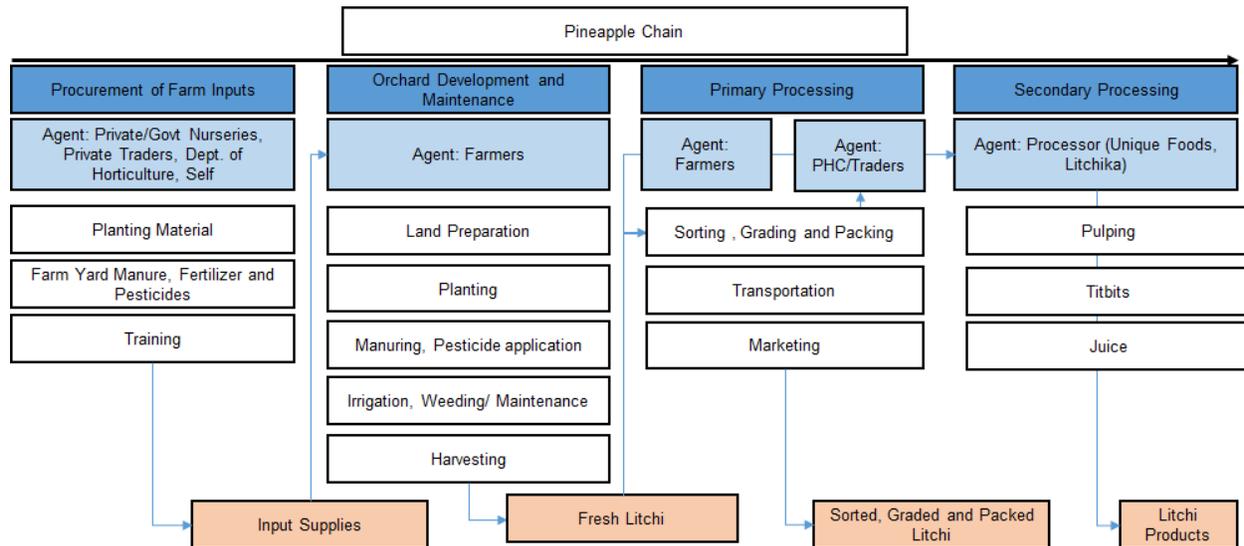
Market infrastructure

As mentioned earlier, post abolishment of APMC act in the state, there are private markets which are providing basic infrastructure such as weighing, trading platform, etc to the traders/farmers. However, none of these private markets have facilities such as pack houses. Limited number of pack houses are available with the private traders/cold storage owners or processors which are mostly for their captive use. Prominent pack house operators include Unique Foods and Amrapali. It is also understood that a pack house in Gaya is operational in the recent past. However, its utility for the litchi cluster is limited. National Litchi Resource Center has also established a pack house in its campus which is available to farmers. It may be noted that as per the “ Recognized Pack House list issued by APEDA as on 07/10/2017” there is not a single pack house in Bihar which is recognized by APEDA

In context to market infrastructure, it is notable that various initiatives by Central as well as State agencies are being taken to improve the litchi value chain. APEDA is in the process of creating required post-harvest infrastructure for promoting litchi exports from the state. Such infrastructures would include pack houses. Similarly a Fruit Dip Treatment Machine is also being established in the cluster to improve the shelf-life of Litchi. While the pack houses will be developed in partnership with private investors the Dip Treatment is being established in collaboration with BARC.

Apart from these infrastructures, Govt. of Bihar is also providing grant assistance for creation of processing and value addition infrastructure under its Industrial Incentive Policy 2016. The policy has identified litchi processing as one of the thrust areas. Under the erstwhile Industrial Incentive Policy of 2011 around 3 litchi processing units and 4-5 Rural Agri-business Centers with focus on Litchi/other fruits have been promoted in the cluster. Ministry of Food Processing, Govt. of India, is also providing necessary assistance to develop cold chain, value addition and preservation infrastructure; backward and forward linkages, etc. Recently a unit of Unique Foods has been sanctioned grant assistance under the Cold Chain scheme for developing an Integrated Cold Chain and Processing Infrastructure with focus on Litchi.

FIGURE 10. TECHNICAL ANALYSIS



3.5. Production Cost-Benefit Analysis

Litchi cultivation requires initial investment in terms of orchard development and recurring expenditure in terms orchard management. Initial investment is approximately Rs.60,500/- assuming that on an average

100 saplings are planted per hectare. However, the same may increase further based on the inclusion of other infrastructures.

TABLE 10: INVESTMENT IN ORCHARD

Particulars	Cost in Rs.
Land Preparation	2500
Litchi Saplings	3000
FYM	2000
Fertilizers	9000
Pesticides	3000
Irrigation Infra (including pump sets)	30,000
Labour	6000
Contingencies	5000
Total	60,500

Annual maintenance cost was found to be approximately Rs. 18,200/- per hectare

TABLE 11: ANNUAL MAINTENANCE COST

Particulars	Cost in Rs.
FYM	2000
Fertilizers	3000
Pesticides	1200
Irrigation	6000
Labour	6000
Total	18,200

Considering average productivity of 7MT/hect¹¹ (considering 70Kg per tree) the farmer would realize approximately Rs.2,10,000/- from a hect of litchi crop. This implies in a normal year a farmer can earn approximately Rs.2 lakh from one hect. Of litchi farming assuming that all post harvest activities are taken care of by Post Harvest Contractors or Traders/Agents. It may be noted that the litchi orchards start yield around 6th year of plantation. A tree can bear fruit till 25-30 years. However, the yield may reduce after 20th year. Further to this context, it may be noted that based on the post harvest activities being undertaken by the farmer he may have to incur additional cost of approximately Rs. 7,500/- per hectare towards harvesting, sorting, grading and packing¹². This cost assumes that the trader will procure the produce from the farm gate itself. However, in such instances where farmer assumes the role of aggregator he has to incur an additional expenditure of approximately Rs.47,000/- over and above the expenditure towards cultivation. Detailed break-up of this expenditure is as follows:

Cost Head	Details	Cost in Rs./Hect
Harvesting	5 labour days	1250
Sorting grading and packing	20 labour days	5000
Packaging box/material	Approx. Rs.20 per 6 Kg pack	23333
Transportation (Up to Patna in Normal Trucks)	Approx. 5000 per a small van of 2 MT carrying capacity	17500

The above additional investments suggests why most of the farmers are not in a position to market the produce directly. The detailed cost benefit analysis is tabulated below:

¹¹ Average productivity in Kanti block was found to be around 8.5 MT

¹² Without including packaging material cost

TABALE 12: DETAILED COST BENEFIT ANALYSIS (PHC MARKETING CHANNEL)

A. Cost of initial investment & maintenance of Litchi orchard (in Rs. / ha)

Activity	Assumption	Establishment Year	Year				
			1	2	3	4	5
Land Preparation	4-6 hrs through tractor	2500	-	-	-	-	-
Planting material	120 saplings @ Rs.25 each	3000	-	-	-	-	-
Use of FYM during land preparation	2 tractor loads	2000	2100	2205	2315	2431	2553
Irrigation Infrastructure (excluding cost of bore well)	Pump set 3-5HP and pipes	30000	-	-	-	-	-
Fertilizer		9200	3255	3418	3589	3768	3956
i. Urea	3-4 bags	1800	945	992	1042	1094	1149
ii. DAP	2 Bags	2400	1260	1323	1389	1459	1532
iii. Labour	20 labour days	5000	1050	1103	1158	1216	1276
Pesticide	LS	3000	1260	1323	1389	1459	1532
Irrigation cost	Labour and Elect	2000	6300	6615	6946	7293	7658
Maintenance Cost (Pruning/Mulching)	20 labour days	5000	6300	6615	6946	7293	7658
Others		4000	-	-	-	-	-
Total (A)		60700	19215	20176	21185	22244	23356
Yield (kg per plant)		-	-	-	-	-	-
Total Production		-	-	-	-	-	-
Average Price		30	31	31	32	32	33
Revenue (B)		-	-	-	-	-	-
Earnings (B – A)		-60700	-19215	-20176	-21185	-22244	-23356

B. Cost of maintenance & annual returns of Litchi orchard (in Rs. / ha)

Activity	Year														
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Use of FYM during land preparation	2680	2814	2955	3103	3258	3421	3592	3771	3960	4158	4366	4584	4813	5054	5307
Fertilizer	4154	4362	4580	4809	5050	5302	5567	5846	6138	6445	6767	7105	7461	7834	8225
i. Urea	1206	1266	1330	1396	1466	1539	1616	1697	1782	1871	1965	2063	2166	2274	2388
ii. DAP	1608	1689	1773	1862	1955	2052	2155	2263	2376	2495	2619	2750	2888	3032	3184
iii. Labour	1340	1407	1477	1551	1629	1710	1796	1886	1980	2079	2183	2292	2407	2527	2653
Pesticide	1608	1689	1773	1862	1955	2052	2155	2263	2376	2495	2619	2750	2888	3032	3184
Irrigation cost	8041	8443	8865	9308	9773	10262	10775	11314	11880	12474	13097	13752	14440	15162	15920
Maintenance Cost (Pruning/Mulching)	8041	8443	8865	9308	9773	10262	10775	11314	11880	12474	13097	13752	14440	15162	15920
Total (A)	24524	25750	27037	28389	29809	31299	32864	34507	36233	38044	39947	41944	44041	46243	48555
Yield (kg per plant)	70	70	70	70	80	80	80	80	80	80	80	80	80	80	80
Total Production	7000	7000	7000	7000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
Average Price	34	34	35	36	37	37	38	39	40	40	41	42	43	44	45
Revenue (B)	236494	241224	246048	250969	292559	298410	304378	310466	316675	323008	329469	336058	342779	349635	356627
Earnings (B – A)	211970	215474	219011	222580	262750	267111	271514	275958	280442	284964	289522	294114	298738	303391	308072

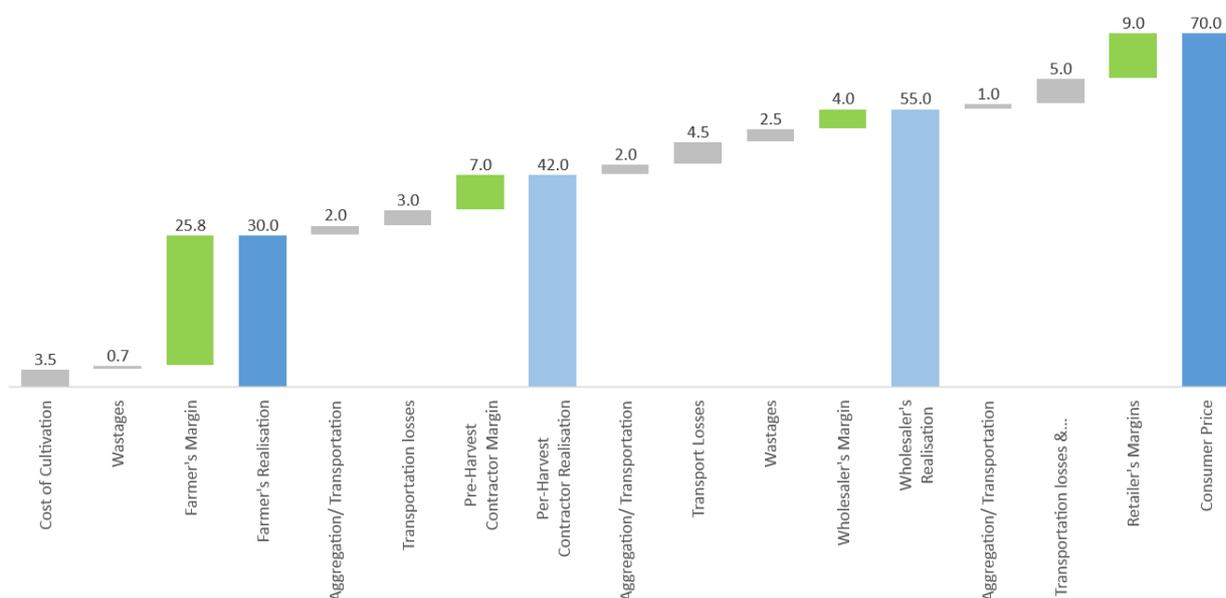
3.6. Analysis of value addition and price build-up from Farmer to Intermediaries to Consumer

As mentioned above, the farm gate price of litchi is approximately Rs.30/Kg¹³. However, the consumer price at Patna is approximately Rs.70/Kg and in Metro Markets such as Delhi it is up to Rs.90/kg. The price built-up till the consumption point is depicted below:

TABLE 13: PRICE BUILD UP PER KG OF LITCHI

	Farmer	PHC	Wholesaler	Retailer
Cost of Cultivation/Procurement	3.5	30.00	42.00	55.00
Aggregation/Transportation	-	2.00	2.00	1.00
Transport loss	-	3.00	4.50	2.50
Wastages	0.70	-	2.50	2.50
Total Cost	4.20	35.00	51.00	61.00
Margin	25.80	7.00	4.00	9.00

The value built up at different phases is diagrammatically depicted below:



3.7. Identified Gaps and Constraints

Production related

- The land holdings are small and the recommended number of saplings are not being adhered to. It was observed that farmers are planting up to 30% more saplings per acre which is affecting the productivity.
- Due to lack of soil testing and knowledge about the soil quality fertilizers are not being used appropriately.
- Farmers do not follow the recommended package of practices especially related to pruning and mulching.
- Increasing incidence of fruit crop damage temperature fluctuations, hailstorm.

¹³ It may be noted that while farmers are selling litchi on per Kg basis in Minapur in Kanti it is mostly per 100 fruits. However, the price variation is not more than Rs.5/- per kg

- In order to address the production practice related issues there is a need to create awareness about
 - Plant spacing and schedule of ploughing, mulching
 - Irrigation practices and frequency
 - Usage of fertilizers and other nutritional inputs

However, it was noted that extension/training services related to above are not adequately available

- Many of the pre and post harvest methods require skilled labors which are scantily available. The scarcity is felt severely during harvesting season and it adversely affects the quality of litchi due to improper plucking and handling. However, it was noted that the labour currently being deployed are not skilled enough to understand the intricacies of harvesting

Post Harvest Management Related

- Currently, the wastage level in supply chain (in terms of value loss) is about 20-25% mostly due to improper sorting, grading and packaging etc. This loss can be minimized by adopting better methods.
- Fumigation by sulphur dioxide is used to control browning of pericarp and some pack houses are fumigating litchi in the studied region. However, some users have raised concern about the residue of sulphur in the crop

Cold Chain and Transportation

- As most of the litchi orchards are small in size the crop need to be aggregated properly and then transported to market through an appropriate medium. Considering the high degree of perishability of the crop it is essential that temperature controlled vehicles are used. Looking at the temperature during the harvesting season pre-cooling may also be required to prolong the shelf life. All these would be possible if there are appropriate cold chain logistics in place. However, the region does not have any integrated cold logistics for the crop
- There are total of 2 pack houses in the area which could process only about 1000 MT- 1200 MT annually. This is insufficient to given the large quantity of litchi trade in the state.

Marketing Related

- The overall efficiency of litchi value chain may increase with more alternative channels for litchi selling. At present, PHC's are the single largest channels which has lots deficiency on terms of quality and price realization to farmers. The popularity of private markets is an indication of need for such more markets.

Processing Related

- As mentioned earlier about 20% of the total produce is being processed in the cluster. While tin one hand processors are not able to procure required quantum of raw material on the other hand farmers are facing value loss. This contradiction can be addressed if there is proper connect between processors and farmers.

4. DEMAND ASSESSMENT

4.1. Litchi Products Map

There are more than 200 cultivars known but very few are in commercial production¹⁴. The international trade of litchi happens in raw form¹⁵ only while other products like canned juice, squash and preserved litchis are also available commercially.



4.2. World Production of Litchi

The litchi was introduced to the tropical and subtropical world from the end of the 17th century and now is found situated within 15-35° latitude in most countries. Large commercial industries have developed in Taiwan, Thailand, India, Vietnam, Madagascar and South Africa. There is substantial interest in the crop in Australia, Mauritius, Reunion, Spain, Bangladesh, Indonesia, Mexico and the United States.

Litchi is a minor crop in the world with total production of the crop being estimated around 2.8 million metric tonnes¹⁶. As has been mentioned earlier the production is confined mostly in Asian countries with Australia and parts of USA showing keen interest in cultivating the crop. More than 50% of the crop is produced in China with India contributing about 20%.

4.3. Domestic Demand and Trade

4.3.1. Production of Litchi in India

India is the second largest producer of litchi after China. In 2014-15, the annual production was 0.52 million tonnes of which 37% alone came from Bihar. The overall area under cultivation was 85 thousand hectares. Major litchi producing states in India are Bihar, West Bengal, Jharkhand, Assam and Chhattisgarh. Muzaffarpur district of Bihar is the hub of litchi production¹⁷.

Bihar's annual litchi production in 2014-15 was 198 thousand MT in an area of 32 thousand hectares. Other states are far below in production quantities. West Bengal production was 76 thousand tonnes while Jharkhand's production was 59 thousand tonnes in 2014-15. While India's production is very high in world statistics, a declining trend has been observed in the last few years. The production in

¹⁴ Overview of Litchi Production in Asia-Pacific Region, Food and Agriculture Organisation (<http://www.fao.org/docrep/005/ac684e/ac684e04.htm> accessed on 31.08.2017)

¹⁵ International Trade in Goods – Exports 2001 – 2016, International Trade Centre (<http://www.intracen.org/itc/market-info-tools/statistics-export-product-country/> accessed on 31.08.2017)

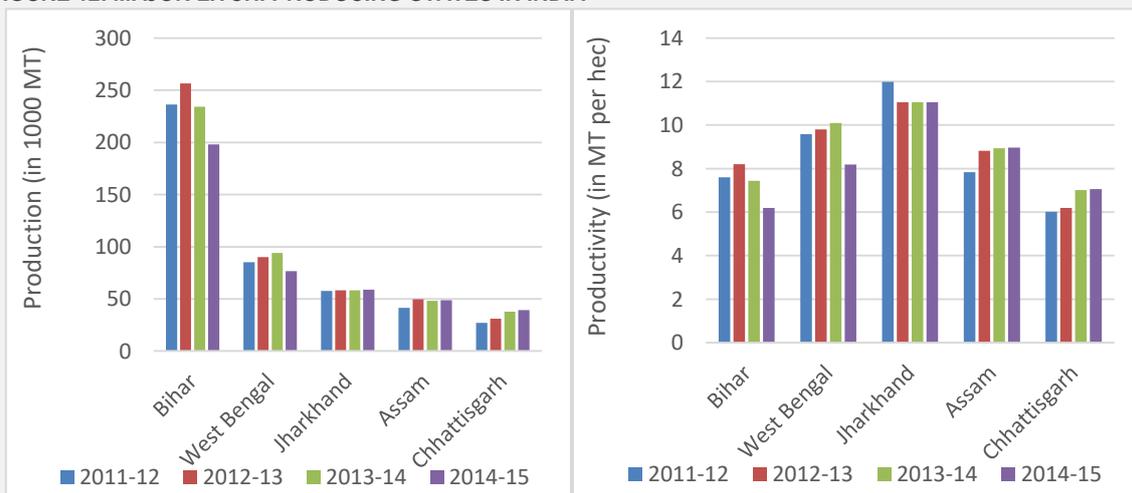
¹⁶ Research paper by International Horticulture Society

¹⁷ Final Area and Production Estimates for Horticulture Crops for 2014-15, National Horticulture Board ([http://nhb.gov.in/area-pro/2014-15\(FinalEstimate\).xlsx](http://nhb.gov.in/area-pro/2014-15(FinalEstimate).xlsx) accessed on 31.08.2017)

2012-13 was -5.8 million tonnes which reduced by 9% in 2014-15. Moreover, Bihar has seen a decline rate of 12.1% annually from 2012-13 to 2014-15¹⁸.

The annual productivity of litchi is 6.22 tonnes per hectare. Bihar has a comparable productivity of 6.19 tonnes per hectare with that of India. Other leading producers have higher productivity. Punjab has the highest productivity of 16.15 tonnes per hectare followed by Jharkhand at 11.04 tonnes per hectare. Similar to production, productivity has also shown a decline from 7.01 tonnes per hectare to 6.22 tonnes per hectare. Recent decreasing trends in litchi production asks for improvement in the value chain to ensure better yield and returns to the farmers¹⁹.

FIGURE 12: MAJOR LITCHI PRODUCING STATES IN INDIA



Source: National Horticulture Database 2014 and 2016

4.3.2. Export / Import of Litchi in India

Indian export market is not diverse and everything produced is consumed within the country only. The year of 2014-15 saw a highest export of 961 tonnes in recent years which is just 0.18% of the total produce. The major importing countries are Nepal, Thailand, UAE, France and Kuwait. However, export market reduced significantly to just 125 tonnes in 2016-17. The presence of China as a significant competitor produces a big challenge to the Indian export market. Significant interventions are required in value chain of the fruit to build the export market. The table below shows the export statistics of India in the last 5 years for litchi in terms of production and corresponding values²⁰.

¹⁸ Statewise area, production and productivity of Litchi, Indian Horticulture Database 2014, National Horticulture Board (http://nhb.gov.in/area-pro/NHB_Database_2015.pdf accessed on 31.08.2017)

¹⁹ Statewise area, production and productivity of Litchi, Indian Horticulture Database 2014, National Horticulture Board (http://nhb.gov.in/area-pro/NHB_Database_2015.pdf accessed on 31.08.2017)

²⁰ Top Destination APEDA, International Trade, APEDA (<http://agriexchange.apeda.gov.in/IntTrade/TopDestinationAPEDA.aspx> accessed on 29.08.2017)

TABLE 14: EXPORT OF FRESH LITCHI FROM INDIA IN TERMS OF QUANTITY AND THEIR CORRESPONDING VALUES

Importer Countries	2012-13		2013-14		2014-15		2015-16		2016-17	
	Quantity	Value								
	tonnes	1000 USD								
Nepal	116.831	46	32.365	22	44.6	29.75	9.4	6.02	53.96	46.02
Thailand	0	0	0	0	0	0	0	0	50	31.11
UAE	0.125	0	0.5	1	0.03	0.02	0.03	0.03	20.371	78.28
France	0	0	0	0	0	0	0	0	0.46	1.79
Kuwait	0	0	0	0	0.09	0.15	0.12	0.47	0.33	0.69
Total	807.848	215	55.385	46	961.43	358.36	9.87	6.84	125.37	158.23

Source: India Export Statistics, APEDA

India being the second largest producer doesn't require significant imports. India has a very small import market required for certain varieties which are not produced indigenously. India imports litchi from Madagascar, Thailand, China and Mauritius. Moreover, the import market has also reduced in recent years. The table below compares the import statistics of India for the last 5 years from different nations in terms of quantity and their corresponding values²¹.

TABLE 15: IMPORT OF FRESH LITCHI FROM INDIA IN TERMS OF QUANTITY AND THEIR CORRESPONDING VALUES

Exporter Countries	2012-13		2013-14		2014-15		2015-16		2016-17	
	Quantity	Value								
	tonnes	1000 USD								
Madagascar	0	0	0	0	0	0	19.2	10.67	44	37.09
Thailand	32.05	35.41	18.77	33.61	360.45	936.05	0.39	0.35	0.2	0.11
UK	0.4	0.75	0.36	0.5	0	0	0	0	0	0
China	20	18.84	87.36	108.31	0	0	17.66	19.22	0	0
South Africa	1.26	0.93	0	0	0	0	0.1	0.09	0	0
Netherlands	0	0	0	0	0	0	0.15	0.2	0	0
Mauritius	0.96	0.7	1.25	1.05	0.6	0.7	0.29	0.35	0	0
Total	54.67	56.63	107.74	143.48	361.05	936.75	37.78	30.88	44.2	37.2

Source: India Export Statistics, APEDA

²¹ India Import APEDA, International Trade, APEDA (<http://agriexchange.apeda.gov.in/IntTrade/TopDestinationAPEDA.aspx> accessed on 29.08.2017)

5. RECOMMENDATIONS/ PROPOSED ACTION PLAN

Considering the gaps that exist at each level of the Litchi value chain in Mujaffarpur, it is essential to adopt an integrated approach for value chain development. The interventions must address both the low (decreasing) productivity and infrastructural constraints for higher value realisation. Given the competing use of land, while it is not expected that the area under the crop will not improve drastically, the production can be improved with adoption of recommended package of practices. With the enhanced production in place, there will be demand for adequate supply chain infrastructure and integration thereof. The interventions must also take into cognizance degree of perishability associated with the crop and should factor in the same for designing any intervention

The Mission for Integrated Development of Horticulture recognizes the important role of developing existing litchi value chain in the cluster. Various centrally and state sponsored schemes have provided the necessary stimulus to the horticulture sector, which has enabled the achievement of a healthy growth rate in the past. However, to compete sustainably in global market and under liberalized trade regime, necessity is recognized to focus on both productivity enhancement as well as value chain development for increased profitability and improved market access.

Having studied the challenges and constraints faced by the sector, a holistic approach comprising of combination of both *soft* and *hard* interventions is proposed to be implemented for increasing litchi production and productivity in the region, develop and integrate required supply chain and facilitating higher value addition.

- Soft interventions are proposed to be implemented across the district and would consist of short term training & exposure visit related to production, post-harvest management and processing/value addition etc envisaged to enhance the technical skill for farmers as well as technician, extension workers, entrepreneurs and other operating in the sector. Such interventions are proposed to be delivered through institutions specializing in the subject area.
- Hard interventions are majorly being proposed to meet cluster specific requirements based on the assessed need. Hard interventions under the programme shall cater to all the value nodes of the litchi value chain and primarily aim at creating tangible common assets to support the developmental requirement of litchi value chain in Muzaffarpur

An effort has been made to align the activities with the overall objective of horticulture mission and initiatives being undertaken by other agencies (State governments, bilateral and multilateral organisations).

Integral with the objective of the interventions, the proposed soft & hard interventions are focused on forging the vertical as well as horizontal linkage along the litchi value chain. Placing the proposed interventions in the value chain context, the soft & hard interventions have been categorized into 5 components viz.

- a) Production related
- b) Post-harvest
- c) Market Infrastructure & Cold Chain
- d) Processing
- e) Overarching (horizontal linkage)

TABLE 16: SUMMARY - RATIONALE OF PROPOSED ACTION PLAN

Component	Objective	Constraints	Required Intervention	Recommended Action Points
Production Related	Increasing production as well as productivity through area expansion and adherence to recommended package of practice	<p>Planting Material</p> <ul style="list-style-type: none"> • Use of varieties which can withstand the effects of climate change <p>Cultivation Practice</p> <ul style="list-style-type: none"> • High density cultivation • Non-adherence to recommended packages of practices especially related to, mulching and integrated pest and nutrition management <p>Other constraints</p> <ul style="list-style-type: none"> • Low scale of production at individual level leading to inadequate focus on creating farm level post harvest infrastructure • Emerging competing use of land especially due to urbanisation 	<ul style="list-style-type: none"> • Area expansion under litchi especially those varieties which are climate resistant • Development of nurseries for new varieties integrated with demonstration plots to cater to the need of quality planting material • Training of existing as well as new farmers (to be brought in under area expansion) on packages of practices 	<p>Infrastructural Assistance</p> <ul style="list-style-type: none"> • Setting-up of 5 nurseries integrated with demonstration plots at decentralized locations with technical linkage with National Litchi Resource Center <ul style="list-style-type: none"> ○ The nurseries will provide required planting material ○ Demonstration plots can be used as training venues • Area Expansion through providing appropriate incentive (in the form of planting material, input kits) in close co-ordination with Horticulture Department <p>Awareness</p> <ul style="list-style-type: none"> • On use of available infrastructure/facilities/institutions • INM/IPM <p>Training</p> <ul style="list-style-type: none"> • Training of farmers on packages of practices • Training of Trainer(s) which may be the extension officers, village agent or progressive farmers • Training on harvesting
Post harvest infrastructure	Creation of appropriate infrastructure to aid in arrest value loss at the field level	<ul style="list-style-type: none"> • Litchi is a highly perishable commodity and is harvested during peak summer season. In order to improve its shelf life the product has to be pre-cooled immediately. However no such facility is available at the farm level • Produce is being sold without proper sorting, grading • Proper packaging is also not done resulting in value loss • Transit storage facility is not available leading to wastage or sale at a lower price 	<ul style="list-style-type: none"> • Development of farm level mobile pre-cooling centers (in close proximity to litchi orchards) • Development of pack houses having sorting, grading and packing facilities • Training of farmers on various aspects of post-harvest management 	<p>Infrastructural Assistance</p> <ul style="list-style-type: none"> • Provision of 10 Farm Level Mobile pre-coolers each having a capacity of 2MT/batch. Each mobile pre-cooler can be used for three batches effectively resulting in a capacity of 6 MT/day <ul style="list-style-type: none"> ○ Over a 30 day harvesting period the mobile pre-coolers can accommodate approximately 1800 MT of produce which is approximately 5% of the current production ○ This should be seen as a demonstrative action driving people to adopt the practice and investing in the same ○ These mobile pre-coolers do not require any land and thus may require very small time to be in place ○ The mobile pre-coolers can be solar powered

Component	Objective	Constraints	Required Intervention	Recommended Action Points
				<ul style="list-style-type: none"> • Development of pack houses in 5 locations <ul style="list-style-type: none"> ○ Such facilities will have sorting, grading and packing facilities ○ A cold room will be attached to the facility for short term storage ○ The cold room may run on alternate energy ○ Each pack house can be of 10 MT capacity ○ Such post harvest infrastructure can be developed and managed by farmer groups • Both the collection center and post harvest infrastructure may collect minimum user fee to meet operating costs <p>Training</p> <ul style="list-style-type: none"> • Training of farmers on post-harvest management/primary processing • Training of Trainer(s) which may be the extension officers, village agent or progressive farmers • Exposure tours within & outside State for growers/ technical staff/ field functionaries
Supply Chain/ Cold Chain Logistics	<p>Seamless Logistics for produce movement</p> <p>Improved market infrastructure</p>	<ul style="list-style-type: none"> • There is no proper markets place for the producers to sell their produce. Existing markets do not have minimum infrastructure such as trading platforms, storage or utilities • Produce is being transported in pick up vans and is exposed to heat, rain, dust etc resulting in value loss • Transportation is a key constraints especially during the peak harvesting season 	<ul style="list-style-type: none"> • Development of private markets • Provision of reefer vans 	<p>Infrastructural Assistance:</p> <ul style="list-style-type: none"> • Development of 2 private markets <ul style="list-style-type: none"> ○ Facilities for trading, price information, storage, ripening, etc to be included ○ Land can be procured from the community ○ The markets can also deal with other produce • Provision of 10 reefer vehicles (of 6 MT capacity each)
Processing	To enhance the market for the	<ul style="list-style-type: none"> • Quantum of processing is low in the cluster and is confined to 2-3 industry 	<ul style="list-style-type: none"> • Development of high end processing units 	Hard Interventions (Infrastructural Assistance):

Component	Objective	Constraints	Required Intervention	Recommended Action Points
	produce and initiate further value addition	players only <ul style="list-style-type: none"> Most of the processing is happening for intermediate products while the final produce is being processed at a distant location 		<ul style="list-style-type: none"> 2 litchi product units
Collective Action and Branding	Improve economies of scale to further develop the value chain (considering the current scale of production at individual levels) Improve bargaining power of the farmers Develop capacities at group level to operate and manage the common facilities	<ul style="list-style-type: none"> Current scale of production at individual level is very low and no common action is observed In the absence of a proper scale of production farmers are not able to effectively interact with the market forces 	<ul style="list-style-type: none"> Develop Farmer Interest groups/Producer Groups Promote organic nature of the produce through sustained campaigns 	<ul style="list-style-type: none"> Creation of State level nodal agency (for overall value chain development activity, whether in Muzaffarpur or other clusters) Interventions for supporting infrastructure Collectivisation of Farmers/Formation of Farmer Interest Groups/Producer Groups Branding and Recognition Development of project management and monitoring framework

5.1. Production Related

Those activities focussing on increased productivity by way ensuring quality planting material supply, transferring best practices, facilitating use of appropriate inputs are covered under this category. The activities would include training / capacity building & setting up of infrastructure facilities related to dissemination of production technologies, supply of planting material, etc.

5.1.1. Infrastructural Assistance

5.1.1.1. Setting-up of nurseries along with demonstration plots

As has been mentioned earlier, the production is going down in the cluster because of climatic changes. This requires adoption of new varieties. While some of the farmers have adopted new varieties this may have to further studied and farmers may be advised appropriately. One step towards this would be development of nurseries which can provide the saplings of the new varieties. Such nurseries may be developed with technical inputs from National Litchi Resource Center (NLRC) which is continuously doing research towards developing climate adaptive varieties.

Thus model nurseries may be established in the cluster which can supply saplings to the farmers at reasonable prices. The nurseries may be integrated with demonstration plots which can be used for training purposes. Considering the importance of nurseries in improving productivity and given the high level of technical handholding required to raise nurseries, it is proposed that initially all the nurseries can be owned and managed by a suitable govt. agency. As per MIDH norms, model nurseries can be established at a cost of Rs.15 lakh/ha. MIDH provides for 100% assistance towards establishment of such nurseries set up in public sector. These nurseries to be accredited as per NHB norms.

Each nursery of 1 ha is expected to supply 25000 saplings to the beneficiaries. Considering the requirement of area expansion, 5 nurseries each over 10 ha may be established. Considering the land constraints in the cluster, the nurseries may be developed outside the cluster also so that these not only serve the district level requirement but also the planting material required in production clusters in the State. It may be noted that the land for nurseries may not be contiguous in nature. However, for required operational efficiency a unit of 10 ha may be considered as a single nursery. While these nurseries may not be adequate to provide required number of planting to the farmers, given the land constraint this seems to be the optimal solution.

Each of these nurseries can be integrated with a demonstration plot of one hect which can be used to demonstrate/impart training on best practices in cultivation and post harvest management. Recurring cost towards these demonstration plots may either be met through State Govt. Sources or CSR funding.

5.1.1.2. Area expansion through establishment of new litchi farms

It is observed that the area under litchi has reduced to some extent over the years. This has resulted in lower production in the cluster. While the reduction in area can be attributed to growing urbanisation and other competing uses of land, it is important that new areas may be identified and farmers are provided required incentive for developing new orchards. Based on the interest of farmers, existing plant replacement can be undertaken in selected orchards. However, at present no budgetary provision is being made for the same. Considering various competing uses of land, it is proposed that additional 1000 ha be brought in under Litchi cultivation which may lead to additional production of approximately 10000

MT. (assuming that the recommended package of practices will be adhered to). MIDH provides for 40% of the cost of new orchard development (without integration) with a cap of Rs.40,000/- per ha

5.1.2. Training & Capacity Building

5.1.2.1. Awareness creation

As has been mentioned earlier, there are multiple agencies/institution working towards development of horticulture sector in general and litchi sub-sector in particular in the cluster area. These institutions include

- NLRC- Which is continuously working on developing new varieties, package of practices, post harvest management technology, etc
- KVK, Saraiya- Which is providing various facilities such as soil testing, training, etc.

The strength of the above institutions should be leveraged for betterment of the clusters instead of creating any other institution/facility. Adequate efforts should be made towards creating awareness among the farmers about these institutions so that the farmers can use the available infrastructure/knowledge. Adequate efforts should also be made towards continuous interaction among farmers and such institutions

Similarly, as a part of the soft intervention, awareness should be created among farmers on aspects such as INM/IPM and interested farmers should be selected for further training on these aspects.

5.1.2.2. Training-cum-exposure programme

Training

It is observed that farmers are inclined towards acquiring new knowledge and technique to improve their production. While some of them had undergone some on field training programme it is important that such knowledge and skill building happens at every level and for each farmer. It is essential that training programmes be customized to the requirement of the cluster. Based on the assessed need the following training programmes may be arranged for improving the overall production and productivity

- Training of nursery growers: For ensuring availability of high quality planting to the farmers, it is critical to sensitize and training the nursery growers on basic compliance related to nursery infrastructure, production system and quality parameters and good nursery management practices.
- Training of farmers undertaking demo plantations: The farmers proposed to be associated with the demonstration plots to be trained well on proper management of elite plant material in their orchards by adopting improved package of practices for achieving highest productivity level.
- Training of farmers: The farmer to be provided training on productivity enhancement techniques like high density plantation, INM, Soil Moisture Management (mulching), Cultural Practices such as weeding and post-harvest handling to extend shelf life and maintaining quality.
- Training of Facilitator (ToF) including the extension officers, dept. field functionaries, village agent or progressive farmers on the latest horticultural practices, nursery production, and other productivity enhancement technologies

Integrating the efforts and for greater impact of various proposed interventions, it is suggested that beneficiary farmers selected for these training should be the ones undertaking various production related activities proposed as sub-components of Production related interventions.

Such training modules may be designed in consultation with NLRC, Muzaffarpur, Rajender Agri University, PUSA and State Horticulture Dept. If possible resources of Agriculture University may be leveraged for imparting the training programmes. As has already been mentioned the demonstration plots may be used as the on-field training venues.

In accordance with MIDH norms, cost assistance of upto Rs 1000/day per farmers to be provided for trainings conducted within the State (including transport). Cost assistance on actual to be provided for trainings that would be conducted outside State. For training of nursery growers budget of Rs 15 lakhs to be set aside under the MIDH cost norms for HRD for Gardener. This financial assistance would be extended to the technical agency which would be implementing the Gardener training. For training of technical staff/ field functionaries, assistance of Rs 300/ day per participant is being budgeted (TA/DA would be additional as admissible). Possibility of convergence under scheme for Agri Sector Skill Development initiative may also considered. It may be targeted to train approximately 5000 farmers on package of practices.²²

Training on Harvesting

²² Considering the fact that approximately 2850 Ha were reported to be under the Litchi crop in the cluster and additional 1000 Ha are expected to be brought in under the crop and assuming that the average landholding is 2.18 acre total beneficiaries would be approximately 4500. Additional 500 numbers have been budgeted for training

The farmers may also be trained on proper harvesting methods including cutting, sorting fruits without soiling or damage, etc.

5.2. Post Harvest Management

As has been mentioned field level post harvest infrastructure especially pre-cooling is a major constraint in the overall litchi value chain. Almost 10% of the produce is being wasted at the field level itself as proper pre-colling is not possible. In addition, there is inadequate infrastructure in the cluster for sorting, grading or storage of the produce. This is resulting in wastage up to 5-10% (in addition to the field level losses due to lack of proper pre-cooling). Low scale of production, at individual farmer level, further adds to the difficulty as it is not financially remunerative for an individual to invest post-harvest infrastructure

To address both the above issues, it is important that appropriate infrastructure for post harvest infrastructure are in place. Moreover, it is also important that farmers understand the importance of appropriate post harvest management activities and learns to undertake the same at individual as well as group levels. It is also important that there is collective action among the farmers so that the post-harvest related activities become economically remunerative

Vietnamese Good Agricultural Practices (VietGAP) to boost litchi production and exports

Vietnam is one of the prominent litchi growing country in Asia. However, due to improper practices and non-adherence to globally acceptable health and safety standards Vietnam was not able to explore the high end markets of USA/EU/Australia. Consequently, Vietnam's litchi only entered the Chinese market at a low value. In order to tackle the situation, the government of Vietnam introduced Vietnamese Good Agricultural Practices (VietGAP) to boost litchi production and exports.

Ministry of Agriculture and Rural Development introduced VietGAP in Luc Ngandistrict, which provided a major boost to district's litchi production and export value. VietGAP was developed based on Global Good Agricultural Practices (GlobalGAP) but with a lenient criteria. The program guided farmers on 12 different standards as follows: (i) Site assessment and selection; (ii) Planting material; (iii) Soil and substrate management; (iv) Fertilizers and soil additives; (v) Water and irrigation; (vi) Crop protection and use of chemicals; (vii) Harvesting and handling; (viii) Waste management and treatment; (ix) Worker health and welfare; (x) Record keeping, recall, and traceability; (xi) Internal Audit; and (xii) Complaints and resolve management. Farmers undergo mandatory training process and guidelines on production practices. The VietGAP certificate, valid for 2 years, is assigned to producer groups instead of individual households after successful assessment and quality check of the specimen. The government has licensed multiple certification organizations to issue certificates after proper evaluation. Irradiation facility was established in Hanoi to treat the produce before exports. This resulted in approval of imports of Litchi from Vietnam by countries such as Australia

Luc Ngan district is a prominent litchi cultivation area. In 2008, annual litchi production from the district was 60,000 tons (comparable to Muzaffarpur) in an area of 18,000 hectares (more than Muzaffarpur). The yield was significantly and export value was only 1 million USD. After interventions made under VietGAP, the litchi production rose to 130,000 tons in the same area in 2014, increasing the yield from 3.33 to 7.22 tons per hectare. Moreover, export value received a major breakthrough reaching 20 million USD. One of the major reasons was global acceptance of VietGAP standards in the foreign market. Moreover, survey reports state that 88.7% of the farmers considered VietGAP as a sustainable practice for future. The study revealed use of international standard pesticides under VietGAP also reduced health issues due to exposure.

5.2.1. Infrastructure Assistance

5.2.1.1. Farm Level Mobile Pre-coolers

In order to address the issue of pre-cooling, it is suggested that 10 Farm Level mobile pre-coolers be provided for in close proximity of the orchards. Such pre-coolers can have a capacity of 2MT/batch. Each mobile pre-cooler can be used for three batches effectively resulting in a capacity of 6 MT/day. Over a 30 day harvesting period the mobile pre-coolers can accommodate approximately 1800 MT of produce which is approximately 5% of the current production. This should be seen as a demonstrative action driving people to adopt the practice and investing in the same. These mobile pre-coolers do not require any land and thus may require very small time to be in place. The mobile pre-coolers can be solar powered. It is expected that the mobile pre-coolers will be owned and managed by big farmers/Aggregators and the services of these would be available to farmers on rental basis. The pre-coolers are expected to play a key role and may act as spokes to the pack houses/private markets

MIDH provides for 35% assistance (on a unit cost of Rs.25 lakh) for development of a mobile pre-cooler

5.2.1.2. Creation of Post-harvest Infrastructure (Pack house and Cold Room)

As mentioned earlier, there is inadequate post harvest infrastructure in the cluster for sorting, grading or storage of the produce. Only about 1200 MTs of produce is properly sorted and graded. Also it may be noted these pack houses are mostly for captive use and are not available for general farmers. Unavailability of adequate pack house (sorting, grading and packing facilities) is resulting in wastage up to 5-10% (in addition to the field level wastage). In order to address the same it is proposed that post harvest infrastructures consisting of small sorting/grading facility (pack house) of 2MT/hr capacity (effective capacity would be approximately 16-20MT/day considering 8-10 hrs of operation per day) and a small cold room of 10 MT capacities in around 5 locations. It is proposed that the pack houses may be established in following locations:

Block	No of Pack Houses
Kanti (Can target Shahi Litchi)	2
Minapur (More of rural set up thus only one is proposed to begin with)	1
Musahari (Urban center and has access to lot of traders/marketers)	2

It is proposed that such facilities may be solar powered. Other Technologies are also available.

It is expected that the produced may be stored in the cold rooms on an average up to one day before they are sent to the market. Thus the cumulative handling capacity of 5 such cold rooms will be approximately 1500 MT (Considering 30 days of harvest) which is approximately 5% of the current production. It may be noted that these facilities are in addition to other pack houses which are being operational by private entrepreneurs and can be considered as a demonstrative project for farmer groups. Post the litchi season these pack houses can be used for other fruits and vegetables also.

It is proposed that such pack houses may be owned and managed by experienced farmers/entrepreneurs who can appreciate the technology and can interact with the market forces effectively. It is expected that the facilities will be available to farmers on rental/user charge basis. It is also expected that by introducing pack houses to the general farmers, required awareness can be created among them about the value proposition of such facilities so that in future farmer groups can also start investing in such facilities. MIDH provides for 35% assistance (on a unit cost of Rs.15 lakh for cold room and Rs.4 lakh for pack house) for development of such post harvest infrastructure.

5.2.2. Soft Intervention: Collectivisation and Training

5.2.2.1. Creation of Farmer Groups

As has been mentioned earlier while to begin with infrastructures are being created by Private individuals a deliberate attempt is also proposed to be made towards collectivising farmers who can invest in

Better value realization through Primary Processing: A case of Apple in Himachal Pradesh

The apples of Himachal Pradesh have a higher value proposition, in the market because they are properly sorted, graded and packed. This has been possible because both the producers and the state are able to realise the importance of primary processing.

This has resulted in a number of primary processing centers developed both by private sector (including big farmers) and Govt. of Himachal Pradesh. Govt. of Himachal Pradesh through HPMC has established a number of Primary Processing Centers in the fruit growing areas of Himachal. These primary processing centers offer sorting, grading and packing facilities to farmers on payment of required service charge. The average current charge is between Rs.6-7 per Kg of apple. The centers are manned by well-trained resources.

Use of sorting, grading and packing facilities is resulting incremental revenue of approximately Rs.12-15 when compared to the price realised by apples of Jammu and Kashmir (which is its competitor). This implies that even after incurring the extra cost on sorting, grading and packing the farmers of Himachal Pradesh are able to get an incremental net benefit

common infrastructure and manage the same. Such collective action by the farmers will help them to derive greater economic benefit. One of the ways to achieve the same is formation of Farmer Interest Groups or Producer Groups. Considering the low scale of production at individual level, it is more so important that the farmers join hands and achieve certain scale of production so as to initiate value chain development related activities. In future such FIGs can be the base of developing registered entities (Read: FPOs) to effectively interact with the market and other support service providers

While formation of FPOs may take some time to materialize and may not be an immediate phenomenon in the given context, it is suggested that approximately 200 farmer groups may be formed in two tehsils of Mujaffarpur (Kanti and Minapur). Considering the high degree of urbanisation in Musahari block efforts should be made to directly integrate them with the market.

TABLE 17: PROMOTION OF FARMER INTEREST GROUPS

Production Cluster/ Block	Litchi Production (Approx.) MT	No. of Farmer Group to be promoted	Targeted no. of member per Farmer Group
Cluster 1. Kanti	7000	100	10-15
Cluster 2.Minapur	6000	100	10-15

As collective, these Farmer Group(s) would estimate the requirement of the various inputs such as fertilizers, in the area under consideration; determine the estimated production flow during the season, operate and manage the common facilities and more importantly initiate negotiation with market forces for better price realisation.

A suitably qualified technical agency should be engaged vide bid process to assist the department in mobilization of producer groups and formation of FPO. The required financial assistance for mobilization and formation of Farmer Groups and for their capacity building to be availed as per norms of SFAC

As has been mentioned earlier, a deliberate attempt will be made under the project to develop common infrastructures with active stake of farmers who can design the services/infrastructure and use the same to the optimum level. This would require not only organising the farmers but also building technical understanding among them so that they become the driving force behind any value addition activity/infrastructure.

For successful implementation of this model, the FIGs created under assistance from MIDH/SFAC would required continued handholding in development of the required infrastructure. It is therefore suggest that a suitably qualified technical agency should be engaged vide bid process to assist the department in integrated development of this activity including - mobilization of producer groups into FPO, facilitating setting up of required infrastructure and procurement of machinery, capacity building of FPOs for managing and operating the facility, handholding assistance for period of about two years.

5.2.2.2. Training and Capacity building

In order to ensure effectiveness of the post harvest infrastructures it is essential that the farmers/users be provided proper training on

- Post harvest Activities: Including sorting, grading (on the basis of size and colour), packing, storage and transportation, etc.
- Operation and Maintenance of Common Facilities

5.3. Market Infrastructure

In the context of Litchi in Bihar there are two critical elements in the overall supply chain and associated logistics:

- Post Harvest Infrastructure
- Adequate Market Infrastructure to facilitate interaction between Farmer/PHC(aggregator)/Buyer

While we have dwelt in detail about the post-harvest infrastructure in previous sections, this section will detail out the interventions related to Market Infrastructure

5.3.1.1. Setting-up Private Markets

As has been mentioned earlier, there is dearth of market infrastructure in the cluster. Appropriate sheds, trading area, storage and utilities are not available in the road-side semi-urban or rural markets. In order to address the same hard intervention in the form of private markets may be thought of. Further, It may be noted that Bihar has repelled the APMC act and thus there is a appropriate policy environment in the state for development of private markets. In order to facilitate appropriate marketing infrastructure, private markets may be established. It may be noted that post withdrawal of APMC Act several private markets

are operational in the area including in the cluster. These private markets are operational over an area of 1-2 acres and have basic facilities for trading.

Another important component for seamless logistics of Litchi is Reefer vehicles. However, there is also a dearth of reefer vehicles in the cluster which is required for long distance travel of the produce. These reefer vehicles should be closer to Private Markets/Pack Houses. Considering the integration requirement of market-pack house the reefer vehicles can be stationed at Private Markets.

a) **Development of Market Infrastructure:** In order to address the above issue and keeping in mind the overall requirement of the cluster, it is proposed that two private markets be developed in the cluster. Such markets may have facilities for

- Trading platform
- Sorting, grading and packing
- Price information
- Storage

The markets may also be well-equipped with utilities such as water-supply, electricity, toilets and solid waste management. These markets other than litchi can deal with fruits such as Mango, Banana and Vegetables

Land for the same can be brought in by the private entrepreneurs. MIDH provides for 40% grant assistance (with a unit cost of Rs.25 lakh) for setting up of community markets which may be treated as rural markets to meet the requirement of MIDH guidelines. The markets can be maintained and managed by the private entrepreneurs. They may charge reasonable facilitation fee from the traders and can also charge the farmers for providing services such as sorting and grading. The markets may handle 60-80MT of produce per day of which litchi may constitute up to 15-20 MTs during its harvesting season.

b) **Reefer Vehicles:** The markets may be equipped with reefer vehicles of 6 MT capacities to transport the produce. The reefer vehicles may be available on rent basis to the farmers/aggregators or traders

5.4. Processing Related

While litchi processing is happening in and around Mujaffarpur the processors are not getting adequate raw material of suitable quality. It may be noted that of the 25000 MT of processing capacity approximately 10000MT of raw material is being procured from the cluster. So while there is a disconnect between the processor and farmer there may also be a scenario that once production is enhanced there may not be ample processing capacity. Moreover, it may be noted that almost all the processing is creating intermediate produce in the cluster while the final product processing is happening in a distant place. This may be addressed by establishing high value adding units (final products such as juice/titbits, etc). Two processing units are proposed to be set up with under private sector participation.

It is notable that the Government of Bihar is providing required incentive for development of such units. Its industrial incentive policy 2016 has identified Litchi as one of the focus commodities for value addition. Under the policy, State Govt. is providing 10% interest subvention to the tune of 30% of the project cost capped at Rs. 5 crore.

5.5. Overarching

It is understood that there would be a set of interventions which would run parallel to the value chain development related activities. Such interventions would include

- Creation of State level nodal agency (for overall value chain development activity, whether in Muzaffarpur or other clusters)
- Interventions for supporting infrastructure
- Collectivisation of Farmers/Formation of Farmer Interest Groups/Producer Groups
- Branding and Recognition
- Development of project management and monitoring framework

5.5.1.1. Creation of a State Level Nodal Agency:

The state may think of appointment/creation of an agency as the nodal agency for all implementation and co-ordination related activities. With the current mandate (nodal agency for implementation of MIDH), State MIDH cell can be thought of as the nodal agency for this

5.5.1.2. Interventions for Supporting Infrastructure:

Supporting infrastructures like power, logistics, packaging, quality control and branding are expected to play a major role in successful realisation of the value chain development objectives.

5.5.1.3. Farmer Interest Group Development

As has been discussed earlier most of the interventions require village level institutions. It is also expected that infrastructures at the field level require operation and management by these institutions. Thus it is important that producer collectives in the forms of farmer interest groups/producer groups be created in the cluster. These producer collectives can be informal bodies like women SHGs. Considering the fact that common community action is prevalent in Bihar, such informal bodies may find buy in from the individual farmers.

The FIGs can take up following responsibilities

- Investing in farm level infrastructures, if possible
- Operating and managing the infrastructures
- Providing extension and/or input services to member producers
- Act as aggregation/value addition nodes in the value chain

It is further suggested that to ensure sustainability of the institutions the state should invest adequately in their capacity building mostly in the following areas

- Management of Common Infrastructures
 - a. Asset and Operations Management
 - b. Cash Management
- Governance
- Resource Mobilisation

5.5.1.4. Increasing Branding Recognition

Agriculture based produce is mostly considered as commodities. A commodity is a product so basic that it cannot be differentiated in the minds of consumers (Keller et al., 2008). Branding of produce as 'products' is the key to make the consumer perceive the differentiating factor of product such that it convinces the consumer the product varies sustainably in quality and is worth higher prices than same unbranded

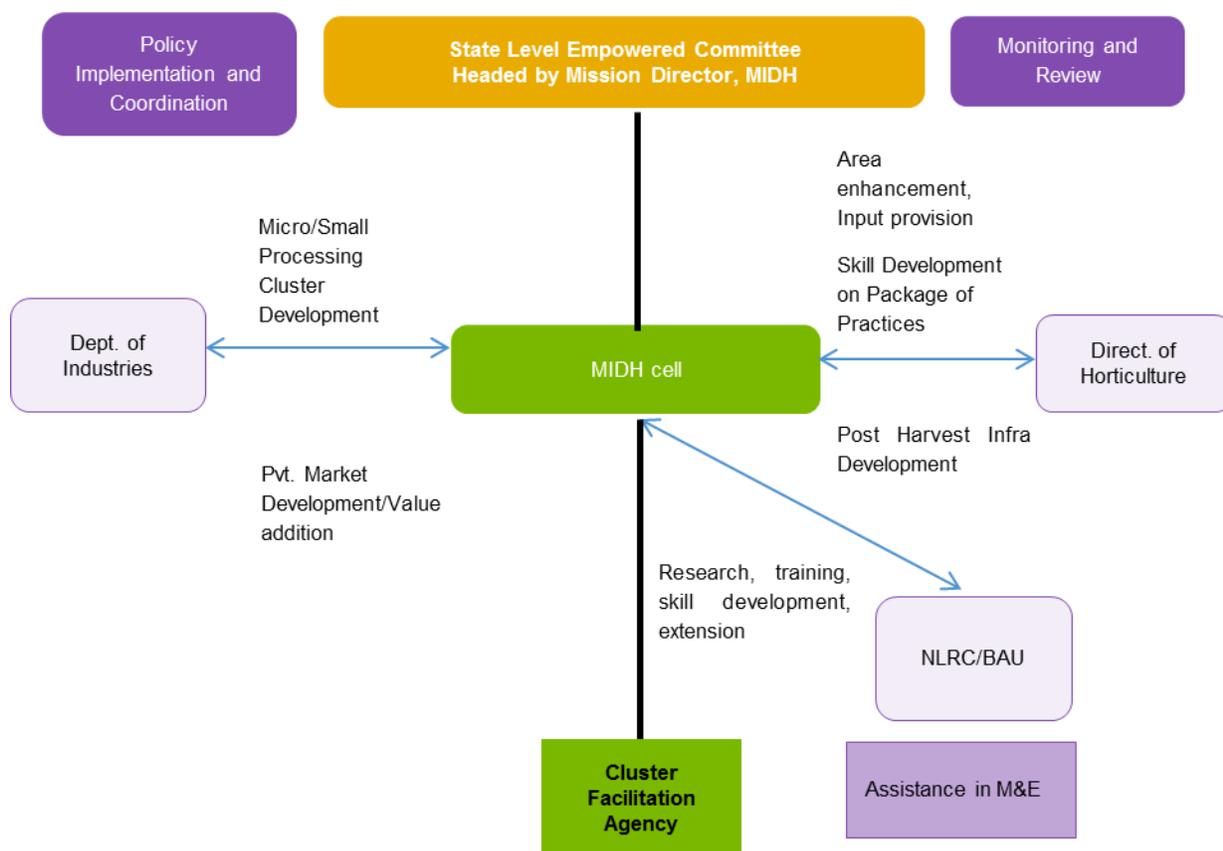
products. Thus, brand building is an integral part of marketing strategy for making the supply chain of the targeted product sustainable and profitable. Brand can be built around certain unique aspects of a commodity which can result in either premium for the produce or high demand or both

In case of the litchi from Mujaffarpur, its flavour and sweetness may be highlighted and a brand synonymous with the same may be developed through sustained campaigns. It may be noted that Agriculture and Industry Departments of Govt. of Bihar are continuously campaigning for creating awareness about the uniqueness of the litchi from this region. The possibility of GI tagging may also be explored for branding.

5.5.1.5. Development of Project Management & Monitoring Framework

In order to develop the Litchi value chain in Mujaffarpur, it is essential to create a strong, responsible, and responsive institutional structure. This is more so important when we consider the fact the core value chain actors (Litchi farmers) do not have adequate resources both in terms of finance and knowledge to improve their current situation. Thus, in the absence of a dedicated institutional structure the core objective of value chain development in the cluster may not be achieved.

Proposed Institutional Structure



As can be seen from the above diagram successful realization of the cluster development objective shall, to a large extent, be dependent on the successful co-ordination among relevant departments and use of existing institutions like NLRC/BAU, State Horticulture Department. While it is expected that the entire implementation shall be driven by MIDH cell as the nodal agency, in view of the involvement of multiple

agencies, it is proposed that a state level steering committee headed by Mission Director, MIDH be formed to ensure timely project execution and co-ordination among all concerned stakeholders.

The committee may have representatives from different line departments such as Industries, Agriculture and other agencies such as Agriculture University, Lead Bank, Panchayat/ULB Chairperson from the cluster area. It may also include some farmer representatives.

The major tasks of the committee may include:

- Facilitating inter-departmental co-ordination
- Finding out/suggesting points of convergence
- Appointment of Cluster Facilitation Agency
- Monitoring and periodic review of the progress
- Setting or re-aligning strategic goals as per the requirement

Considering the fact that the proposed value chain development project adopting a cluster approach is complex in nature (considering both the involvement of multiple stakeholders and the quantum of cross-cutting activities), it is also proposed that a professional **Cluster Facilitation Agency (CFA)** be appointed to assist the nodal agency MIDH Cell in overall implementation of the value chain development activities. The CFA is expected to bring in required technical inputs, knowledge and market interface to assist the state. Specifically, the functions of the CFA may include:

- Organising the farmers into Farmer Interest Groups/Producer Groups so as to bring in collective action in production as well as marketing. This common action may also lead to economies of scale during post harvest management activities.
- Assess the Capacity Building/Skill Development requirement of the farmer members
- Organising and delivering Skill Development related activities
- Assisting the Farmer Interest Groups/Producer Groups in procurement of required inputs either through direct linkage with the suppliers or through leveraging available schemes of Govt. of Bihar or both
- Assessing the requirement of common post-harvest/processing infrastructure for the litchi farmers; developing a business case for the infrastructure so as to mobilize commercial funding, wherever available
- Assessment of the requirement for private markets including space and other infrastructure; Coordinating with Panchayats/ULBs and Nodal agency for development of private markets; development of operation and maintenance mechanism for such markets; development of a business case for mobilizing commercial finance, wherever required
- Identify and develop sustainable market linkages for the produce
- Analyse Identify points of convergence among various schemes and suggest the nodal agency appropriate mechanism to leverage the convergence points
- Identify technologies/best practices which can be replicated in the cluster for overall value chain development
- Assisting the nodal agency in input/grant disbursement
- Assisting the nodal agency in monitoring the progress of the projects
- Represent the nodal agency in different forums, wherever required

Project Operations and Maintenance

The operation and management of common infrastructures/project assets is a critical component of the overall value chain development related activities. Given the structuring of the project, the following classes of assets will be developed during the course of the project implementation

- Individual Assets: These would include Litchi farms, any farming equipments, implements, etc
- Common Infrastructures/Assets: These may include post-harvest infrastructures such as collection center, sorting/grading yard, transport vehicle, etc
- Community Infrastructure: This will pre-dominantly include market yards

The overall O&M would be different for each of the above class of assets. The individual assets will be managed by the farmers with support/inputs (skill/knowledge related, inputs) from various agencies. The farmers will bear the entire cost of cultivation and will take away the entire proceeds from the sale of the produce.

The common infrastructures shall be operated and maintained by a group of farmers. In order to bring in some degree of accountability among the users, it is proposed that nominal user charges may be collected from the farmer users towards using such assets. This user charge should be sufficient to meet

- Expenses on account of manpower deployment for running the assets
- Expenses on utilities such as electricity
- Expenses to meet normal wear and tear

Selected farmers may be trained in running/operating the common assets. The farmer group may also decide the operational aspects (such as timing of use, priority, etc) for such assets

The common infrastructures will be essentially managed by the FIGS. While it is understood that there is no APMC Act in force in Bihar and thus no cess/market fee is collected, in case of Private markets they may collect nominal user fee from bulk buyers (depending on the demand of users of such markets)

6. FINANCIAL OUTLAY

Considering the importance of litchi crop in the cluster and in the state of Bihar as a whole, there is a need to provide adequate level of finance and technical support to promote litchi value chain development in the State. The proposed strategy calls for an integrated approach adopting a program mode for developed of various production clusters in the State. Along with the enhanced levels of assistance, the state may also have to build physical infrastructure along the value chain as also supplement the efforts/assistance to strengthen value chain activities.

The total cost of suggested interventions is estimated Rs 3894.10 Lakhs. Out of which approximately 54% of budgetary support of Rs 2168 lakhs may be sought under various Central Government Scheme/programme including MIDH. Whereas the remaining cost of Rs.1726 lakhs are expected to be mobilized from State Government or private players.

Details of the financial outlay is provided below:

Project components	No. of Units	Cost per Unit (Rs. In Lakhs)	Estimated Total Cost (Rs. In lakhs)	GoI (MIDH/other schemes)		Proposed Outlay from State Government/ Beneficiaries	Remark	
				Pattern of Assistance	Financial Assistance (Rs in lakhs)			
A. Production Related								
Infrastructural Assistance								
a.	Planting Material							
	Nurseries	5 sub-units under the project (each having 10 ha)	Rs.15 lakh per ha	750.0	100%	750.0	-	
	Demonstration Plots of 1 ha each along with nurseries (for a period of 5 years)	5 sub units under the project	Rs.5 lakh (recurring and establishment cost)	25.0	No assistance available	-	25.0	While no assistance under MIDH is available, it is expected that Govt. of Bihar will arrange fund to meet the recurring and establishment cost towards maintaining the demonstration plots. Such plots may be used as the training venues for package of practices and post-harvest management
b	Area expansion through establishment of new orchards							
	Facilitating establishment of new litchi orchards under climate resistant varieties	1000 ha	Rs 100,000/- / ha	1000.00	@40% of cost in general areas areas	400.0	600.0	Area under litchi has reduced to some extent over the years. This has resulted in lower production in the cluster. While the reduction in area can be attributed to growing urbanisation and other competing uses of land, it is important that new areas may be identified. Considering various competing uses of land, it is proposed that additional 1000 ha be brought in under Litchi cultivation which may lead to additional production of approximately 10000 MT. It is expected that 60% of the total cost to be borne by the beneficiaries,
Capacity building Intervention								
a.	Training programme							
	Training of farmers undertaking demo plantations	10 No. (for 7 day)	Rs 1000/day per farmers	0.70	100% assistance	0.70	-	

Project components	No. of Units	Cost per Unit (Rs. In Lakhs)	Estimated Total Cost (Rs. In lakhs)	GoI (MIDH/other schemes)		Proposed Outlay from State Government/ Beneficiaries	Remark
				Pattern of Assistance	Financial Assistance (Rs in lakhs)		
Training of farmers (Including package of practice/harvesting)	6000 farmers (7 day training)	Rs 1000/day per farmers	420.0	100% assistance	420.00	-	The component of training should be linked with capacity building of beneficiary farmers being targeted under Area expansion
Training of Facilitator (ToF)	100	Rs 300/ day per participant	2.10	100% assistance	2.10	-	
b Awareness Programme (Awareness camps in 20 Locations which are considered for mobile pre-cooler)	20	Rs.10000/ camp	2.00	-	-	2.00	
B. Post Harvest & Processing Related Infrastructure							
a. Creation of Farmer-linked and operated Value Added Centre							
Promotion of FIGs, Producer Groups (approximately 10-15 members each)	200	As per norms issued by SFAC/ NABARD		As per norms issued by SFAC/ NABARD			
Post harvest Infrastructures							
Mobile Pre-coolers	10	Rs 25 lakhs/ unit	250.0	@ 35% of total cost	87.5	162.5	In order to address the issue of pre-cooling, Farm Level mobile pre-coolers be provided for in close proximity of the orchards. Such pre-coolers can have a capacity of 2MT/batch. MIDH provides for 35% assistance on a unit cost of Rs.25 Lakh Pack houses will have integrated operation for sorting, grading and packing and will be equipped with a cold room. MIDH provides for 35% back ended subsidy Reefer vehicles will be attached to the private markets described below. MIDH provides for 35% assistance on reefer vehicles in general areas
Pack house and Cold Room	5	Rs. 65 lakh (Rs.15 lakh for cold room and Rs.50 lakh for pack house)	325.0	@35% of total cost	113.75	211.25	
Reefer Vehicles	4	Rs.17.33 lakh (proportionately for 6 MTs)	69.3	@35% of total cost	24.26	45.06	

Project components		No. of Units	Cost per Unit (Rs. In Lakhs)	Estimated Total Cost (Rs. In lakhs)	GoI (MIDH/other schemes)		Proposed Outlay from State Government/ Beneficiaries	Remark
					Pattern of Assistance	Financial Assistance (Rs in lakhs)		
b.	Setting-up of Private markets	2	Rs.25 lakhs	50	at 40% of eligible project cost	20.0	30.0	Land can be brought in by the private entrepreneurs as their equity. Private markets can be set up either in cluster areas or adjoining areas which can influence the produce movement in the cluster
b	Development of Litchi Processing Units-Private Sector	2	Rs.500 lakh	1000	MOFPI can provide assistance up to 35% of the capital cost of the project Govt. of Bihar has also a scheme for interest subvention	350.0	650.0	There are progressive farmers, interested entrepreneurs in related fields (such as cold chain/other F&V processing). These individuals may be identified and encouraged to set up processing units
TOTAL				3894		2168	1726	