CHAPTER – I

INTRODUCTION

1.1 Background

Litchi is the most important sub-tropical evergreen tree and most renowned edible fruits of soapberry family, Sapindaceae. It is botanically designated as *Litchi chinensis Sonn. (Nephelium litchi cambess)* and is widely known as litchi and regionally as *lichi, lichee, laichi, leech or lychee*. It is known as queen of the fruit due to its attractive deep pink/red colours, deliciously flavoured sweet and juicy aril. It has high nutritive value and suitable for geotropic weak person. Litchi appears to be native of Southern province of China, where it flourishes especially along rivers and near the seacoast. It has a long and illustrious history having been praised and pictured in Chinese literature from the earliest known record in 1059 A.D. The cultivation of litchi is spread over the years through neighbouring areas of south-eastern Asia and offshore islands. Litchi reached Eastern India *(Tripura)* first via Burma *(Now Myanmar)* by the end of 17th Century and thereafter by the end of 18th Century it was introduced to Bengal. Litchi is now an important commercial fruit crop in India due to its high demand in the season and export potentiality. Cultivation of litchi is widely spread in eastern India covering approx 100 kms width from foot hills of Himalaya from Bengal to Punjab, which provides livelihood opportunities to millions of people in the region. In India bulk of litchi growing areas lies in Bihar, other areas are sub-mountain tracts of Uttar Pradesh, West Bengal, Punjab, Assam, Tripura and Odisha. The concentrated pockets of litchi production in different states have been listed in table 1.1.

Table No. 1.1: Major Litchi Growing areas in India

SN	States	Districts
1.	Tripura	West Tripura, North Tripura, South Tripura, Dhalai, Tripura
2.	Assam	Bongoigaon,Kamrup, Goalpara, Nalbari, Barpeta, Sonitpur, Naogaon, Lakhimpur, Golaghat, Jorhat, Cachar.
3.	West Bengal	Murshidabad, 24-Parganas, Nadia, South 24-Parganas, Malda, Uttar Dinajpur, Dakshin Dinajpur, Hubli.
4.	Bihar	Muzaffarpur, Vaishali, Samastipur, Sitamarhi, East Champaran, West Champaran, Gopalganj, Sheohar, Darbhanga, Madhubani, Purnea, Katihar, Begusarai, Saharsa, Bhagalpur, Araria, Kishanganj, Khagaria, Madhepura, Munger, etc.
5.	Odisha	Sundergarh, Sambalpur, Angul, Deogarh.
6.	Uttarakhand	Udham Singh Nagar, Champawat, Nainital, Dehradun, Tehri Garhwal, Pauri Garhwal, Haridwar, etc.
7.	Punjab	Gurudaspur, Hoshiarpur
8.	Uttar Pradesh	Saharanpur, Muzaffar nagar, Kushinagar, Deoria, Basit, Gorakhpur, etc.

Source: NRC – Litchi, Muzaffarpur.

1.2 Litchi Scenario in India

The cultivation of litchi is restricted to very few countries in the world with a total area of about 8 lakh ha and production of about 24 lakh MT. India and China account for 91.00 per cent of the world litchi production. According to NHB database (2013), about 580.10 thousand MT of litchi is produced annually from 82.70 thousand ha of land in our country. The climatic requirements of this crop are exacting in nature, therefore, making production limited to few states. There is sizeable increase in acreage and production of litchi in India over the years. Cultivation of litchi has increased from 49.30 thousand ha in 1991-92 to 82.70 thousand ha in 2012-13. In terms of production, it has increased from 243.80 thousand MT to 580.10 thousand MT during the same period. The total production of litchi is concentrated mainly in Bihar, West Bengal, Uttarakhand, Assam and Jharkhand and to a smaller extent in Tripura, Punjab and Orissa. Litchi accounts for around 1.00 per cent of the total area under fruits in the country, but it has a definite economic significance in its growing areas. Although the specific soil and climatic requirements of litchi crop restrict it cultivation only to certain regions in the country, our productivity (7 MT/ha) is the highest in the world, next only to Taiwan. As per quantum of produce, India is the second largest producer of litchi in the world next to China. Globally, the countries of southern hemisphere such as South Africa, Madagescar, Australia and Brazil harvest litchi during October to March whereas in northern hemisphere, the fruits are harvested between April to August. Approximately 90.00 per cent of the litchi produce is utilized as fresh, of which at least 25.00 per cent is subjected to post harvest losses at various stages. Usually, there is glut of fresh fruits in the market during harvesting season, which is of very short span of 15-20 days at one place. The litchi maturity in our country starts from Tripura followed by West Bengal, Jharkhand, Bihar, Uttar Pradesh, Uttarakhand, Punjab and Himachal Pradesh. A meager quantity is exported, though, there is great demand and has lot of scope to increase the quantum of export, since the harvesting season is quite different in other parts of the world. This can be further boost up by exploring the newer areas of litchi production in the southern part of the country where the fruits can be harvested during November to January and encouraging more area and improved production technologies in Tripura, Assam and other north eastern states where fruits can be harvested little early and send to International and domestic market at premium price *(vision 2030, NRCL, 2011).*

The area, production and productivity of litchi in India during 1991-92 to 2012-13 and area, production and productivity of litchi during 2012-13 across the states have been presented in tables 1.2 and 1.3 respectively.

Table No. 1.2: Area, Production and Productivity of Litchi in India

SN	Year	Area ('000 ha)	Production ('000 MT)	Productivity (MT/ha)
1.	1991-92	49.3	243.8	4.9
2.	2000-01	53.6	412.0	7.6
3.	2005-06	63.2	391.8	6.2
4.	2010-11	77.6	497.3	6.4
5.	2011-12	80.4	538.1	6.7
6.	2012-13	82.7	580.1	7.0

Source: Indian Horticulture Database, 2013.

Table No. 1.3: Area, Production and Productivity of Litchi in different states during 2012-13

SN	States	Area ('000 ha)	Production ('000 MT)	Productivity (MT/ha)
1.	Bihar	31.28 (37.81)	256.43 (44.20)	8.2
2.	West Bengal	9.19 (11.11)	90.00 (15.51)	9.8
3.	Jharkhand	5.27 (6.37)	58.24 (10.04)	11.0
4.	Assam	5.63 (6.81)	49.64 (8.56)	8.8
5.	Chhatisgarh	4.99 (6.03)	30.89 (5.33)	6.2
6.	Punjab	1.75 (2.12)	26.52 (4.57)	15.2
7.	Odisha	4.46 (5.39)	20.26 (3.49)	4.5
8.	Uttarakhand	9.46 (11.44)	19.16 (3.30)	2.0
9.	Tripura	3.46 (4.18)	17.97 (3.11)	5.2
10.	Others	7.23 (8.74)	10.98 (1.89)	1.5
	Total	**82.72 (100.00)**	**580.10 (100.00)**	**7.0**

Source: India Horticulture Database, 2013
In brackets percentage to total have been shown

1.3 Litchi in Bihar

Litchi occupies an important place in the Horticulture landscape of Bihar owing to its geographic confinement and the magnitude of its share to the overall production in the country. The soil and the climatic conditions of north Bihar (almost 27 districts of the state) favour high yields with quality fruits of litchi. During the last five years (2009-10 to 2013-14), the area under total fruits was around 290-300 thousand hectares, which is about 5.50 to 6.00 per cent of net sown area (table 1.4). Litchi is the third largest fruit next to Mango and Banana in terms of area and production. It occupies about 10-11 per cent of total fruits' area and around 6.00 per cent of total fruit production (table 1.5). During 2013-14, the total production of litchi was 234.20 thousand MT from the area of 31.48 thousand hectare. The compound annual growth rate (CAGR) of litchi production during the last five years was 2.02 per cent whereas that of total fruit 1.56 per cent (table 1.6). Table 1.7 and 1.8 provides data on litchi regions and area and production respectively of litchi in all the 27 litchi producing districts in the state. Based on this information, these districts could be divided in four broad segments. The first segment comprises of six districts, five of which are in Tirhut/Muzaffarpur division while one i.e., Kaithar is in north-eastern region i.e., in Purnea division. These districts typically have more than 1300 ha under litchi cultivation with production over 10,000 MT. The second segment has districts with production between 5,000 to 10,000 MT and area between

6,000 to 1,300 ha. There are eight districts in this segment. Third and fourth segments have ten and three districts respectively. The area and production limits for these segments are given in table 1.7.

Table No. 1.4: Percentage of total Fruits' Area to Net Sown Area in Bihar

SN	Year	Percentage
1.	2009-10	5.51
2.	2010-11	5.64
3.	2011-12	5.55
4.	2012-13	5.47
5.	2013-14	5.38

Table No. 1.5: Percentage of Area and Production of Litchi to Area and Production of total Fruits in Bihar

SN	Year	% of Area	% of Production
1.	2009-10	10.42	6.21
2.	2010-11	10.48	5.80
3.	2011-12	10.39	5.99
4.	2012-13	10.55	6.10
5.	2013-14	10.85	6.20

Table No. 1.6: Area and Production of Litchi vis-à-vis total Fruits in Bihar

SN	Year	Litchi		Total Fruits	
		Area ('000 ha)	Production ('000 MT)	Area ('000 ha)	Production ('000 MT)
1.	2009-10	30.60	215.13	293.58	3464.92
2.	2010-11	31.06	226.98	296.42	3911.62
3.	2011-12	31.10	236.43	299.25	3946.23
4.	2012-13	31.14	233.86	295.30	3834.56
5.	2013-14	31.48	234.20	290.21	3777.46
	CAGR	**---**	**2.02**	**---**	**1.56**

Source: Economic Survey, Bihar: 2014-15, Government of Bihar

Table No. 1.7: Litchi Regions in Bihar

SN	Area (ha)	Production (MT)	Districts
1.	More than 1,300	More than 10,000	Muzaffarpur, Vaishali,Sitamarhi,East Champaran, West Champaran, Katihar
2.	600 - 1,300	5,000 – 10,000	Samastipur, Purnea,Siwan, Gapalganj, Saran, Sheohar, Darbhanga, Madhubani
3.	100 – 600	1,000 – 5,000	Begusarai, Bhagalpur,Sharsa, Araria, Kishanganj, Khagaria, Munger, Jamui, Madhepur, Supaul
4.	Less than 100	Less than 1,000	Sheikhpura, Lakhisarai, Banka

Source: Directorate of Horticulture, Bihar

Table No. 1.8: District wise Area and Production of Litchi in Bihar

(Area in '000 hectare/production in '000 MT)

Districts		Litchi			
		2012-13		2013-14	
		Area	Production	Area	Production
1.	Patna	---	---	---	---
2.	Nalanda	---	---	---	---
3.	Bhojpur	---	---	---	---
4.	Buxar	---	---	---	---
5.	Rohtas	---	---	---	---
6.	Kaimur	---	---	---	---
7.	Gaya	---	---	---	---
8.	Jehanabad	---	---	---	---
9.	Arwal	---	---	---	---
10.	Nawada	---	---	---	---
11.	Aurangabad	---	---	---	---
12.	Saran	1.08 (2.8)	7.53 (3.2)	1.08 (3.6)	7.53 (3.2)
13.	Siwan	1.12 (2.9)	8.16 (3.5)	1.12 (3.7)	8.16 (3.5)
14.	Gopalganj	1.20 (3.2)	8.67 (3.7)	1.20 (4.0)	8.67 (3.7)
15.	West Champaran	2.08 (5.5)	15.41 (6.6)	2.08 (6.9)	15.41 (6.6)
16.	East Champaran	1.90 (5.0)	13.48 (5.8)	1.95 (6.5)	13.57 (5.8)
18.	Muzaffarpur	7.30 (19.1)	58.98 (25.2)	7.30 (24.1)	58.98 (25.2)
17.	Sitamarhi	2.19 (5.7)	16.18 (6.9)	2.19 (7.2)	16.18 (6.9)
19.	Sheohar	0.99 (2.6)	6.92 (3.0)	0.99 (3.3)	6.92 (3.0)
20.	Vaishali	3.60 (9.4)	26.99 (11.5)	3.61 (11.9)	27.05 (11.6)
21.	Darbhanga	8.82 (23.1)	5.6 (2.4)	0.82 (2.7)	5.6 (2.4)
22.	Madhubani	0.81 (2.1)	5.68 (2.4)	0.81 (2.7)	5.68 (2.4)
23.	Samastipur	1.29 (3.4)	9.81 (4.2)	1.29 (4.3)	9.81 (4.2)
24.	Begusarai	0.63 (1.7)	4.69 (2.0)	0.63 (2.1)	4.69 (2.0)
25.	Munger	0.25 (0.7)	1.78 (0.8)	0.25 (0.8)	1.78 (0.8)
26.	Sheikhpura	0.10 (0.3)	0.68 (0.3)	0.10 (0.3)	0.68 (0.3)
27.	Lakhisarai	0.05 (0.1)	0.33 (0.1)	0.05 (0.2)	0.33 (0.1
28.	Jamui	0.18 (0.5)	1.50 (0.6)	0.18(0.6)	1.50 (0.6)
29.	Khagaria	0.33 (0.9)	2.40 (1.0)	0.33 (1.1)	2.40 (1.0)
30.	Bhagalpur	0.54 (1.4)	4.83 (2.1)	0.58 (1.9)	5.01 (2.1)
31.	Banka	0.06 (0.2)	0.44 (0.2)	0.06 (0.2)	0.44 (0.2)
32.	Saharsa	0.55 (1.4)	3.99 (1.7)	0.55 (1.8)	3.99 (1.7)
33.	Supaul	0.19 (0.5)	1.32 (0.6)	0.19 (0.6)	1.32 (0.6)
34.	Madhepura	0.29 (0.8)	2.05 (0.9)	0.29 (1.0)	2.05 (0.9)
35.	Purnea	0.28 (0.7)	9.33 (4.0)	0.28 (0.9)	9.33 (4.0)
36.	Kishanganj	0.41 (1.1)	2.95 (1.3)	0.41 (1.4)	2.95 (1.3)
37.	Araria	0.41 (1.1)	2.89 (1.2)	0.41 (1.3)	2.89 (1.2)
38.	Katihar	1.50 (3.9)	11.29 (4.8)	1.50 (5.0)	11.29 (4.8)
	Bihar	**38.15 (100.00)**	**233.87 (100.00)**	**30.24 (100.00)**	**234.20 (100.00)**

Note: Figure in bracket denotes percentage.

Source: Economic Survey, Bihar: 2014-15, Government of Bihar

1.4 Maturity Indices of Litchi

Litchi being a non-climacteric fruit requires to be harvested after attaining full maturity on the tree. Red colour of the fruit is a good indicator of maturity along with fruit size (minimum of 25 mm in diameter). Harvesting of litchi fruits is primarily done much before the attainment of full maturity due to huge demand in distant market, better shelf life of early harvested produce and availability of labour and transporter. They intended to extend the period of availability of litchi for

longer duration. The progressive farmers practice the harvesting of litchi based on development of surface colour and flattening of tubercles. The TSS in early harvested fruit range from 14-15° Brix but the optimum mature fruits must have TSS ranges from 19-22°B. In practice, most orchards in the region are harvested on the basis of taste and general appearance. The most reliable guide to maturity is titratable acidity (TA) or the Brix Acid ratio (BAR). Table 1.9 explains the litchi cultivars classified according to TSS: TA Ratio (BAR).

Table No. 1.9: Litchi Cultivars Classified according to TSS: TA Ratio (BAR) in Bihar

SN	TSS:TA Ratio	Cultivar
1.	< 60	China & Deshi
2.	60-70	Shahi

Source: NRC for Litchi, ICAR, Muzaffarpur

1.5 Varieties of Litchi

In India, about 50 cultivars are under cultivation. However, China, Shahi, Desi and Manraji are ruling commercial varieties in Bihar. The description of few varieties growing in Bihar has been given below:

i. **Shahi:** This is the most popular cultivar of north Bihar. The fruits have distinct rose aroma and hence called as Rose scented. It is known as "Shahi" in Bihar. This is an early season maturing cultivar ripens during 21-25th May in north Bihar. Trees are vigorous (7.6 m height and 8.2 m canopy spread) and high yielder (90-100 kg/tree) but mature fruits after prone to cracking. Fruits are medium to large in size (3.2 cm length and 3.1 cm diameter), medium in weight (20.49 g./ fruit). Pulp grayish white, soft moderately juicy (54.8%) and sweet with 20° Brix TSS, 12.79 per cent total sugar and 0.33 per cent total acidity. Seeds are small (1.89 cm length, 1.32 cm diameter and 2.07 gram weight), smooth, shinning, round-ovate in shape and blackish-chocolate in colour. Rind: Pulp: Seed Ratio by weight is 12.22: 75.93: 11.85. The fruits are known for excellent aroma and quality aril *(Singh et.al, 2011).*

ii. **China:** This is one of the best cultivar of litchi in Bihar. This is a medium late cultivar ad fruits ripen during 7-10 June in north Bihar. Trees of cultivar China are dwarf (4.0m height, and 6.0 m spread) and high yielder (80-100 kg/tree) but prone to alternate bearing. It bears fruits in cluster of 12-18. The plants bear less fruit in southern direction. Fruits are large in size (3.86 cm length and 3.26 cm diameter), medium in weight (22.0 gm/fruit), oblong in shape and tyrant rose in colour with dark dubercles at maturity. Aril is creamy-white, soft, juicy, sweet having 18.17 per cent TSS, 11.00 per cent total sugar and 0.43° Brix titrable acidity. Seeds are glaucons, dark chocolate in colour, oblong to concave or Plano convex in shape, medium in size (2.9 cm length and 1.5 cm

diameter average in weight (3.49 gram/seed). The ratio of Rind: Pulp: Seed by weight is 16.42: 69.22: 14.36 *(Singh et.al, 2011).*

1.6 Bio-Chemical and Nutrient Composition of Litchi

Litchi is a delicious fruit of excellent quality. The fruit has high sugar content varies from 10.00 to 22.00 per cent due to cultivar and climatic conditions. Besides, it is of about 65.00 per cent juice, 8.00 per cent pulp, 19.00 per cent seed and 13.00 per cent rind. It contains 0.7 per cent protein, 0.3 per cent fat, 0.7 per cent minerals (particularly calcium and phosphorus) and vitamin C (64 mg/100gm pulp), vitamin A_1B_1 & B_2 also present in considerable amount. The details of its chemical composition may be seen in table No. 1.10.

Table No. 1.10: Chemical Composition of Litchi

SN	Particulars	Standard (%)	In 100 gm of eatable part		
			Units	Fresh	Dried
1.	Moisture	84.30	%	81.93 -84.83	17.90-22.30
2.	Protein	0.7	gram	0.68-1.00	2.90-3.80
3.	Fat	0.3	gram	0.30-0.58	0.20-1.20
4.	Calorie/100gm	42	gram	63.00-64.00	277.00
5.	Sugar	15	gram	13.31-16.40	70.70-77.50
6.	Fiber	2.25	gram	0.23-0.40	1.40
7.	Calcium	0.21	mg	8.00-10.00	33.00
8.	Sfur	---	mg	30.00-42.00	---
9.	Minerals	0.03	mg	0.40	1.70
10.	Carbohydrate	9.4	---	---	---
11.	Phosphorous	0.31	---	---	---
12.	Sodium	---	mg	3.00	3.00
13.	Potassium	---	mg	170.00	1100
14.	Theimin	---	mg	28.00	---
15.	Nicotinic Acid	---	mg	0.40	---
16.	Riboflebin	---	mg	0.05	0.05
17.	Carotein	14	---	---	---
18.	Vitamin B/100 gm	87.5	---	---	---
19.	Vitamin B_1/100 gm	122.5	---	---	---
20.	Vitamin C/100 gm	64.0	mg	24-60	42.0

Source: ***Litchi ki kheti*** *(2014) by Rajesh Kumar (NCRL, MFP) published by Krishi Gyan Ganga, Astral International (Pvt) Ltd., New Delhi & Litchi (in Hindi), published by FAO, New Delhi, 2013*

1.7 Insect Pest and Disease in Litchi

The litchi is prone to attack by pests and diseases, which are one of the major limiting factors in its successful production of temperate fruits. Estimates of yield losses caused by pests and diseases attack range from 10 to 30 per cent. Unlike agricultural crops, litchi is grown as monoculture, the pest and disease problems are entirely different and complex in nature. Such pest and disease situations have led to repeated and excessive use of chemical pesticides. This has resulted in development of resistance in the pest species, contamination of fruits, environmental pollution as well as rejection of export produce. In Bihar, pests and diseases are mainly foliar disease and pest however; sometimes soil borne disease/nematode and

termites may affect the nursery plants. The list of some of the disease and pest as observed by NRC-Litchi, Muzaffarpur has been given in details in the table 1.11.

Table No. 1.11: Major Pests and Diseases and its Solution in Bihar

SN		Name of Pest/ Diseases	Infection Area/Part	Causal Organism	Diagnosis	Treatment
A.		**Insect/Pest**				
	1.	Leaf miner	Leaf	*Acrocercops hierocosma Meyr*	Visual; larvae damage the leaves of new flush; bore and mine in the mid rib of leaves making tunnel resulting into dark brown to black strip al along midribs	Two sprays of Sevin 50 WP (2g/1 water) or Neem based pesticides (5 ml/1 water) at 7-10 days interval during new flush
	2.	Litchi mite	Leaf	*Acerya litchi Keifer*	Visual; presence of chocolate velvety brown growth on ventral surface of leaves, tender shoots, etc.	Two spray of Omite or Kernel S (3.5 ml/1 water) at 7-10 days interval.
	3.	Shoot borer	Leaf	*Clumesia transversa or Conopomorpha cramerella*	Visual; yellowing and wilting of leaves due to damage of conducting vessels, common on young flush	Two sprays of Sevin 50 WP (2g/1 water) or Neem based pesticides (5 ml/1 water) at 7-10 days interval during new flush.
	4.	Leaf roller	Leaf	*Platypeplus aprobola*	Visual; longitudinal roll of tender leaves together and feeding by chewing	Spraying of Diemethoate (0.03%)/ Imidiachlorpid (0.5 ml/1 water) twice at 7 days interval.
	5.	Leaf Cutting weevil	Leaf	*Myllocerous spp*	Visual; cutting of older leaves from margin (serrated)	Spraying of Dimethoate 0.03% twice at 7-10 days interval.
B.		**Disease**				
	1.	Anthracnose	Leaf	*Botryodiplodia theobromae*	Appearance of brown to black irregular spots on few leaves	Spraying of copper Oxychloride 2g/1 twice at 10 days interval
	2.	Leaf spot	Leaf	*Pestalotia pauciseta*	Appearance of circular brown to black irregular spot on leaf	---
	3.	Dieback	Shoot	*Diplodia spp*	Appearance of brown lesion on shoots, premature leaf drop and drying from the top	---

In this regard UNCED in 1992 identified IPM in horticulture as one of the requirements for promoting sustainable horticulture. IPM requires through preplanning even before establishing the orchard which includes selection of suitable site, type, improved pest/disease free planting materials, regular pest/disease and weather monitoring of orchard, balanced used of fertilizer, water management, proper training and pruning, improved cultural practices, augmentation and conservation of parasitoids and predators, application of bio-pesticides and need based formulation and need based use of selective pesticides.

Moreover, it is to be appropriate to mention here that in Bihar, about 25-30 per cent of the total area under litchi cultivation is under old senile orchards, which are highly uneconomical and act as source of pest and disease infestation. The unexpected quantum increase to fulfill present level of litchi requirement through new plantation will be a long term venture whereas the existing unproductive and uneconomical orchards can be brought back under production ones through rejuvenation of orchards. The rejuvenation *(The various operations in rejuvenating old senile trees is not a onetime process. Usually it requires a period of 2-3 years to complete the process and later on maintenance and management continues. The cost of reiterative pruning and subsequent operations in litchi orchard comes to around Rs. 12,250/ acre in Bihar, as estimated by Singh et.al, NCR-L, Muzaffarpur, 2011)* ensures quality production from the existing old plants/trees under minimum period of time as compared to establishment of new orchard, which attains the commercial bearing stage after 8-10 years.

1.8 Present Situation in Marketing of Litchi in Bihar

Litchi being a temperature sensitive fruit is highly perishable. It is available for very short duration (25 May to 20 June). Its market can be broadly classified into three categories:

i. Domestic Market in Bihar
ii. National Market
iii. Export Market

According to IL & FS Cluster Survey (2010), about 80.00 per cent of litchi produced in the state is marketed out of the state. Major markets are Delhi, Lucknow, Kanpur, Varanasi, Mumbai, Chandigarh, Kolkata and Bangalore. Around 30 MT of fresh produce is also exported from the state to Nepal, UAE etc; which accounts for only 18.00 per cent of the total volume of litchi exported out of the country.

Marketing of fruits is done in different forms. Growers rent their orchards to contractors (PHCs), who in turn harvest early and sell to local markets. Due to

increased numbers of middlemen in marketing channels reduces the share of growers in the price of produce paid by the consumers. Farmers directly sell their produce to the middlemen. The fruit is sold through post-harvest contractor to the wholesale or commission agents, who do harvesting and packing, in addition to transporting the produce to the market. Majority of the litchi is sold through pre-harvest contractor and about 10 – 20 per cent growers undertake self-marketing. In certain cases, the crop is leased out (orally) to pre harvest contractors (PHCs) for 1-3 years. The PHCs negotiate and settle the price with the growers in their own terms and conditions for payment to the growers. Most of the produce is sold through this mode. The PHCs have a clear picture in their mind of the yield potential of the orchard based on whole and performance level of individual trees in the orchard. The price offered on a per tree varies with age category i.e., a tree in its prime bearing stage (10 to 30 years) with an annual yield of 100 kg fetches Rs. 500-1000 per year from pre harvest contract whereas the rate for trees in early bearing period (5 to 10 years) is Rs. 300-500 per tree per year. Harvesting of fruits is done by the contractor. The farmers usually receive 50.00 per cent of the settled price in advance just to firming up the deal and the rest is paid at the time of harvest. Harvesting, sorting, packaging are done in the farms by the contractors. Loading the truck (for transport) to distant cities is done at the farm gate itself. The pre-harvest contract system prevailing in the state has an impact on the health and life of the litchi orchards. The pre harvest contract is done at leaf or flowering stage and usually valid only for a year. The owners are responsible for cultural operations except for spray against fruit fly carried out by the contractor.

However, the cost incurred on this count is deducted by the contractor from the final settlement. Where the contract is done for 2 – 3 years, contractor is responsible for all operations; he works with short term profit motive in mind and does not take care much to upkeep the orchard. Contractors are not keen on investing in the orchard as they are not sure of continuing the contract during the next term. Most of such orchards belong to absentee landlords and suffer in the long run. Further, if the orchard owner is not present, harvesters may damage the twigs and branches while harvesting, causing harm in the long run.

Moreover, the Indian and world markets for litchi are fast expanding. During the Indian litchi season (May to July), good quality of litchi is not available from other parts of the world except from Thailand (May & June) and Israel (July). In spite of these advantages, India has negligible share (< 1%) in the world trade with exports of 795 MT valued of Rs. 1.18 crore during 2012-13 (Apeda Website, 2014). As of now, the major mode of marketing of litchi in India is through inter-state trade. Presently, Muzaffarpur (Bihar) renowned as the litchi district in India has a share of 64.00 per

cent of the litchi trade in the country. The state of the district in litchi trade is expected to touch 1.5 lakh MT by 2012-13. In view of its prominence in Indian litchi trade (in terms of quantity and quality), an analysis of the marketing aspects of Muzaffarpur litchi is depicted in the following section.

Local markets of Muzaffarpur include road side sales, on farm markets, retailers, restaurants and agro-tourism opportunities. Export market opportunities in the pacific are most likely limited to inter island trade where frequent, rapid and inexpensive transport opportunities are available. Export markets in Europe, North America, and Asia are already well supplied by various litchi producing countries. Europe is well supplied by Madagascar, South Africa, Mauritius and the Seychelles. North America (the mainland of US) produce litchi in Florida and imports fruit from China and Mexico as well as from Hawaii. Canada imports the bulk of its litchi from China. In Asia, fruit is exported early producing regions such as Thailand to China, Hong Kong and Singapore. Chinese fruits are exported to Hong Kong and Singapore.

1.9 Processing of Litchi in Bihar

The value addition to fruits and vegetables through processing is as low as 7.00 per cent in India as against 23.00 per cent in China and 88.00 per cent in United Kingdom. In case of litchi it is less than 2.00 per cent of total litchi produced in India is processed *(Singh et.al, 2011).* Litchi is negligibly exploited at post-harvest level for processing and value addition of fruits. Nevertheless fresh litchi dominates over dried and canned fruits. The produce is mostly marketed fresh with negligible processing and value addition. In Bihar as per the available information of Government of Bihar, there are only 45.00 per cent licensed fruits and vegetable processing units. Most of these units are engaged in the manufacture of fruit juices, fruit pulps, squashes, pickles, ketchup, sauce, Jam/Jelly etc.

In Bihar, the number of litchi processors is mainly found in DME category of industries and may be enumerated on fingers. Since litchi is highly perishable and susceptible to browning and rotting so it's processing in unorganized sector is almost not found.

Generally processing is made of degraded (C grade) litchi. According to this survey estimates, about 20-25 thousand MT pulp, 5 thousand MT concentrates, 50 MT Canned, 25 MT squash etc. are being produced in the state. These DME, are mainly located in Muzaffarpur, Samastipur, East Champaran, Vaishali and Patna districts of Bihar. Besides, the region has 5 pack houses, which are operated by private litchi processors. Around 1,600-1,700 MT of produce, is handled by them annually. The

pack houses handle fresh as well as processed litchi where about 500-600 MT of fresh litchi is traded and around 25 thousand MT is processed into pulp, juices etc. The pack houses have facility for pre-cooling and cold storage. Mostly the pre-coolers are of 4-10 MT capacity and their maintenance is far from being satisfactory *(ILFS Survey, 2010).* The cold stores are used by pack house operators to store litchi for 10-15 days only and thus for transit purpose alone. Around 50-60 per cent of fresh litchi is transported through reefer vans/trucks as its availability is of a huge concern. Some of the pack house operators also hire reefer vans/trucks for Delhi, Pune, Kolkata and Patna. Rest of the produce is transported through normal trucks. The installed capacity of pulping units in around 7 MT/hour and the pulped products are stored in deep freezers at (-) 18° to (-) 25° Celsius. Other products manufactured by them include litchi shreds/whole in sugar syrup.

1.10 Problems in Marketing and Processing of Litchi

Focusing on just the processing of food grains in Bihar is like addressing the tip of iceberg. The processing of fruits and vegetables needs as much attention, if not more. The produce is mostly marketed fresh with negligible processing and value addition. Only a handful of processing facilities and that too are mainly in fruits-- litchi and mangoes are present and operational. Litchi, being a highly temperature sensitive and delicate fruit, the access to market is constrained by unavailability of cool chains to transport it to distant markets. It is important to reach the produce to distant locations at ambit temperature within 24-36 hours after plucking, in order to retain its desired colour. The supply chain from farm to find consumers outside the state market is not so efficient to maintain the timings. This is often cited as one of the major bottlenecks in marketing of litchi in Bihar. Also, the current processing capacity is insufficient to cater to the value added market and prolonging the shelf life. In this regard, an old Chinese proverb described, "*Once litchi fruits are detached from the tree, off colour happens in the first day, off fragrance in the second, off flavor in the third and all gone after 4 to 5 days.*" In fact fruits' post harvest life is not an issue where fruit is rapidly consumed at the local level, but in commercial production environments where fruits are to be transported to distant markets or the rate of consumption does not match the supply, appropriate post harvest management is critical to successful marketing. Ideally, fruits should be shipped on the day of harvest.

The processing segment is marked by a complete absence of cold chain along the value chain resulting in quality deterioration and degradation of the fruits. Similarly, even after processing, the products are kept under minimal refrigeration or no refrigeration. Units which are engaged in processing are mainly working on work order basis for larger chains and as such find that the operating margins being

thin leave no scope of either technology upgradation or expansion. This study could studied only two Firms in the state which are engaged in producing value added products of litchi like; litchi drink/juice, litchi whole *(Rasagolla)* and litchi squash in the state itself in the brand names of litchika international and suman-vatika. Besides, there are 4 to 5 processors which are found working in preparation of litchi pulp and concentrates. The major constraints in processing are lack of capital, skilled technicians/manpower, technology, uncertainly in production, high cost of production due to poor technology, lack of processors' syndicate etc.

1.11 SWOT Analysis of Litchi

SN	Strength	Weakness	Opportunities	Threat
1.	Substantial area under litchi production	Lack of appropriate packaging	Climate specific crop	Climate-specific crop
2.	Suitable climate	Lack of quality planting material	Possibility of area expansion	Short storage life
3.	Bihar is widely known for litchi	Very short shelf life	Possibilities of increasing yield by better management practices	Susceptible to pest and diseases
4.	Better return per unit area	High post-harvest losses	Scope for value addition by increasing shelf life and processing	---
5.	---	Lack of proper post harvest and processing facilities	High export potential	---

CHAPTER – II

STATUS OF FOOD PROCESSING INDUSTRIES IN BIHAR

2.1 Background

The contribution of Bihar's industrial sector to its GSDP was estimated at 18.4 per cent in 2013-14, a little higher than the share in 2012-13 (18.1%), but still lower than 19.9 per cent achieved in 2011-12 (table 2.1). However, it was 16 per cent as against 26 per cent of the national average in 2009-10.

Table No. 2.1: Contribution of Industrial Sector in GSDP in Bihar vis-à-vis India (In %)

SN	State/India	2009-10	2011-12	2012-13	2013-14
1.	Bihar	16.0	19.9	18.1	18.4
2.	India	26.0	28.2	27.3	---

Source: Economic Survey (Bihar), 2014-15

According to Annual Survey of Industries (2011-12), out of a total of 2.18 lakh factories covered throughout the country, only 3232 units were in Bihar, which implies a share of only 1.49 per cent for the state. As may be observed from the table 2.2 the total number of factories in India increased by 55 per cent in 2011-12 over 2005-06, for Bihar the increase was 94 per cent. However, the share of Bihar in total fixed capital in India registered a decline between 2005-06 and 2011-12. As regards the working capital, the state's share also dropped sharply from 0.77 per cent in 2005-06 to (-) 0.04 per cent in 2011-12. The emerging scenario is reflective of relatively less capital intensive units coming up in the state. However, the share of Bihar in terms of number of persons engaged, value of output, and net value added showed increases over the period. This was due to the addition of more number of agro-based industries in the state, including the rice mills.

Table No. 2.2: Status of Industries in 2005-06 and 2011-12

SN	Characteristics	2005-06			2011-12		
		India	Bihar	Percentage Share of Bihar	India	Bihar	Percentage Share of Bihar
1.	Number of Factories	140159	1669	1.19	217554	3232	1.49
2.	Fixed capital (Rs. Crore)	606940	2924	0.48	1949551	7547	0.39
3.	Working Capital (Rs. Crore)	184463	1415	0.77	588794	(-) 236	(-) 0.04
4.	Persons engaged (Nos.)	9111680	67447	0.74	13429956	126592	0.94
5.	Value of output (Rs. Crore)	1908355	16785	0.88	5776024	60167	1.04
6.	Net value added (Rs. Crore)	311864	422	0.14	836703	5644	0.67

Source: Annual Survey of Industries, 2005-06 & 2011-12

The fact that there was a substantial addition of agro-based industries in recent years is further corroborated through the figures in table 2.3. In 2005-06, the share of Bihar in agro-based industries was 0.76 per cent, which increased to 1.39 in 2011-12. In

case of non-agro-based industries, there was also a modest increase in the share of Bihar from 1.32 per cent in 2005-06 to 1.80 per cent in 2011-12.

Table No. 2.3: Number of Industries in 2005-06 and 2011-12

SN	Categories of Industry	No. of Factories			Factories in Operation			Percentage	
		India	Bihar	Bihar's Share (%)	India	Bihar	Bihar's Share (%)	All-India	Bihar
2005-06									
1.	Agro-based	61936	470	0.76	57863	440	0.76	93.42	93.62
2.	Non-agro-based	78223	1199	1.53	74161	978	1.32	94.81	81.57
	Total	**140159**	**1699**	**1.21**	**132024**	**1418**	**1.07**	**94.20**	**83.48**
2011-12									
4.	Agro-based	93251	1126	1.21	72769	1014	1.39	78.04	90.05
5.	Non-agro-based	124303	2106	1.69	102939	1858	1.80	82.81	88.22
	Total	**217554**	**3232**	**1.49**	**175708**	**2872**	**1.63**	**80.77**	**88.86**

Source: Annual Survey of Industries, 2005-06 & 2011-12

The net value added by agro-based industries in Bihar was Rs. 1744 crore in 2011-12, which was 17.2 per cent of the gross value of output (Rs.10144 crore). Among various industry groups, Food Products/Beverages/Tobacco Products presented a better performance, both in terms of the value of output and the net value added during the year *(table A 2.1).* But its performance in 2011-12 over 2005-06 was not good particularly in terms of net value added *(table A. 2.2).*

The table 2.3 reveals that of the total factories in India covered in 2005-06, around 94 per cent were found to be in operation, for both agro and non-agro-based industrial units. In 2011-12, the percentage of factories in operation dropped to around 81 per cent, with the proportion of operational agro-based and non-agro-based industries being around 78 and 83 per cent, respectively. However, in case of Bihar, 83 per cent of the total units were found to be operational in 2005-06, which increased to 89 per cent in 2011-12. Thus, it is found that the operational status of the factories, both under agro-based and non-agro-based categories, had improved in Bihar during 2005-06 to 2011-12, whereas it has indeed deteriorated for India.

Further, the industrial units in Bihar are normally of smaller size, compared to the national average. This structural feature of industries in Bihar is further reflected through the per factory fixed capital, net value added and number of employees, the data for which have been presented in table 2.4. As may be seen, compared to a fixed capital of Rs. 11.10 crore per factory at the all-India level, Bihar reported only Rs. 2.63 crore, barely one-fourth of the national figure. Again, the workers per factory and employee per factory in Bihar worked out to be only 64 and 57 per cent of the all-India figures. Similarly, the net value added per factory and net value added per employee in Bihar worked out to 58 and 72 per cent of all-India figures, respectively.

Table No. 2.4: Structural Ratios of Industries in India and Bihar (2011-12)

SN	Characteristics	India		Bihar	
		All	Manufacturing	All	Manufacturing
1.	Fixed capital per factory (Rs. lakh)	1110	1046	263	259
2.	Net Value Added per factory (Rs. lakh)	476	480	197	136
3.	Workers per factory (Number)	59	61	38	40
4.	Employee per factory (Number)	76	79	44	46
5.	Net Value Added per employee (Rs. lakh)	6.23	6.10	4.46	2.97

Source: Annual Survey of Industries, 2011-12

2.2 Agro-based Industries

In India, the agro-based industries, particularly the food processing ones, are considered as sunrise industry on account of its huge potential for uplifting agricultural economy through the establishment of more food processing units, creation of food chain facilities, employment generation and export earnings.

In terms of the production of fruits and vegetables, Bihar happens to be the seventh largest state in the country and, consequently has relatively better opportunities for agro-based industries. Bihar offers enormous opportunities for investment in the food processing sector. Besides food processing, the beverages, tobacco, etc. cover a large number of products, with high net value addition and employment potential. The tea and dairy industries have also started expanding in the state. Bihar grows a variety of fruits and vegetables in huge quantities. The total area under fruits in the state in 2013-14 was 290 thousand hectares and, under vegetables, it was 778 thousand hectares. The fruits like banana, mango, guava and litchi are important in the state in terms of production. The total fruits production was worked out to be 3777 thousand tones in 2013-14. Out of the total production of fruits in 2023-24, banana constituted 38 per cent, closely followed by mango (34 %). The guava and litchi constituted around 6 per cent each of the total fruit production. The vegetables production in 2013-14 was 15,629 thousand tones. Potato is an important crop among the vegetables constituting around 41 per cent of the total production. Other important vegetables were onion (8%), cauliflower and tomato (7% each). The floriculture has also started in the state on commercial basis, covering an area of 793 hectares, the total production being 8831 tones in 2013-14. Marigold, with 77 per cent of the total flower production, occupies the most important position.

2.3 Present Status of Food Processing

In the food processing sector, up to December 2013, a total of 191 project were sanctioned with a total project cost of Rs. 2606 crore, and a grant amounting to Rs. 202 crore was released. The employment generation was 15.181 (table 2.5). Out of the sanctioned projects, only 111 had gone into commercial production. By September 2014, the total number of sanctioned projects increased to 328 with a total cost of Rs. 3871 crore. Of these, 180 units started commercial production. The grant

released amounted to Rs. 294 crore and the estimated employment generation also increased to 21,240. It is also observed from the table that the three principal types of food processing industries are rice milling, wheat milling, and maize milling. Between December 2013 & September 2014 i.e., a period of nine months, as many as 30 rice milling, 6 wheat milling, and 11 maize milling units were installed in Bihar. This was indeed a substantial addition to the state's industrial scenario.

Table No. 2.5: Present Status of Food Processing Units

2014 (as on September)						
SN	Project	Physical Progress		Financial Progress (Amount in Rs. lakh)		Employment (Nos)
		Total No. of Units	Units in Commercial Production	Approved Project Cost	Grant released so for as per progress	
1.	Rice Mills	139	67	122825.47	9134.92	4614
2.	Wheat Milling	36	19	31263.77	3218.00	2215
3.	Maize Processing	33	21	39114.16	2473.12	1348
4.	Rural Agri Business Centre (RABC)	51	24	45019.54	5095.46	1816
5.	F & V Processing	14	12	10193.80	1023.42	532
6.	Milk Processing	10	4	13533.18	1063.92	584
7.	Makhana Processing	3	2	369.69	64.82	56
8.	Honey Processing	2	2	224.14	69.80	32
9.	Biscuits Manufacturing	8	8	19400.83	2361.90	1861
10.	Edible Oil Manufacturing	9	8	48224.05	2754.39	1941
11.	Ice Cream	4	2	1073.38	184.37	64
12.	Other Projects	17	11	22228.36	1770.76	1388
13.	Food Park	2	0	33611.67	150.00	4789
	Total	**328**	**180**	**387082.00**	**29364.88**	**21240**
2013 (as on December)						
1.	Rice Mills	68	37	59047.94	5993.04	2361
2.	Wheat Milling	21	13	17584.89	2137.55	941
3.	Maize Processing	20	10	25761.08	880.42	735
4.	Rural Agri Business Centre (RABC)	36	19	30313.77	3952.11	1175
5.	F & V Processing	10	6	5702.34	1012.86	356
6.	Milk Processing	7	4	11329.96	619.96	479
7.	Makhana Processing	2	2	278.79	7.28	44
8.	Honey Processing	2	2	224.14	81.15	32
9.	Biscuits Manufacturing	4	4	16615.07	2000.00	1581
10.	Edible Oil Manufacturing	7	5	45151.70	1990.59	1898
11.	Other Projects	12	9	14985.35	1570.76	790
12.	Food Park	2	0	33611.67	0.00	4789
	Total	**191**	**111**	**260606.7**	**20245.71**	**15181**

Source: Department of Industry, Directorate of Food Processing, Government of Bihar

2.4 Government Assistance

The Directorate of Food Processing is currently providing special assistance to the sector under the following schemes:

i. Integrated Development Project

Under this project, the ongoing subsidy for cluster scheme will be payable at 40 per cent and for individual units it is kept at 35 per cent. Till date, the DPRs of 254 projects have been approved, of which 153 projects have started

commercial production, and a total of 19,934 persons have been provided with employment. In 2013-14, Rs. 657.53 crore was approved for 152 projects, of which Rs. 223.47 crore was released. The project provides the following facilities:

a. For the capacity expansion under the cluster scheme, the maximum subsidy amount payable is Rs. 10 crore and, for individual unit, it is Rs. 5 crore.
b. For the scheduled castes/scheduled tribes/women/handicapped entrepreneurs, an additional 5 per cent subsidy is payable.
c. For the project cost of Rs. 50-100 crore, an interest subsidy of 3 per cent and on the projects costing above Rs. 100 crore an interest subsidy of 6 per cent is also payable.

ii. Food Park Scheme

Under this scheme, the rate of payable subsidy has been raised to 30 per cent with a maximum of Rs. 50 crore. The establishment of a Food Park at Buxar has been under progress. In 2013-14, a sum of Rs. 30 crore was approved for subsidy payment.

iii. Modernization Scheme for Established Rice Mills

Under National Food Processing Mission of the Government of India, the traditional rice milling units are paid 25 per cent subsidy for modernization. Under this scheme, an additional state subsidy of 15 per cent is payable in accordance with the guidelines of the Government of India. Up to the end of 2012-13, the central government had released its contribution of Rs. 856 lakh approved as subsidy for the scheme, with the state contribution being Rs. 380 lakh. In 2013-14, the central government has released the first installment of Rs. 229 lakh against the approved amount of Rs. 907 lakh. Till date, a total of Rs. 809.84 lakh had been distributed as subsidy.

iv. Cold Storage Scheme

The cold storage with a capacity of 5 to 10 thousand tones would be paid a subsidy of 30 per cent on the capital expenditure. For a capacity of more than 10 thousand tones, 35 per cent subsidey will be payable. The maximum amount of subsidy will be Rs. 5 crore.

v. Establishment of Silo for Maize Storage

Under this scheme, the benefit of subsidy will be given for establishment of silos for the storage of maize. The construction of silo with a storage target of

5 thousand tones of maize will be considered as one unit and a subsidy of 35 per cent will be payable on this.

In the Vision Document 2015 for the integrated development of food processing industries in Bihar, 16 business plans have been identified. For the projects under food processing, four Project Management Agencies (PMAs), viz., IL & FS-CDI, Shreyee, Dara Shaw and Spa are to be appointed on contract. Their responsibilities include every step, from conceptualization to the implementation of the projects, including the identification of entrepreneurs, selection of sites, selection and organization of SPV (Special Purpose Vehicle), source of technique, market linkage, preparation of DPRs, project approval, make subsidy available and provide need based consultancy to the government for effective implementation of projects. For these works, the PMAs are paid a fee of 2 per cent of the total project cost, 1 per cent as project development and implementation fee and the remaining 1 per cent on completion of the project as success fee. Till September, 2014 DPRs of 229 projects had been approved. For preparation of DPRs under the food processing sector, a sum of Rs. 467.12 lakh has been approved for payment of consultancy fees. In 2013-14, for the preparation of DPRs under Silk Development Projects, an amount of Rs. 5.50 lakh was paid as consultancy fees, and Rs. 26.23 lakh was approved for wasteland mapping.

2.5 Challenges and Outlook

Bihar, despite many investment proposals in recent years, continues to remain industrially weak. The State Investment Promotion Board has so far approved 1891 proposals for setting up a number of units. Out of this, above 60 per cent of the proposals are for food processing units. Bihar has identified several thrust areas for industrialization, including the food processing sector.

The development of food processing industry is largely dependent on the level of production of fruits and vegetables. It is significant to note that there are large areas in Bihar under different fruits like mango, banana, litchi, guava and others. For vegetables too, the production levels are quite high. In the absence of required storage, preservation and proper marketing facilities within the state, good quantities of these fruits and vegetables are wasted and more often than not, sold at un-remunerative prices. If these wastages are taken care of, there is a great potential for the establishment of food processing units in the state. Similarly, there is a high prospect of cereal-based processing industries, which include paddy, wheat and maize.

The Government of India encourages the activities in the non-farm sector, and agro-processing is one of them. Agro-processing is essentially a process of value addition

to the agricultural produces, making agriculture a more effective contributor to the industrial growth. This will motivate the farmers for better productivity and open up the prospects of industrial development of the state.

In order to facilitate investment in the industrial sector of Bihar, one of the provisions of states' New Industrial Policy of 2011 is the exemption of stamp duty and registration fee on acquisition of land for industrial use. The land conversion charges are also reimbursed. Provisions of capital subsidy on investment in plant and machinery and on captive power generation are also available to the investors. So far as the availability of land is concerned, as a part of *'Aao Bihar'* initiative, the government has made available an online platform through which the land owners are encouraged to publish their land details for the ready reference of the entrepreneurs. The state is also in the process of setting up of a *'land bank'* and the government will acquire land wherever there is a demand (GoB, 2015).

Appendix

Table No. A 2.1: Value of Output and Net Value Added of selected Agro Based Industries in 2011-12 for Bihar & India

SN	Industrial Group	Value of Output			Net Value Added		
		India	Bihar	Bihar's Percentage Share	India	Bihar	Bihar's Percentage Share
1.	Food products/beverages/tobacco products	761927	9430.57	1.24	79976	1581	1.98
2.	Textiles/wearing apparel	372675	156.18	0.04	46519	30	0.06
3.	Leather & Leather products	35911	71.57	0.20	5690	10	0.18
4.	Wood & wood products/furniture	27244	125.58	0.46	3488	18	0.52
5.	Paper & paper products/printing & reproduction of recorded media/publishing activities	104479	360.16	0.34	17766	105	0.59
	Total	**1302236**	**10144.06**	**0.78**	**153439**	**1744**	**1.14**

Source: Annual Survey of Industries, 2011-12

Table No. A 2.2: Structure of Agro-based Industries in Bihar in 2005-06 & 2011-12

Industrial Group	No. of Factories		Factories in operation		Total output (Rs. Crores)		Net value added (Rs. crore)		Percentage Share					
									Factories In Operation		Total Output		Net Value Added	
	2005-06	2011-12	2005-06	2011-12	2005-06	2011-12	2005-06	2011-12	2005-06	2011-12	2005-06	2011-12	2005-06	2011-12
Food products/beverages/ tobacco products	273	804	259	724	166096	9431	50896	1581	18.27	25.21	10.29	15.67	47.36	28.00
Textiles/wearing apparel	19	30	14	25	5881	156	1286	30	0.99	0.87	0.36	0.26	1.20	0.53
Leather & Leather products	7	7	5	6	7264	72	692	10	0.35	0.21	0.45	0.12	0.64	0.18
Wood & wood products/furniture	121	213	116	205	2045	126	342	18	8.18	7.14	0.13	0.21	0.32	0.32
Paper & paper products/printing & reproduction of recorded media/publishing activities	50	72	46	54	23078	360	10450	105	3.24	1.88	1.43	0.60	9.72	1.87
Total	**470**	**1126**	**440**	**1014**	**204364**	**10144**	**63666**	**1744**	**31.03**	**35.31**	**12.67**	**16.86**	**59.24**	**30.92**

Source: Annual Survey of Industries, 2005-06 & 2011-12

CHAPTER – III

METHODOLOGY

3.1 Objectives

With a view to reduce information gap at macro and micro levels and address some of the concerns related to litchi, the present study has the following six objectives:

i. *To study acreage, production and productivity of litchi in important states of India.*
ii. *To assess exports and export potential of litchi from India.*
iii. *To study the cost of production of litchi of alternate varieties in different production environment of the region.*
iv. *To study efficiency in post harvest operations of litchi in different market channel (local, national, international, processed litchi or litchi juice).*
v. *To study the role of institutions in production, marketing and exports of litchi.*
vi. *To identify constraints in efficient production, marketing and processing of litchi.*

3.2 Method, Sample and Coverage

The study is based on secondary and primary information. Fulfillment of the first and second objectives of the study done mainly on the basis of secondary information and from third to the last one have been attended through primary information with the help of duly structured schedules meant for litchi growers and pre-harvest contractors (PHCs). Six case studies were also undertaken for processors of litchi fruits in Bihar.

The study has adopted a multi-stage stratified random sampling technique to choose sample farmers. Bihar is the most important litchi producing state accounting for about 44.20 per cent (2012-13) of litchi production in the country. In the first stage of sampling 03 districts, which encompass different kinds of litchi production and marketing were preferably/purposively selected. These districts were Bhagalpur, Samastipur and East Champaran (Motihari). These districts include a widest possible range of litchi growing in the state. In each of the chosen district, two clusters of villages depending on infrastructural facilities of roads etc. were selected in a manner where each cluster of villages were separated from other cluster by a distance of about 15-20 kms. At the bottom stage of sampling 15 litchi cultivators across different land and orchard size were selected from the list of litchi cultivators systematically prepared with the help of village residents. The detail distribution of sample farmers may be seen in table 3.1.

Table No. 3.1: Distribution of Sample Farmers

Districts	Blocks	Village Cluster	No. of Respondents	Category of Farmers		
				Small (< 2 ha)	Medium (2-5 ha)	Large (>5 ha)
Bhagalpur	Kharik	Kharik	15	07	05	03
	Bihpur	Amarpur	15	06	06	03
East Champaran (Motihari)	Chakia	Baragovind	15	05	04	06
	Mehsi	Partapur	15	06	05	04
Samastipur	Hasanpur	Nayanagar	15	04	07	04
	Hasanpur	Maldah	15	08	04	03
		Total	90 (100.00%)	36 (40.00%)	31 (34.44%)	23 (25.56%)

Source: Primary survey.

Pre-harvest contractors (PHCs) are the most important players in the existing marketing channel of litchi. In all the three districts covered during the survey PHCs are an integral part of the system and more than 75.00 per cent of the litchi is marketed through them. They were identified in each of the selected districts with the help of litchi growers. Of them, 3 in each district were chosen for interrogation with the help of an interview schedule. Besides, 3 each wholesalers and retailers from each of the selected districts were also chosen for case studies. As regards the processors it is to clear here that they are very limited in numbers and can be counted on fingers (8 to 10). All of them are under small category of entrepreneurs (<Rs. 5 crore of capital investment). These entrepreneurs are mainly spread over in Muzaffarpur, Vaishali districts and operate in a radius of 50-60 kilometres for procurement of raw litchi. The district wise distribution of these sample market functionaries are depicted in table 3.2 below:

Table No. 3.2: Distribution of Sample Market Functionaries.

Districts	No. of Respondents		
	PHCs	Wholesalers	Retailers
Bhagalpur	03	03	03
East Champaran	03	03	03
Samastipur	03	03	03
Total	09	09	09

Source: Primary survey.

The distribution of selected processors for case studies from Bihar is presented in table No. 3.3.

Table No. 3.3: Distribution of Selected Processors in Bihar.

SN	Name of the Processors/Firm	Location of Establishment	Activity
1.	Shahi Fresh Foods India Ltd.	Nayanagar, Samastipur	Pack House
2.	M/s R K Impex Pvt. Ltd.	Sikandarpur, Muzaffarpur	Pulp & Concentrate
3.	M/s Litchika International	Industrial Area, Bela, Muzaffarpur	Pulp, Concentrate, Canning, Squash, etc.
4.	M/s Shyam Agro-Foods & Exports	Ratwara, Muzaffarpur	Pulp, Canning & Squash
5.	M/s Suman Vatika Food Products	Dayapur, Vaishali	Pulp, Canning, Juice & Squash
6.	Mr. Daroga Prasad	Jamalabad, Muzaffarpur	Concentrate & Juice

Source: Primary survey.

3.3 Nature and Sources of Data

The study is based on secondary and primary information. The secondary data and information were collected from vision 2030, National Research Centre for Litchi (NRCL), Muzaffarpur; various publications of NRCL, Muzaffarpur, FAO (2013), New Delhi. Report on Litchi Resource Mapping, Bihar, prepared by IL & FS. The primary information and data were collected from the sample districts with the help of duly structured schedule meant for litchi growers. Besides, some case studies were also undertaken with different market players such as pre-harvest contractors (PHCs), wholesalers and retailers and processors with the help of interview schedules/guide. Focus group discussions at the village level and functionaries of the Horticulture Department at the district level were also made. Scientists of NRCL involved in production and post-harvest management were also approached for capturing their views and insights.

3.4 Analytical technique

Analytical technique uses different statistical technique to measure different concepts of marketing used in the study. The concepts used are based on measuring price spread, market margin, market efficiency, etc.. The above ratios are based on computation as per below:

Price spread is the difference between prices in different stages, e.g. price received by farmer and price paid by consumer. The price spread is worked out by using the modal value of price at comparable stage.

Similar is the concept for producer's share in consumer's rupee. It is expressed mathematically as:

$$PS = (Pg/Pc)*100$$

Where Pg and Pc is the price received by farmer or grower of litchi and price paid by consumer for litchi in the retail market.

Market Efficiency (ME) Shepherd (1965) first suggested formula to measure the concept of ME. According to Shepherd market efficiency index (MEI) is the ratio of value addition by the marketing system (VA) to the marketing cost including margins (MC). Thus MEI = (VA/MC)*100 The value addition by the marketing system is the difference in price at growers field to the consumers market, while marketing cost is total cost and margin of market functionaries in the post harvest operations of litchi.

The **modified marketing efficiency (MMEI)** as suggested by Acharya and Agrawal (2001) is the ratio of net price received by grower (NPg) to the total cost of marketing

margin (MM), maketing cost (MC) and loss of litchi in post harvest operation of marketing litchi (TL). Thus MMEI = NPg / (MC+MM+TL)

The **post harvest losses (TL)** in litchi can broadly happen at three stages at the levels of orchard, transportation and markets (wholesalers and retailers level). The questionnaire also deals about wastage at production level. These losses are attributed to different market functionaries (producers, pre-harvest contractors, wholesalers, retailers) depending on their involvement in market functions. Simple averages and percentages were used to calculate post harvest losses at different stages of litchi marketing. It uses following concepts and ratios related to market efficiency.

Producers net price realized by litchi grower is estimated as difference in gross price received by him and the sum of marketing cost incurred by producer (if any) including economic losses (grading, packaging, etc.) after price contract. Thus producer's net price (NPg) may be explained mathematically by following equation.

NPg/m/r = (GPg/m/r – GPo) - Cg/m/r – (Lg/m/r*GPg/r)

Where,

NPg/m/r is the net price received by litchi growers, middleman, wholesaler or retailer in the market.

GPg/m/r is the gross price received by grower or wholesale price to traders

Cg/m/r is the cost incurred by grower, middleman, wholesaler or retailer during operation of different marketing functions (MC= Cg + Cm +Cr).

Lg/m/r is the physical loss in fruits from orchards to markets and at different functionary of market (TL= Lg+ Lm+ Lr).

GPo is the price paid by the respective functionary to the earlier functionary of market.

In the above equation the first bracket (second and third expressions) indicate gross return, the fourth expression (Cg/m/r) indicates cost incurred by different functionaries in marketing the commodity and fifth expression present total loss of different market functionaries in post harvest operations of commodity.

Ranking of Problems of respondents have been worked out by Garret's method. This has been followed to analyze the constraints to growers of litchi. The respondents were asked to rank various constraints. These orders of merits transformed to units of scores by using following formula. The percent position = 100(Rij -0.50) Nj where, Rij is the rank given for ith problem of jth individual. Nj is

the number of problems/factors ranked by the jth individual. The percent position of each rank is converted into scores by referring to the table given by Garret and Woodworth (1969). Then for each factor the scores of individual respondents are added together and divided by the number of respondents for whom scores are added. The mean score for all factors are ranked in descending order and the most influential factors are identified through the ranks assigned.

3.5 Potential Districts of Litchi in Bihar

Out of 38 districts in state, 27 districts (71.05%) are recognized litchi growing districts in terms of area and production of litchi fruit. Of the 27 districts, only 8 districts occupy an area of 69.84 per cent with production of 68.73 per cent during the year 2013-14. It reveals that about two-thirds of litchi area and production lie with 8 districts only whereas less than one-third of total area and production of litchi with 19 litchi growing districts. Moreover, it is to note here that Muzaffarpur district alone occupies about one fourth area and production of litchi in the state. The detail of highest districts area, production and yield note is depicted in table 3.4. As regards the productivity is concerned, the state's figure is at 7.74 MT/ha whereas in highest area and production districts, it is 7.62 MT/ha. The yield rate in remaining districts is 8.03 MT/ha, a little higher the state's average yield and the yield of highest area and production district.

Table No. 3.4: Highest Districts Area, Production and Productivity of Litchi in Bihar in 2013-14.

SN	Districts	Area ('000 ha)	Production ('000 MT)	Productivity (MT/ha)
1.	Muzaffarpur	7.30 (24.1)	58.98 (25.2)	8.08
2.	Vaishali	3.61 (11.9)	27.05 (11.6)	7.49
3.	Sitamarhi	2.19 (7.2)	16.18 (6.9)	7.39
4.	West Champaran	2.08 (6.9)	15.41 (6.6)	7.41
5.	East Champaran	1.95 (6.5)	13.57 (5.8)	6.96
6.	Katihar	1.50 (5.0)	11.29 (4.8)	7.53
7.	Samastipur	1.29 (4.3)	9.81 (4.2)	7.60
8.	Gopalganj	1.20 (4.0)	8.67 (3.7)	7.22
	Sub-total	21.12 (69.84)	160.96 (68.73)	7.62
	In remaining districts	9.12 (30.16)	73.24 (31.27)	8.03
	Total	30.24 (100.00)	234.20 (100.00)	7.74

Source: Compiled from Economic Survey, Bihar; 2014-15, Government of Bihar,
Figure in brackets denotes percentage to the total.

3.6 Description of the Study Area

The description of the study area or location of study is presented as below:

3.6.1 District wise Details of Study Area

Demography and development have long been recognized. According to Census, 2011 Bihar is the third populous state of India, with a population of 1040.90 lakh. The decadal growth rate of population for Bihar (25.10%) is much higher than that of India (17.60%), indicating the absence of the demographic transition that many parts

of India have already experienced. The state has 39015 inhabited villages and spread over in 94163 sq. kms in 2001 & 2011 also. The percentage of rural population is 88.71 per cent in 2011 Census, which was 89.54 per cent in 2001 Census. Male population constitutes 52.14 per cent and female population 47.86 per cent in 2011 Census. The male literacy has significantly increased to 73.39 per cent in 2011 as compared to 59.68 per cent in 2001 Census. Alike male literacy, the female literacy has also increased from 33.12 per cent in 2001 census to 53.33 per cent in 2011 census. The gender gap in literacy also fell down from 26.53 per cent in 2001 to 20.06 per cent in 2011 census. The demographic features of Bihar vary much among the studied districts viz., Bhagalpur, Samastipur and East Champaran (Motihari). These districts are spread over in 2569 sq. kms (2.73% the state), 2904 sq. kms (3.08 % of the state and 3968 sq. kms (4.21% of the state) respectively. The number of inhabited villages in these districts are 934 (2.39% of state's total), 1122 (2.88% of state's total) and 1278 (3.28 % of state's total) respectively. In 2011 census the total population in Bhagalpur district is 30.4 lakh (2.92 % of the state), 42.6 lakh (4.9% of the state) in Samastipur and 51.00 (4.9% of the state) in East Champaran. The percentage of rural population is 80.26, 90.48 and 92.16 respectively in these studied districts in 2011 census. Similarly the male literacy is 72.30 per cent, 73.09 per cent and 69.02 per cent and the female literacy 56.49 per cent, 53.52 per cent and 47.36 per cent respectively in 2011 census. The details of these demographic features are shown in table 3.5.

Table No. 3.5: Demographic Features of Sampled Districts and State as per Census 2001 & 2011

Particulars	Bhagalpur		Samastipur		East Champaran		Bihar	
	2001	2011	2001	2011	2001	2011	2001	2011
Geographical Area (In Sq. kms)	2569	2569	2904	2904	3968	3968	94163	94163
No. of inhabited villages	934	934	1122	1122	1278	1278	39015	39015
Total Population (In lakh)	24.20	30.40	34.00	42.60	39.50	51.00	829.90	1040.90
Rural Population	19.70 (81.40)	24.40 (80.26)	32.70 (96.18)	41.10 (96.48)	36.90 (93.41)	47.00 (92.16)	743.10 (89.54)	923.40 (88.71)
Male Population	12.90 (53.30)	16.20 (53.28)	17.60 (51.76)	22.30 (52.35)	20.80 (52.66)	26.80 (52.55)	432.40 (52.10)	542.70 (52.14)
Female Population	11.30 (46.70)	14.20 (46.72)	16.40 (48.24)	20.30 (47.65)	18.70 (47.34)	24.20 (47.45)	397.50 (47.90)	498.20 (47.86)
Male Literacy (%)	59.22	72.30	57.59	73.09	49.31	68.02	59.68	73.39
Female Literacy (%)	38.13	56.49	31.67	53.52	24.27	47.36	33.12	53.33

Source: Bihar through figures: 2007, Bihar Statistical Handbook: 2010 & DCH, 2011.
In parentheses percentage figures are shown.

The land use pattern of the studied districts vis-à-vis the state is depicted in table 3.6. The table reveals that the area under non-agricultural uses have increased during the period of 2003-04 to 2011-12 (8 yrs) by 3.52 per cent in Bihar and that of in studied districts by 4.64 per cent in Bhagalpur, 2.77 per cent in Samastipur and 2.61 per cent in East Champaran, indicating shrinkages in agricultural lands perhaps due to urbanization and non-profitable agriculture. During the same period, the net area sown (NSA) in these districts and the state as well has also fell 5.53 in Bihar and

13.78 per cent in Bhagalpur, 6.40 per cent in Samastipur and 5.78 per cent in East Champaran, districts. In this scenario, to be self reliant in food grains and other produce to the state and studied districts, there is need to increase the productivity of the agricultural crops. The cropping intensity has been marginally increased from 1.38 to 1.42 in Bihar and that of by 0.14 in Samastipur and 0.32 in East Champaran except in Bhagalpur district, where it fell by 0.02.

Table No. 3.6: Land use Classification of Selected Districts and State during 2003-04 & 2011-12

Particulars	Bhagalpur		Samastipur		East Champaran		Bihar	
	2003-04	2011-12	2003-04	2011-12	2003-04	2011-12	2003-04	2011-12
Geographical Area ('000 ha)	254.30	254.30	262.40	262.40	431.70	431.70	9359.60	9359.60
Land put to non-agril. Uses	67.47	70.60	62.08	63.80	75.33	77.30	1644.58	1702.50
Net Area Sown	145.67 (57.28)	125.60 (49.39)	184.72 (70.40)	172.90 (65.89)	288.80 (66.90)	272.10 (63.03)	5712.08 (61.03)	5395.70 (57.65)
Area sown more than once	31.90	25.20	67.47	88.60	34.49	146.50	2170.29	2251.10
Gross Cropped Area	177.57	150.80	252.19	261.50	323.29	418.60	7882.37	7646.80
Cropping Ingtensity	1.22	1.20	1.37	1.51	1.12	1.54	1.38	1.42

Source: Bihar through figures (2007) for 2003-04 & Economic Survey (Bihar): 2014-15 for 2011-12 figures.
In parentheses percentage to Geog. Area are shown.

The number on different categories of farms and the area of holdings under the respective category is presented in table 3.7. the results presented over the period 1995-96 to 2010-11 for Bihar state indicate that the numeric strength of various farm sizes is highly skewed and do not match with the area of holdings. The percentage of marginal farms has increased during the period indicating thereby marginalization of land holdings pattern whereas all other categories have registered a decline in their respective number. In regard to area by various categories of farms, more or less, also indicate highly skewedness of the holdings. Though, it may be due to bifurcation of erstwhile Bihar by creation of Jharkhand state in November, 2000. Almost similar situation of marginalization of land holdings has been indicating in the studied districts.

Table No. 3.7: Number & Area of Holdings by Size Groups in Selected Districts and Bihar for the Year 2010-11

Farm Size	Bhagalpur		Samastipur		East Champaran		Bihar			
							1995-96		2010-11	
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
Marginal (up to 1 ha)	461194 (94.22)	104266 (65.11)	652546 (95.15)	133450 (70.17)	862309 (92.19)	198695 (58.17)	11344173 (80.14)	3870980 (36.24)	14744098 (91.06)	3668728 (57.44)
Small (1-2 ha)	17811 (3.64)	21052 (13.14)	25465 (3.71)	28722 (15.10)	46631 (4.99)	55335 (16.20)	1526489 (10.78)	2017895 (18.89)	948016 (5.86)	1185695 (18.56)
Semi-Med (2 – 5 ha)	9500 (1.94)	27072 (16.90)	6818 (0.99)	19083 (10.03)	23623 (2.53)	68558 (20.07)	1110865 (7.85)	3315278 (31.04)	414664 (2.56)	1072969 (16.80)
Med. (5-10 ha)	791 (0.16)	5268 (3.29)	814 (0.12)	5624 (2.96)	2588 (0.28)	16012 (4.69)	144042 (1.02)	998930 (9.35)	81484 (0.50)	414941 (6.50)
Large (> 10 ha)	180 (0.04)	2491 (1.56)	204 (0.03)	3313 (1.74)	245 (0.02)	2967 (0.87)	29121 (0.21)	478896 (4.48)	3129 (0.02)	45228 (0.70)
All	489476 (100.00)	160149 (100.00)	685847 (100.00)	190193 (100.00)	935396 (100.00)	341567 (100.00)	14154690 (100.00)	10681979 (100.00)	16191391 (100.00)	6387561 (100.00)

Source: Bihar through Figures, 2010 & www.agcensus.dacnet.nic.in
In parentheses percentage figures are shown.

As regards the number and area of operational holdings by ownership category is concerned, the data presented in table 3.8 reveals that of the total holdings of respective districts about 76.00 per cent in Bhagalpur, 81.00 per cent in East Champaran and 96.00 per cent in Samastipur districts are occupied under individual farmers. The farms occupied under joint ownership are about 24.00 per cent in Bhagalpur, 19.00 per cent in East Champaran and 4.00 per cent in Samastipur districts. The number of institutional ownership of operational holdings is less than 1.00 per cent across the studied districts. It shows that the ownership pattern of the operational holdings is in favour of individual farms in all the studied districts.

Table No. 3.8: Number and Area of Operational Holdings (Agril. Census, 2010-11) in Studied Districts

Districts	Individual		Joint		Institutional		Total	
	No.	Area	No.	Area	No.	Area	No.	Area
Bhagalpur	371666 (75.93)	118258 (73.84)	116826 (23.87)	40949 (25.57)	984 (0.20)	941 (0.59)	489476 (100.00)	160149 (100.00)
East Champaran	755204 (80.74)	262739 (76.92)	177855 (19.01)	76533 (22.41)	2337 (0.25)	2295 (0.67)	935396 (100.00)	341567 (100.00)
Samastipur	658310 (95.98)	176395 (92.94)	24958 (3.64)	12019 (6.32)	2579 (0.38)	1779 (0.94)	685847 (100.00)	190193 (100.00)
Bihar	13839660 (85.47)	5195381 (81.34)	2325883 (14.37)	1165401 (18.24)	25848 (0.16)	26771 (0.42)	16191391 (100.00)	6387557 (100.00)

Source: www.agcensus.dacnet.nic.in
In parentheses percentage to respective total have been shown

One of the foremost input requirements for agriculture is the timely availability of irrigation for agricultural operations. Newer and modern technology of agriculture can succeed only where there exist facilities of assured irrigation. During the period 2000-01 to 2008-09 about 60.00 to 62.00 per cent of the net sown area is irrigated in Bihar through various sources. The total net irrigated area and the area irrigated by different sources in the state is almost stagnant during the last decade. The data presented in table 3.9 reveals that the major source of irrigation is wells and tube wells followed by canals, tanks and others in the state. In studied district about 75.00 per cent of the net sown area is irrigated in Samastipur followed by 48.00 per cent in East Champaran and 40.00 per cent in Bhagalpur districts. Its source wise analysis reveals that in absence of canal irrigation in all the three districts, the only source of irrigating the fields is through wells/tube wells (96.00 to 100.00%). In fact there is large prevalence of water markets in these districts through tube wells irrigation for the decades.

Table No. 3.9: Net Irrigated Area by Different Sources in Selected Districts Vis-à-vis Bihar during 2000-01 to 2008-09

Particulars	Bhagalpur			East Champaran			Samastipur			Bihar		
	2000-01	2005-06	2008-09	2000-01	2005-06	2008-09	2000-01	2005-06	2008-09	2000-01	2005-06	2008-09
Total Net Irrig. Area ('000 ha)	55	60	50	155	148	141	98	98	130	3429.00	3144.00	3537.00
% to Net Sown Area	37.78	42.59	39.81	52.41	49.81	47.78	52.48	53.24	75.19	60.55	56.59	61.92
Source wise ('000 ha)												
Canals	5 (9.09)	---	---	19 (12.26)	---	---	---	---	---	940.00 (27.41)	840.00 (26.72)	886 (25.05)
Wells & Tube wells	34 (61.82)	57 (95.00)	48 (96.00)	135 (87.10)	148 (100.00)	141 (100.00)	98 (100.00)	98 (100.00)	130 (100.00)	2141.00 (62.44)	2057.00 (65.43)	2437.00 (68.90)
Other Sources	10 (18.18)	---	---	01 (0.64)	---	---	---	---	---	207.00 (6.04)	127.00 (4.04)	84.00 (2.37)
Tank	6 (10.91)	3 (5.00)	2 (4.00)	---	---	---	---	---	---	141.00 (4.11)	120.00 (3.81)	130.00 (3.68)

Source: Bihar Statistical Handbook: 2000-2006 & 2010 and Bihar Economic Survey, 2014-15.

In table 3.10, the cropping pattern in studied district has been shown for the period of 2010-11 to 2012-13. The data reveals that the agricultural economy of the studied districts is very much tilted in favour of the subsistence sector, since the acreage under food grains (cereals + pulses) is about 80.00 to 90.00 per cent. The percentage of area under vegetables has shown around 7.00 to 11.00 in Bhagalpur district, 4.00 to 5.00 in East Champaran district and 6.00 to 7.00 per cent in Samastipur district during the same period. The fruits sector occupies about 3.00 to 7.00 per cent across the studied districts. As regards the percentage share of litchi fruit to the net sown area, it is 0.40 to 0.45 per cent in Bhagalpur, 0.61 to 0.71 per cent in East Champaran and 0.74 to 0.75 per cent in Samastipur districts. It shows that litchi occupy only 0.40 to 0.75 per cent of the net sown area across the studied districts.

Table No. 3.10: Area under Different Crops including Litchi Orchard in the Studied Districts during 2010-11 to 2012-13

Crops	Bhagalpur			East Champaran			Samastipur		
	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13
Rice	30.80 (20.35)	26.60 (17.64)	35.14 (22.13)	132.30 (41.16)	193.30 (46.17)	188.51 (46.70)	88.40 (35.77)	88.40 (33.80)	92.56 (35.40)
Wheat	43.70 (28.87)	41.20 (27.32)	42.92 (27.02)	102.60 (31.92)	111.00 (26.52)	115.14 (28.52)	61.70 (24.97)	59.20 (22.54)	59.18 (22.63)
Maize	39.50 (26.10)	48.92 (32.44)	44.80 (28.21)	15.90 (4.95)	51.40 (12.28)	46.73 (11.58)	42.80 (17.32)	40.28 (15.40)	40.29 (15.41)
Pulses	13.90 (9.18)	10.39 (6.89)	13.96 (8.79)	11.50 (3.58)	11.57 (2.76)	12.83 (3.18)	14.20 (5.75)	15.74 (6.00)	15.67 (5.99)
Potato	7.64 (5.05)	8.23 (5.46)	6.29 (3.96)	10.29 (3.20)	11.46 (2.74)	8.76 (2.17)	11.65 (4.71)	12.01 (4.39)	9.18 (3.51)
Onion	1.64 (1.08)	1.64 (1.09)	1.64 (1.03)	2.15 (0.67)	2.39 (0.57)	2.38 (0.59)	1.40 (0.57)	1.40 (0.54)	1.40 (0.54)
Cauliflower	1.65 (1.09)	1.65 (1.09)	1.65 (1.04)	2.78 (0.86)	2.84 (0.68)	2.84 (0.70)	3.00 (1.21)	3.00 (1.48)	3.00 (1.48)
Brinjal	1.71 (1.13)	1.71 (1.13)	1.71 (1.08)	1.63 (0.51)	1.63 (0.38)	1.63 (0.40)	2.32 (0.94)	2.32 (0.88)	2.32 (0.89)
Mango	7.55 (4.99)	7.55 (5.00)	7.55 (4.75)	9.26 (2.88)	9.28 (2.22)	9.30 (2.30)	10.30 (4.17)	10.50 (4.02)	10.60 (4.05)
Guava	0.70 (0.46)	0.70 (0.46)	0.70 (0.44)	1.62 (0.50)	1.65 (0.39)	1.67 (0.41)	0.65 (0.26)	0.65 (0.25)	0.65 (0.25)
Banana	1.30 (0.86)	1.31 (0.87)	1.35 (0.85)	1.02 (0.32)	1.05 (0.26)	1.08 (0.27)	2.23 (0.90)	2.23 (0.85)	2.27 (0.87)
Litchi	0.51 (0.34)	0.54 (0.36)	0.58 (0.37)	1.88 (0.58)	1.90 (0.46)	1.95 (0.48)	1.29 (0.52)	1.29 (0.49)	1.29 (0.49)
Others	0.75 (0.50)	0.36 (0.25)	0.52 (0.33)	28.47 (8.87)	19.13 (4.57)	10.88 (2.70)	7.16 (2.91)	24.48 (9.36)	23.09 (8.52)
Net Sown Area	126.30	125.60	127.20	308.40	272.10	274.30	174.90	172.90	173.14
Gross Cropped Area	151.35 (100.00)	150.80 (100.00)	158.80 (100.00)	321.40 (100.00)	418.60 (100.00)	403.70 (100.00)	247.10 (100.00)	261.50 (100.00)	261.50 (100.00)
CI (%)	119.98	120.06	124.84	104.21	153.84	147.17	141.28	151.24	151.03
% Litchi area to NSA	0.40	0.43	0.45	0.61	0.70	0.71	0.74	0.75	0.75

Source: Economic Survey (Bihar) for 2014-15, 2013-14 & 2012-13
In brackets percentage to GCA is indicated.

The annual normal rainfall in Bihar is 1176.40 mm, which is reasonably adequate for the state's agricultural operations. However, it is the year to year variation in rainfall which tends to create flood or drought like situations in the state in almost every year. This causes serious damage to crop production which affects the state economy. During the period 2001-2013, the annual actual rainfall in the state varies from being 682.60 mm in 2010 to 1494.90 mm in 2007, resulted to 42.00 per cent deficient to 27.00 per cent excess respectively to the annual normal rainfall in the state. The results of the table 3.11 reveal that except in 4 years, there is no normal rainfall in the state during the last 13 years. In studied districts, the total annual actual rainfall has been substantially lower than the normal in 03 years in Bhagalpur, 07 years in East Champaran and 04 years in Samastipur during the last 13 years. These figures clearly indicate a wide variation across the districts in terms of actual annual rainfall.

Table No. 3.11: Annual Average Actual Rainfall in Selected Districts vis-à-vis Bihar during 2001-2013

(In mm)

Year	Bhagalpur (Normal - 1136.30)	East Champaran (Normal - 1241.60)	Samastipur (Normal - 1142)	Bihar Normal - 1176.40)
2001	1026.60	1179.30	1153.00	1202.50
2002	NA	1661.10	1186.60	1037.70
2003	NA	1255.40	1116.00	1225.00
2004	NA	1227.40	1272.70	1079.00
2005	1134.00	1569.20	712.40	872.90
2006	1178.30	1090.80	1031.00	1034.90
2007	1248.40	2042.30	1795.40	1494.90
2008	915.40	1330.00	1123.40	1196.00
2009	1018.80	900.60	798.10	871.30
2010	475.00	743.30	525.50	682.60
2011	984.40	1287.90	1105.90	1113.10
2012	596.60	934.30	702.00	797.00
2013	911.30	715.10	767.00	773.60

Source: Directorate of Economics & Statistics, Government of Bihar

3.6.2 Block wise Features of the Study Area

As presented earlier in table 3.1, the study area covers a total of 5 blocks. Out of these, 2 blocks namely Kharik and Bihpur are from Bhagalpur district, 2 blocks namely Chakia and Mehsi from East Champaran district and 01 block namely Hasanpur from Samastipur district. Table 3.12 presents the area and demographic profile of all the 5 studied blocks. In Bhagalpur district, block – I (Kharik) is spread over in geographical area 13.84 thousand hectares (5.44% of total geog. area of the district) and block - II (Bihpur) with a geographical area of 18.24 thousand hectares (7.17 % of total geog area of the district) and both are located is the north of river Ganges. There are 28 inhabited villages in block-I and 30 inhabited villages in block-II, accounting for 1.84 per cent and 1.97 per cent of total inhabited villages of the district. As per the census, 2011 block – I has a total population of about 1.33 lakh (4.37 % of the total population of the district and block-II with a population of about 1.23 lakh (4.06% of the total population of the district). The percentage of rural population in these two blocks is 5.46 per cent and 5.07 per cent respectively of the total rural population of the district. These two blocks have no urban population. The percentage of males and females population in these two blocks is 53.33 & 46.67 and 53.22 & 46.78 respectively. The literacy rate among the males and females population in these two blocks are 53.73 & 39.23 and 55.60 & 42.38 respectively, which are much below the literacy rate of the district on both counts.

Blocks - III & IV (Chakia & Mehsi respectively) lie in East Champaran district. These two blocks are spread in a geographical area of 24.03 thousand hectares (5.57% of total geog. area of the district) and 25.16 thousand hectares (5.83 % of total geog. area of the district) respectively. There are 65 & 71 inhabited villages respectively in these two blocks. As per census, 2011 the total population of these two blocks are 2.16 lakh and 1.73 lakh respectively accounting for 4.24 per cent and 3.40 per cent respectively of the total population of the district. The rural population in these two

blocks is 90.44 per cent and 84.99 per cent respectively of the total population of the respective blocks. Males and females literacy rates are 54.90 per cent and 38.74 per cent and 52.18 per cent & 35.82 per cent respectively.

Block – V (Hasanpur) lie in Samastipur district. It has a total geographical area of 15.30 thousand hectares, which occupies about 5.83 of the total geographical area of the district. The block has 76 inhabitated villages. As per census, 2011, the block has a total population of 22.74 lakh, accounts for 5.34 per cent of total population of the district. The block has no urban population. The percentage of male & female population is 52.41 and 47.59. The literacy rate among the males is 54.44 per cent and females 36.38 per cent, which is lower to the respective literacy rate of the district.

Table No. 3.12: Demographic Features of Studied Blocks as Compared to Sampled Districts

Particulars	Block – I (Kharik)	Block – II (Bihpur)	I-Bhagalpur
Geographical Area ('000 ha)	13.84 (5.44)	18.24 (7.17)	254.30 (100.00)
No. of Inhabited villages	28 (1.94)	30 (1.97)	1519 (100.00)
Total Population	132898 (4.37)	123386 (4.06)	3037766 (100.00)
Rural Population	132898 (5.46)	123386 (5.07)	2435234 (100.00)
Male Population	70873 (4.39)	65664 (4.06)	1615663 (100.00)
Female Population	62025 (4.36)	57722 (4.06)	1422103 (100.00)
Male Literacy (%)	53.73	55.60	72.30
Female Literacy (%)	39.23	42.38	56.49
Particulars	**Block – III (Chakia)**	**Block – IV (Mehsi)**	**II-East Champaran**
Geographical Area ('000 ha)	24.03 (5.57)	25.16 (5.83)	431.70 (100.00)
No. of Inhabited villages	65 (4.83)	71 (5.27)	1346 (100.00)
Total Population	216276 (4.24)	173140 (3.40)	5099371 (100.00)
Rural Population	195590 (4.16)	147145 (3.13)	4698028 (100.00)
Male Population	112004 (4.18)	90886 (13.39)	2681209 (100.00)
Female Population	104272 (4.31)	82254 (3.40)	2418162 (100.00)
Male Literacy (%)	54.90	52.18	68.02
Female Literacy (%)	38.74	35.82	47.36
Particulars	**Block – V (Hasanpur)**		**III-Samastipur District**
Geographical Area ('000 ha)	15.30		262.40 (100.00)
No. of Inhabited villages	76		1260 (100.00)
Total Population	227421 (5.34)		4261566 (100.00)
Rural Population	227421 (5.52)		4113769 (100.00)
Male Population	119193 (5.34)		223003 (100.00)
Female Population	108228 (5.33)		2031563 (100.00)
Male Literacy (%)	54.44		73.09
Female Literacy (%)	36.38		53.52

Source: Primary Census Abstract, 2011 (Bihar) & District Statistical Handbook – 2010.
In brackets percentage to respective totals of district have been shown

3.6.3 Village wise Features of the Study Area

As stated earlier, this study has been undertaken in six village clusters distributed among five blocks and three districts. In table 3.13 the demographic and workers profile of these studied villages has been presented. In Bhagalpur district, Kharik, village falling under kharik block and Amarpur village falling under Bihpur block were selected. Similarly in East Champaran district, Bara Gobind and Partapur villages and in Samastipur district, Nayanagar and Maldah village were selected. The results of table reveals that village – I is largest followed by village – V, II, III, VI & III in terms of total number of households and population. As regards the male

literacy it is 61.04 per cent in village IV followed by village – II (60.25%), I (59.62%), V (58.09%) and III (39.00%). In terms of female literacy, it is higher in both the villages (I & II) of Bhagalpur district followed by village IV, V, VI & III. The percentage of total workers to total population varies from 28.29 (village-III) to 39.24 (village – IV). Percentage of main workers to total workers is higher in village – III (78.15%) followed by village – I (70.93%), VI (66.34%), V (54.30%), IV (51.79%) and II (49.12%). The percentage of agricultural workers is largely varied from 16.55 in village –II to 77.20 in village – III.

Table No. 3.13: Demographic Features of Study Villages

Districts/Blocks/Villages	Bhagalpur		East Champaran		Samastipur	
	Kharik	Bihpur	Chakia	Mehsi	Hasanpur	
	I Kharik	II Amarpur	III Bara Gobind	IV Partapur	V Nayanagar	VI Maldah
Total No. of Households	8344	1666	800	432	1946	597
Total Population	42354	7733	4119	2421	10247	2782
Male Population (%)	53.56	53.74	50.35	53.33	52.38	51.62
Female Population (%)	46.44	46.26	49.65	46.67	47.62	48.38
Male Literacy (%)	59.62	60.25	39.00	61.04	58.09	50.07
Female Literacy (%)	47.36	52.05	29.63	43.00	40.43	33.43
% of Total workers to total Population	29.22	29.28	28.89	39.24	31.27	33.21
% of Main Workers to total workers	70.93	49.12	78.15	51.79	54.30	66.34
% of Main Agril. Lab to main workers	51.10	16.55	77.20	31.10	47.70	52.69

Source: Compiled from PCA-2011, Bihar

CHAPTER – IV

RESULT & DISCUSSIONS

This chapter presents a brief overview of the selected litchi orchard growers followed by a detailed discussion on their cropping pattern, income and employment pattern, per hectare cost and return of litchi cultivation, marketed surplus of litchi, technological information in litchi cultivation, credit behavior of sample litchi households, perishability of litchi at different stages of production of litchi, prevailing prices of litchi at local and regional market, possible supply chains of litchi, price spread and marketing efficiency of litchi, problems in litchi cultivation, marketing etc. Analysis is classified into farm size categories and district wise, however in some cases clubbed at the state level.

4.1 Socio-Economic Profile of the Selected Litchi Growers

Table 4.1 presents a brief profile of the selected litchi growers in six village clusters across three selected districts of Bihar. As already stated in table 3.1 of Chapter-II that out of the total selected 90 households in the state, 36 (40.00%) were small farmers with operational holdings less than 2 hectares, 31 (34.44%) were medium farmers with operational area of 2-5 hectares; and rest 23 (25.56%) were large farmers operating above 5 hectares of land. These farm households owned litchi orchards of different sizes. The social classification of the total sample households was 54.44 per cent from general castes followed by 43.33 per cent from OBCs and only 2.23 per cent from SCs. No STs were reported among the sample. On the educational status 28.89 per cent were graduate followed by 26.67 per cent matriculate, 20.00 per cent literate, 15.56 per cent intermediate, 5.56 per cent post-graduate and 3.00 per cent illiterate at the overall level. On an average, household size (number of members per family) was 5.81 members and it was lowest (5.67) in East Champaran and highest (6.07) in Samastipur. More than 75.00 per cent of the selected households at the overall level primarily belonged to farming alone. The other occupations like service (12.22%) and business/trade (11.11%).

Table No. 4.1: A Brief Profile of the Sample Households.

SN		Particulars	Bhagalpur			East Champaran			Samastipur			Overall
			V1	V2	Total	V3	V4	Total	V5	V6	Total	
A.	Sample Growers (No)		15	15	30	15	15	30	15	15	30	90
B.	Social Category (%)											
	a.	General	23.33	20.00	43.33	20.00	26.67	46.67	40.00	33.33	73.33	54.44
	b.	SC	---	6.67	6.67	---	---	---	---	---	---	2.23
	c.	ST	---	---	---	---	---	---	---	---	---	---
	d.	OBC	26.67	23.33	50.00	3.00	23.33	53.33	10.00	16.67	26.67	43.33
C.	Educational Qualifications (%)											
	a.	Illiterate	3.33	6.67	10.00	---	---	---	---	---	---	3.33
	b.	Literate	6.67	10.00	16.67	10.00	13.33	23.33	10.00	10.00	20.00	20.00
	c.	Matric	13.33	3.33	16.66	20.00	13.33	33.33	16.67	13.33	30.00	26.67
	d.	Inter	6.67	20.00	26.67	10.00	3.33	13.33	3.33	3.33	6.67	15.56
	e.	Degree	20.00	10.00	30.00	10.00	16.67	26.67	20.00	10.00	30.00	28.89
	f.	P G	---	---	---	---	3.33	3.33	13.33	---	13.33	5.56
D.	Avg. Size of Family (In persons)		6.2	5.4	5.8	4.8	6.33	5.67	6.2	5.93	6.07	5.81
E.	Primary Occupation (%)											
	a.	Agriculture	30.00	33.33	63.33	40.00	36.67	76.67	46.67	43.33	90.00	76.67
	b.	Service	10.00	6.67	16.67	3.33	6.67	10.00	3.33	6.67	10.00	12.22
	c.	Business/Trade	10.00	10.00	20.00	6.67	6.66	13.33	---	---	---	11.11
F.	Secondary Occupation (%)											
	a.	Agriculture	20.00	10.00	30.00	---	3.33	3.33	3.33	6.67	10.00	14.44
	b.	Service	10.00	---	10.00	6.67	---	6.67	---	---	---	5.56
	c.	Business/Trade	6.67	6.67	13.34	3.33	---	3.33	6.67	---	6.67	7.78
	d.	None	13.33	33.33	46.66	40.00	46.67	86.67	40.00	43.33	83.33	72.72

Source: Primary Survey.

4.2 Income and Employment Pattern of the Sample Households

Similarly the share in income and employment of sample households had a direct relationship with their different vocations. The data presented in table 4.2 showed the income and employment pattern of the sample households across the sample districts. As regards the income at the overall level, about 67.16 was earned from the cultivation of crops including the litchi orchards followed by 14.03 per cent from other sources i.e., service (private and public sectors) and pensions; 7.47 per cent from the livestock sector; 7.46 per cent from off-farm sector; 2.68 per cent from non-farm sector and 1.20 per cent from remittances out of migration of their family members. It reveals that crop cultivation was the major source of earnings of the sample households at the overall level. Across the sample districts, crop cultivation was also the major source of income.

The employment pattern of the sample households was almost similar to the income pattern. It was largely from the crop cultivation (44.33%) followed by non-farm sector (15.60%), livestock (10.68%), others (10.02%), off-farm (9.85%) and migration (9.52%). Across the districts, the crop cultivation was the largest source of employment of household members. However, in case of other vocations, it was little different across the districts. Moreover, it is quite clear that agriculture and allied sector played a dominant role, which provides most than half-of the total employment to the sample households.

Table No. 4.2: Income and Employment Pattern of Sample Households (In %)

SN	Particulars	Income			
		Bhagalpur	East Champaran	Samastipur	Overall
1.	Crops (including Orchard)	62.71	70.12	69.98	67.16
2.	Livestock	9.37	8.17	4.37	7.47
3.	Off farm	11.22	9.07	2.11	7.46
4.	Non Farm	3.16	1.02	4.17	2.68
5.	Migration	0.32	---	2.03	1.20
6.	Others	13.22	11.62	17.34	14.03
	Total	**100.00**	**100.00**	**100.00**	**100.00**
		Employment			
1.	Crops (including Orchard)	46.34	46.21	40.54	44.33
2.	Livestock	9.68	13.00	9.80	10.68
3.	Off farm	11.43	7.58	10.31	9.85
4.	Non farm	9.24	19.68	19.09	15.60
5.	Migration	11.28	10.65	6.58	9.52
6.	Others	12.03	2.88	13.68	10.02
	Total	**100.00**	**100.00**	**100.00**	**100.00**

Source: Primary Survey.

4.3 Cropping Pattern and Importance of Litchi Orchard

Cropping pattern means area under cultivation of major crops. As our sample consist of farmers who also cultivate litchi fruit besides other fruits. The data in table 4.3 presents cropping pattern followed by the selected farmers in three sample districts. The statistics presented in table reveal that the selected farmers were growing paddy, maize, wheat, pulses, vegetables, others (oilseeds, sugarcane, etc.) and horticultural crops mainly litchi and others like mango, papaya, guava, banana, etc. Among the crops grown by the selected farmers at the overall level, the proportion of different crops show that cereals (paddy+maize+wheat) contributed largely in East Champaran (52.45%) followed by Samastipur (44.63%) and Bhagalpur (36.27%) of the gross cropped area. Except in Bhagalpur, litchi orchard occupied next position with 38.16 per cent in Samastipur, 31.84 per cent in East Champaran and 41.08 per cent in Bhagalpur. Further the table 4.3 reveals that the importance of litchi orchards in cropping pattern of the farmers is decreasing according to the size group of farmers. But the decrease was in percentage terms not in absolute terms. In absolute terms it was 0.68 ha (52.70 % the GCA) on small group of farms, 1.42 ha (43.03 % of the GCA) on medium group of farms and 2.68 ha (34.41% of the GCA) on large group of farms in Bhagalpur district. Similarly these were 0.53 ha (37.59% of the GCA), 1.29 ha (34.03% of the GCA and 2.92 ha (29.15 % of the GCA) on respective group of farms in East Champaran district and 0.53 ha (42.40 % of the GCA), 1.57 ha (36.35 % of the GCA) and 3.17 ha (37.04 % of the GCA) on respective group of farms in Samastipur district. If we see the area under total orchards, it becomes first in Bhagalpur (53.16%) followed by Samastipur (45.63%) and East Champaran (37.75%). It is to clear here that the study area in Bhagalpur was north of Bhagalpur, which is highly prone to Kosi and Ganga floods and so kharif crops are grown in lesser area. Other crops (oilseeds, sugarcane etc.) with third position in Samastipur (4.99%) and East Champaran (4.70%) whereas vegetables (5.44%) in

Bhagalpur. Pulses occupied around 1 to 2 per cent area out of the total cropped area. It is interesting to know that across the all farm sizes concentration on horticultural crops was high compared to kharif and rabi crops. It is perhaps due to high cost of crop cultivation compared to horticultural crops, wherein there is little operational costs because of increased role of pre-harvest contractors (PHCs) and middlemen.

Table No. 4.3: Importance of Orchard (Litchi) in Cropping Pattern of Selected Small, Medium & Large Farms (In %)

SN	Particulars	Bhagalpur				East Champaran				Samastipur			
		Small	Med	Large	All	Small	Med	Large	All	Small	Med	Large	All
1.	Paddy	5.43	6.67	12.97	8.16	16.32	19.53	27.15	22.85	9.60	18.06	22.32	19.46
2.	Maize	11.63	14.25	16.94	16.32	3.55	3.70	10.18	7.56	8.00	11.12	5.48	7.97
3.	Wheat	8.53	8.49	18.10	11.79	17.73	16.88	24.16	22.04	10.40	17.13	20.80	17.20
4.	Pulses	1.55	1.22	0.77	1.20	2.12	2.11	1.30	1.43	3.20	2.55	1.64	2.25
5.	Vegetables	8.53	5.74	3.08	5.44	8.50	5.02	2.10	3.67	7.20	2.31	1.51	2.50
6.	Others (Oilseeds, Sugarcane, etc.)	2.33	3.33	6.55	3.93	6.39	11.61	1.90	4.70	6.40	2.78	6.43	4.99
7.	Litchi Orchard	52.70	43.03	34.41	41.08	37.59	34.03	29.15	31.84	42.40	36.35	37.04	38.16
8.	Others' Orchard	9.30	17.27	7.18	12.08	7.80	7.13	4.10	5.91	12.80	9.70	4.78	7.47
9.	GCA	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
10.	CI	126.47	124.53	126.47	125.38	139.61	134.26	145.22	139.61	127.17	136.71	142.20	135.94

Source: Primary Survey.

4.4 Assets Holdings

The level of farm efficiency depends to a considerable degree on the investment made by farmers on different households and farm assets. As credit was taken mostly for productive purposes in the agricultural sector in almost all the cases, a large amount of that went into building long term agricultural or farm assets. Table 4.4 presents distribution of the selected households and farm assets of the sample households in terms of Rs. per household and Rs. per hectare. It is seen from the data presented in the table that the larger proportions were that of construction of pucca houses and purchase of motorcycle among the household assets in all categories of farms across the sample districts. As regards the farm assets, the larger the proportions were on purchase of tractor among all the categories of farms in the sample districts. Per household assets value at the time of survey was measured for small farms at Rs. 44295 in Samastipur, Rs. 49090 in East Champaran and Rs. 66637 in Bhagalpur districts. Similarly it was Rs. 131637 in Samastipur, Rs. 157628 in East Champaran and Rs. 208426 in Bhagalpur districts for medium farms and that of Rs. 250936 in East Champaran, Rs. 320774 in Samastipur and 336366 in Bhagalpur districts for large farms. Per hectare assets value was higher for medium farms in Bhagalpur (Rs. 78648) and East Champaran (Rs. 55892) and for large farms (Rs. 53283) in Samastipur districts. Like per household assets, farm size variations were a common phenomenon and medium size category possessed more assets in value terms except in Samastipur district. Therefore, a positive relationship was not observed farm size and per hectare value of selected household and farm assets.

Table No. 4.4: Distribution of the Selected Household and Farm Assets

Assets	Bhagalpur						East Champaran						Samastipur					
	In Rs. Per Household			In Rs. Per Hectare			In Rs. Per Household			In Rs. Per Hectare			In Rs. Per Household			In Rs. Per Hectare		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Pucca House	22461	32768	147513	22020	12365	23946	11909	22114	61352	11791	7841	8891	24382	29687	141935	24879	9394	23577
Television	1077	7278	5833	1055	2746	946	3402	4142	5210	3368	1468	755	2990	3673	4185	3051	1162	695
Motorcycle	37462	49352	47831	36727	18623	7764	30112	34918	40117	29813	12382	5814	13582	36112	39352	13859	11427	6536
Cattle	2312	3926	2911	2266	1481	472	1509	1210	1829	1494	429	265	597	2475	1968	609	783	326
Tractor	---	109087	126252	---	41164	20495	---	88759	129342	---	31474	18745	---	54317	128571	---	17188	21357
Diesel Engine	1508	4288	3217	1478	1618	522	1326	3427	3866	1312	1215	560	1257	3631	2899	1282	1149	481
Power Tiller	---	---	---	---	---	---	---	2019	7211	---	715	1045	---	---	---	---	---	---
Sprayer	1817	1727	2809	1781	651	456	832	1039	2009	823	368	291	1487	1742	1874	1517	551	311
Total	**66637**	**208426**	**336366**	**65327**	**78648**	**54601**	**49090**	**157628**	**250936**	**48601**	**55892**	**36366**	**44295**	**131637**	**320774**	**45197**	**41654**	**53283**

Source: Primary survey, S= Small, M= Medium & L = Large Farms

4.5 Credit Behaviour

Rural credit market in India is characterized by few distinctive features like formal credit readily available for large farmers who are trusted by the institutional lenders on the basis of their paying capacity. On the other hand, the access of poor marginal and small farmers to institutional credit is quite limited *(Rao 1980; Basu 1983; Swain 1986; Gupta & Shorf 1987; Sarap 1991; & Jodhka 1995).* The inability of small farmers to provide collateral such as land, jewellery, house etc. as mortgage is the major hindrance for them in availing institutional credit. So the poor marginal and small farmers are automatically screened out as potential beneficiaries of formal credit agencies *(Swain 2001; Swain & Swain 2007).* As a result, they fail to avail the benefits of a large numbers of development programmes specifically meant for them. The only alternative left for the landless and marginal farmers is to repeatedly visit the moneylenders' doorstep to get the linked loans at exorbitant interest rates accepting large scale exploitation. Tables 4.5 & 4.6 provide details on sources and purpose of credit by the selected per farmer households. At the total farmers, per household credit was measured at Rs. 8922 , Rs. 12341 and Rs. 17583 in Samastipur, Bhagalpur and East Champaran districts that varied from Rs. 4167 in case of small farm households in Samastipur district to Rs. 25661 in case of large farm households in East Champaran district. Among different sources of credit, institutional credit constituted the major amount around 80 to 84 per cent and non-institutional had only 16-20 per cent. Among the non-institutional sources moneylenders occupied the largest share among different categories of farm households. Whereas large farm households had around 85-93 per cent credit from the institutional sources, marginal farmers were lesser ones who had 50-67 per cent except one exception in East Champaran district, share from the institutional sources. Examining the credit taken by purpose, it was observed that a major part of the loans were spent in productive activities like farming. However, while the large farm households used proportionately higher amounts of loans for productive purposes, the small and medium farm households were found spending proportionately higher amount of non-productive purposes like daily consumption, illness, social and family ceremonies.

Table No. 4.5: Details of Source of Credit by the Selected Households (In Rs. / household)

Sources	Bhagalpur				East Champaran				Samastipur			
	S	M	L	Tot	S	M	L	Tot	S	M	L	Tot
Institutional Loan by Banks	3203 (67.21)	12867 (83.05)	21310 (92.77)	10368 (84.01)	8071 (84.64)	14375 (77.95)	22035 (85.87)	14617 (83.13)	2115 (50.76)	7056 (74.78)	13935 (85.67)	6685 (74.93)
Money Lenders	875 (18.36)	1265 (8.16)	940 (4.09)	1031 (8.35)	1150 (12.06)	1920 (10.41)	2055 (18.00)	1683 (9.57)	365 (8.76)	1130 (11.98)	1590 (9.77)	931 (10.43)
Input Dealers	688 (14.43)	337 (2.17)	722 (3.14)	566 (4.59)	315 (3.30)	926 (5.02)	676 (2.63)	619 (3.52)	270 (6.48)	318 (3.37)	740 (4.56)	397 (4.45)
Friends/ Relatives	---	1025 (6.62)	---	376 (3.05)	---	1220 (6.62)	895 (3.50)	664 (3.78)	1417 (34.00)	932 (9.87)	---	909 (10.19)
Total	**4766 (100.00)**	**15494 (100.00)**	**22972 (100.00)**	**12341 (100.00)**	**9536 (100.00)**	**18441 (100.00)**	**25661 (100.00)**	**17583 (100.00)**	**4167 (100.00)**	**9436 (100.00)**	**16265 (100.00)**	**8922 (100.00)**

Source: Primary survey
In parenthesis percentage figure is shown.

Table No. 4.6: Details of Purpose of Credit by the Selected Households (In Rs. / Household)

Purposes	Bhagalpur				East Champaran				Samastipur			
	S	M	L	Tot	S	M	L	Tot	S	M	L	Tot
Productive Uses	3250 (68.19)	11958 (77.18)	19768 (86.05)	9747 (78.98)	5417 (56.81)	13658 (74.06)	22431 (87.41)	13561 (77.13)	2362 (56.68)	5721 (60.62)	13161 (80.92)	6113 (68.52)
Non-Productive Uses	1516 (31.81)	3536 (22.82)	3204 (13.95)	2594 (21.02)	4119 (43.19)	4783 (25.94)	3230 (12.59)	4022 (22.87)	1805 (43.32)	3715 (39.38)	3104 (19.08)	2809 (31.48)
Total	**4766 (100.00)**	**15494 (100.00)**	**22972 (100.00)**	**12341 (100.00)**	**9536 (100.00)**	**18441 (100.00)**	**25661 (100.00)**	**17583 (100.00)**	**4167 (100.00)**	**9436 (100.00)**	**16265 (100.00)**	**8922 (100.00)**

Source: Primary survey
In parenthesis percentage figure is shown.

4.6 Cost and Return on Cultivation of Litchi

This section presents cost and return on cultivation of different varieties of litchi popularly grown in selected districts of Bihar. Out of 3 selected districts, Shahi and China varieties are grown in Samastipur and East Champaran districts whereas Manraji and Desi varieties are grown in Bhagalpur district. Among Small farms, on an average 0.53 hectare of area is under litchi crop in Samastipur & East Champaran districts. Per household area under litchi in the case of medium and large farm households are 1.29 ha & 2.92 ha and 1.57 ha & 3.17 ha in East Champaran and Samastipur districts. On overall basis, 1.36 hectares of area are under litchi in Bhagalpur, 1.56 hectares and 1.53 hectares are in East Champaran and Samastipur districts. The variety wise cost and return analysis on cultivation of litchi are as below:

4.6.1 Shahi

As stated earlier, this is the most popular cultivar of north Bihar particularly in Tirhut and Darbhanga divisions of Bihar. Table 4.7 presents per hectare cost incurred and returns realized by the selected farmers growing shahi variety of litchi. The cost incurred consists of 5 items of variable cost. The variable cost is the running cost every year at the time of plant bearing fruit. The major components/items of variable costs in litchi were tillage of the orchard, materials such as compost, fertilizer and medicines/pesticides, labour (for tillage, mannuring, fertilizing, spraying of medicines and harvesting), irrigation and watch & guard. On average,

total variable cost was measured at Rs. 22638 and Rs. 24232 in East Champaran and Samastipur districts respectively. Out of the total variable costs, labour cost was 45.74 per cent in Samastipur and 50.40 per cent in East Chamaparan district. It was followed by cost on watch & guard (18 to 19%), materials (16 to 18%), irrigation (9 to 11%) and tillage of orchard (about 5%). Across the farm size categories except watch and guard small farmers incurred higher amount on tillage, materials, labour and irrigation whereas medium and large farmers had better in terms of cost in both the districts. Besides, the total cost was lower on small farmers compared to medium and large farmers. It had almost increasing trend except one exception in Samastipur district. Thus, it is difficult to conclude any specific category of farmers having advantage in cultivation of Shahi variety of litchi over the other categories.

Looking at the profitability per hectare, the total and net revenue/return obtained by the farmers by selling their fruit exceeded the total cost among all categories of farmers without any exception. However, these were lower on small farms compared to medium and large farmers. The cost benefit ratio had also not definite trend across the farms. But it was more than three times across all the farms.

Table No. 4.7: Per Hectare Cost & Return (In Rs.) on Cultivation of Litchi (*Variety : Shahi)*

SN		Items	Samastipur				East Champaran			
			S	M	L	Tot	S	M	L	Tot
A.		Tillage of the Orchard	1150 (5.52)	1475 (5.51)	1200 (4.60)	12.80 (5.28)	1170 (6.02)	1350 (5.77)	1225 (4.80)	1242 (5.49)
B.		Materials	3785 (18.16)	4670 (17.47)	4810 (18.42)	4349 (17.95)	3215 (16.55)	3937 (16.83)	3864 (15.15)	3648 (16.11)
	i.	Compost	825	1140	1125	1011	770	810	775	784
	ii.	Chemical Fertilizer	2470	2805	2875	2687	1895	2058	2135	2024
	iii.	Pesticides/Medicines	490	725	810	651	550	1069	954	840
C		Labour	10030 (48.11)	11625 (43.49)	12045 (46.13)	11085 (45.74)	9515 (48.99)	12019 (51.39)	12942 (50.75)	11409 (50.40)
	i.	Ploughing, Levelling, etc.	735	685	742	718	825	1120	2052	1322
	ii.	Mannuring	680	715	816	725	470	828	1407	890
	iii.	Fertilizing	925	982	1014	967	1123	1634	1429	1378
	iv.	Spraying	1076	1018	987	1034	1652	2317	1225	1709
	v.	Harvesting	6614	8225	8486	7641	5445	6120	6829	6110
D.		Irrigation	2632 (12.63)	2945 (11.03)	3012 (11.53)	2835 (11.70)	1881 (9.68)	2089 (8.93)	2417 (9.48)	2122 (9.37)
E.		Watch & Guard	3250 (15.58)	6015 (22.50)	5045 (19.32)	4683 (19.33)	3642 (18.76)	3991 (17.08)	5054 (19.82)	4217 (18.63)
		Total Cost	**20847 (100.00)**	**26730 (100.00)**	**26112 (100.00)**	**24232 (100.00)**	**19423 (100.00)**	**23386 (100.00)**	**25502 (100.00)**	**22638 (100.00)**
		Gross Return	**95950**	**111230**	**110215**	**104881**	**88142**	**96317**	**103741**	**95794**
		Net Return	**75103**	**84500**	**84103**	**80649**	**68719**	**72931**	**78239**	**73156**
		C B Ratio	**1:3.60**	**1:3.16**	**1:3.22**	**1:3.33**	**1:3.54**	**1:3.12**	**1:3.07**	**1:3.23**

Source: Primary Survey.
In parenthesis percentage figure is shown.

4.6.2 China

This is one of the best cultivar of litchi in north Bihar. Its shape and size is comparatively better than shahi variety but in terms of aroma, it is next to shahi.

Table 4.8 presents expenditure on various components invested in cultivation of litchi particularly of china variety. It can be seen from the table that per hectare total cost was Rs. 17948 and Rs. 21019 in East Champaran and Samastipur districts respectively. On total farms the share of labour cost (50 to 53%) was larger followed by expenses on materials (17%) and watch & guard (14 to 18%), irrigation (9 to 10%) and tillage of orchard (5 to 6 %). The expenses on labour component were in increasing trend as according to farm sizes in Samastipur district whereas that of decreasing in East Champaran district. In fact, there was no definite trend in terms of expenses made on different items for cultivation of china variety of litchi across the farmers. The net returns from china variety of litchi turned out Rs. 82192 in Samastipur and that of Rs. 59133 in East Champaran districts. It had increasing trend across the farms with the increase of its sizes.

The profitability ratio per hectare was measured at 1:3.91 in Samastipur and 1:3.29 in East Champaran districts. Across the farm it varied but it was more than 3 to 4 times over the total cost of production.

Table No. 4.8: Per hectare Cost and Return (In Rs.) on Cultivation of Litchi ***(Variety: China)***

SN		Items	Samastipur				East Champaran			
			S	M	L	Tot	S	M	L	Tot
A.		Orchard Tillage	1227 (6.69)	975 (4.33)	1098 (4.71)	1104 (5.25)	927 (6.28)	1124 (6.47)	1183 (5.38)	1071 (5.97)
B.		Materials	3257 (17.77)	3841 (17.07)	3704 (15.90)	3575 (17.02)	2715 (18.40)	3219 (18.53)	3403 (15.48)	3095 (17.24)
	i.	Compost	628	589	607	609	425	642	810	618
	ii.	Chemical Fertilizer	2109	2485	2517	2342	1219	1991	1584	1572
	iii.	Pesticides/Medicines	520	767	580	624	1071	586	1009	905
C.		Labour	9017 (49.18)	11428 (50.79)	11927 (51.20)	10580 (50.33)	8081 (54.77)	9217 (53.06)	11303 (51.42)	9496 (52.91)
	i.	Ploughing, Levelling, etc.	812	925	940	883	610	1120	1345	1008
	ii.	Mannuring	845	1037	1120	979	380	415	625	472
	iii.	Fertilising	2112	2882	2701	2532	695	956	855	827
	iv.	Spraying	1708	1935	2249	1917	870	655	913	820
	v.	Harvesting	3540	4649	4917	4269	5526	6071	7565	6369
D.		Irrigation	1837 (10.02)	2241 (9.96)	2187 (9.39)	2067 (9.83)	927 (6.28)	1803 (10.38)	2481 (11.29)	1708 (9.52)
E.		Watch & Guard	2995 (16.34)	4017 (17.85)	4380 (18.80)	3693 (17.57)	2105 (14.27)	2009 (11.56)	3610 (16.43)	2578 (14.36)
		Total Cost	**18333 (100.00)**	**22502 (100.00)**	**23296 (100.00)**	**21019 (100.00)**	**14755 (100.00)**	**17372 (100.00)**	**21980 (100.00)**	**17948 (100.00)**
		Gross Return	**92780**	**107881**	**113756**	**103211**	**65435**	**78992**	**88172**	**77081**
		Net Return	**74447**	**85379**	**90460**	**82192**	**50680**	**61620**	**66192**	**59133**
		CB Ratio	**1:4.06**	**1:3.79**	**1:3.88**	**1:3.91**	**1:3.43**	**1:3.55**	**1:3.01**	**1:3.29**

Source: Primary survey.
In parenthesis percentage figure is shown.

4.6.3 Manraji

This is one of the cultivar of litchi in north-eastern region of Bihar particularly in Bhagalpur region. It bears alternatively. Its colour is deep pink and of medium size with medium level of fragrance. A detail regarding economics of cultivation of this variety is presented in table 4.9. The table shows that the variable cost consisted of

tillage of the orchard, material used (manure, fertilizer & pesticides), labour cost, irrigational cost and the expenses incurred on services of watch & guard. The major component of the cost was laour across all size groups of the farmers, which accounted for 48 to 49 per cent of the total cost of cultivation per hectare. Materials cost was found to be the second major item, which accounted for about 24 to 26 per cent. Watch & Gurad, orchard tillage and irrigational costs were next to labour and material components of the total variable cost. The labour cost was as low as Rs. 7124 per hectare in case of small farmers whereas it was Rs. 9456 per hectare in case of large farms and Rs. 9556 per ha in case of medium farms. The total cost of cultivation was measured at Rs. 17429 per ha. It was as high as Rs. 19612 per ha for large farmers whereas it was Rs. 14686 per ha for small farmers.

Among the categories of farmers, the highest net returns of Rs. 68502 per hectare were realized by large farmers and the lowest Rs. 55452 per hectare was obtained by the marginal farmers. The medium farmers made net returns of Rs. 59882 per hectare. But the net returns on cultivation of shahi & china varieties of litchi were higher compared to the net returns on cultivation of manraji variety of litchi.

4.6.4 Desi

Desi is an indigenous variety of litchi cultivated extensively in Bhagalpur region. It bears every year. Table 4.9 presents the economics of litchi cultivation of desi variety in one of the selected districts viz., Bhagalpur. The total cost incurred towards the cultivation of desi variety of litchi per hectare was Rs. 16205 at the aggregate level. Across the farmers, it was found increasing with the increase of farm sizes. The highest total cost towards the cultivation of desi litchi was incurred by the large farmers, which accounted for Rs. 18729 per hectare whereas the lowest cost to the tune of Rs. 13838 per hectare was incurred by the small farms. The share of labour cost was highest in the total cost at the aggregate level which accounted for 50.67 per cent followed similar share as was the case of other varieties of litchi. The net return was calculated at Rs. 61062 at the aggregate level. It was higher at large farmers (Rs. 69992) and lower in case of marginal farmers (Rs. 64568) and small farmers (Rs. 53973).

Table No. 4.9: Per hectare Cost and Return (In Rs.) on Cultivation of Litchi *(Variety : Manraji & Desi)*

SN		Items	Variety : Manraji				Variety : Desi			
			Bhagalpur				Bhagalpur			
			S	M	L	Tot	S	M	L	Tot
A.		Orchard Tillage	1000 (7.49)	1250 (6.42)	1270 (6.48)	1189 (6.82)	955 (6.90)	1120 (6.35)	1225 (6.54)	1070 (6.60)
B.		Materials	3845 (26.18)	4534 (23.28)	4741 (24.17)	4277 (24.54)	3236 (23.38)	4508 (25.58)	4630 (24.73)	3981 (24.56)
	i.	Compost	825	842	935	853	690	945	981	842
	ii.	Chemical Fertilizer	2100	2822	2765	2498	1735	2839	2652	2323
	iii.	Pesticides/Medicines	920	870	1041	926	811	724	997	816
C.		Labour	7124 (48.51)	9556 (49.06)	9456 (48.22)	8482 (48.67)	7220 (52.18)	8659 (49.13)	9542 (50.94)	8212 (50.67)
	i.	Ploughing, Levelling, etc.	1550	1600	1670	1592	1312	1987	2014	1700
	ii.	Mannuring	625	819	840	739	729	917	1038	860
	iii.	Fertilizing	1310	1440	1390	1374	1400	2075	2110	1789
	iv.	Spraying	1470	1525	1517	1500	1608	1981	1750	1773
	v.	Harvesting	2169	4172	4039	3277	2171	1699	2630	2090
D.		Irrigation	965 (6.57)	1015 (5.20)	1155 (5.89)	1021 (5.86)	1219 (8.81)	1044 (5.92)	1129 (6.03)	1137 (7.03)
E.		Watch & Guard	1652 (11.25)	3125 (16.04)	2990 (15.24)	2460 (14.11)	1208 (8.73)	2295 (13.02)	2203 (11.76)	1805 (11.14)
		Total Cost	**14686 (100.00)**	**19480 (100.00)**	**19612 (100.00)**	**17429 (100.00)**	**13838 (100.00)**	**17626 (100.00)**	**18729 (100.00)**	**16205 (100.00)**
		Gross Return	**70138**	**79362**	**88114**	**77115**	**67811**	**82194**	**88721**	**77267**
		Net Return	**55452**	**59882**	**68502**	**59686**	**53973**	**64568**	**69992**	**61062**
		CB Ratio	**1:3.78**	**1:3.07**	**1:3.49**	**1:3.42**	**1:3.90**	**1:3.66**	**1:3.74**	**1:3.77**

Source: Primary survey.
In parenthesis percentage figure is shown.

4.7 Technical Backup

An appropriate and timely technological backup is required for proper management of litchi orchard. Propagation of healthy and genuine combination of materials is combination of art and science, which needs advanced techniques and requires technological knowledge, besides capital investment and human labour. The data presented in 4.10 shows the sources of technological information for the sample households. It may be noted that about 26 to 33 per cent of the sample households at aggregate level was received technological guidance through the extension workers of the state agriculture department i.e., Kisan Salahkar. The private agencies like; input dealers and KVK scientists also provided technological backup to the sample households at the aggregate level by about 26 to 33 per cent and 23 per cent respectively across the sample districts. Progressive farmers had equally played a significant role in providing technological knowledge to the sample households. They provided help to 20 to 30 per cent of the sample farmers. Relatives/friends were next to progressive farmers for technical backstopping to the sample farmers. The role of state agriculture officers does not appear significant. It is interesting to clear here that there was not a single source, which provided technological back to more than one third of sample litchi growers.

Table No. 4.10: Source of Technological Information in Litchi Cultivation

Sources	Bhagalpur				East Champaran				Samastipur			
	S	M	L	All	S	M	L	All	S	M	L	All
Kisan Salahkar /Co-ordinator	4 (13.33)	3 (10.00)	1 (3.33)	8 (26.66)	3 (10.00)	4 (13.33)	2 (6.67)	9 (30.00)	2 (6.67	4 (13.33)	4 (13.33)	10 (33.33)
State Agril. Officers	---	1 (3.33)	---	1 (3.33)	---	---	2 (6.67)	2 (6.67)	---	---	---	---
KVK Scientists	2 (6.67)	3 (10.00)	2 (6.67)	7 (23.34)	3 (10.00)	4 (13.33)	3 (10.00)	10 (23.33)	2 (6.67)	4 (13.33)	1 (3.33)	7 (23.33)
Pvt. Agency (Inputs Dealers)	4 (13.33)	4 (13.33)	2 (6.67)	10 (33.33)	2 (6.67)	3 (10.00)	1 (3.33)	6 (20.00)	4 (13.33)	3 (10.00)	1 (3.33)	8 (26.66)
Progressive Farmers	3 (10.00)	4 (13.33)	2 (6.67)	9 (30.00)	3 (10.00)	1 (3.33)	4 (13.33)	8 (26.66)	4 (13.33)	2 (6.67)	---	6 (20.00)
Relatives/Friends	2 (6.67)	3 (10.00)	---	5 (16.67)	2 (6.67)	---	2 (6.67)	4 (13.34)	3 (10.00)	2 (6.67)	3 (10.00)	8 (26.66)

Source: Primary Survey.

In parenthesis percentage figure is shown.

4.8 Perishability of Litchi Fruits at different Stage of Production

Litchi is a non-climacteric fruit and harvesting is done when fruits are fully matured on the tree. But before its maturity, it is perished at different stages of production mainly because of attack of insect pest and biotic pressure and pressure of temperature and heat. The litchi is prone to attack by pests and diseases, which are one of the major limiting factors in its successful production of temperate fruits. Estimates of yield losses caused by pests and disease attack range from 10 to 30 per cent in various parts of country during different seasons of the year. Unlike agricultural crops, litchi is grown as monoculture, the pest and disease situations have led to repeated and excessive use of chemical pesticides *(Singh et.al, 2011).* The data presented in table 3.11 showed the perishability of litchi grown in the state of Bihar at different stages of production. The table reveals that there are three different stages between inflorescence to maturity of litchi fruits, which has been depicted in the referred table. The responses of the sample farmers across the three sample districts were captured in percentage terms. It may be observed that between inflorescence and flowering, which usually becomes during February-March months, litchi perished between 7.75 to 9.50 per cent due to pest and biotic pressure and between 3.25 to 5.50 per cent due to temperature and biotic pressure across the sample districts. Similarly between flowering and fruit bearing stage, the larger the volume of production was perished due to heat waves and winds (Easterly winds) i.e., 8.75 to 11.75 per cent across the sample districts. Between fruit bearing and maturity stage (in the month of May), temperature i.e., long stretch of westerly winds (6 to 8.25 %) caused main factor for perishability of the fruit. It is to be noted here that heat waves and winds (Easterly & Westerly during February & April-May respectively) are the major reasons for larger perishability of litchi fruit.

Table No. 4.11: Perishability of Litchi at different stage of Production

SN		Stage of Litchi	Probable Stage in months	Perishability (In %)		
				Bhagalpur	East Champaran	Samastipur
1.		Between Inflorescence and Flowering	02 (Feb. – March)	---	---	---
	a.	On disease, pest and biotic pressure	---	7.75	8.50	9.50
	b.	On temperature, heat and biotic pressure	---	4.50	5.50	3.25
2.		Between Flowering and Fruit bearing	02 (April - May)	---	---	---
	a.	On disease, pest and biotic pressure	---	2.25	3.50	1.75
	b.	On temperature, heat and biotic pressure	---	11.75	8.75	9.50
3.		Between Fruit bearing and maturity	01 (May)	---	---	---
	a.	On disease, pest and biotic pressure	---	---	---	---
	b.	On temperature, heat and biotic pressure	---	6.00	8.25	6.50

Source: Primary Survey.

4.9 Price of Litchi at Local and Regional Markets during 2014

The prevailing prices of litchi are prices at which litchi are finally sold in the markets. Litchi ripens during 21-25 may and since then it comes to market for sale. It is a very short duration fruits. It stays in the market for 20-25 days only in Bihar. In the beginning, the prices are stable but it increases with the increase of time. Stability in prices is normally witnessed for a week or so only. In these circumstances, we have observed the prices' trend during 24th May to 21st June (27 days) period in local and regional market as well during 2014. Table 4.12 presents the prevailing prices of litchi at local markets and table 4.13 at regional markets. In the local markets, it was observed that the prices of shahi litchi was higher since the start of season to the end of the season compared to other varieties of litchi in local and regional markets both. During the peak marketing period, it was Rs. 90 to 100 per hundred piece of litchi, subsequently the price rose to Rs. 110 per hundred in and around 14th June and its price at departure time was Rs. 150/- hundred. The price of other varieties of litchi was found lower to shahi litchi. The availability of litchi is suddenly vanishes from the market after 21-22 June. During its glut, the prices are not abruptly high. Here supply and demand functions of the market are seen. Actually, litchi is largely consumed in local areas because of its short shelf life. It was learnt that only after third day packaging in Bihar, the litchi fruits reached in Delhi and it takes 5 days to Mimbai. As per one estimate about 40.00 per cent of litchi fruits loose their freshness in the form of discolourization of peel while marketing in Delhi and 40-50 per cent of marketable form of litchi reached in Mumbai market. However, this huge loss is compensated by the high market price of the produce. In spite of high demand in nearly markets the traders do not send their produce with the fear of sudden fall of price due to glut if sent in one market.

Table No. 4.12: Prevailing Price of Litchi at Local Market (In Rs/100 pcs) during 2014

Variety/Date	24th May	31st May	7th June	14th June	21st June
China	80.00	80.00	90.00	100.00	140.00
Shahi	90.00	90.00	100.00	110.00	150.00
Manraji	80.00	90.00	80.00	90.00	110.00
Desi	80.00	85.00	90.00	110.00	125.00

Source: Primary Survey.

Table No. 4.13: Prevailing Price of Litchi at Regional Market (In Rs/100 pcs) during 2014

Variety/Date	24th May	31st May	7th June	14th June	21st June
China	90.00	90.00	100.00	110.00	140.00
Shahi	90.00	100.00	120.00	125.00	150.00
Manraji	---	---	---	---	---
Desi	90.00	100.00	125.00	125.00	140.00

Source: Primary Survey.

4.10 Marketed Surplus by average size of holding

The marketed surplus which is an ex-post concept referring to the actual amount marketed. To have a clearer picture on the conceptual issues, two concept of marketed surplus are used in recent literature—gross and net. Gross marketed surplus refers to the actually marketed quantities irrespective of the requirements for family consumption, farm needs and other payments; whereas net marketed surplus is the gross marketed surplus minus family consumption farm needs and other payments. In this section, the data on both the counts are available. Before analyzing it, it is clear here that the total consumption refers to such consumptions which are made for family requirements, payments in kind to labour, other miscellaneous consumption and wastages. Data presented in table 4.14 showed the volume of net marketed surplus along with the average size of holding and average size of litchi orchards across the holdings, total production etc. It reveals that the average size of litchi orchards on total farms was 1.36 hectare, 1.56 hectare and 1.53 hectare in Bhagalpur, East Champaran and Samastipur districts respectively. It varied from 0.68 ha in case of small farms (< 2ha) to 2.68 ha in case of large farms (> 5 ha) in Bhagalpur; 0.53 ha in case of small farms to 2.92 ha in case of large farms in East Champaran and 0.53 ha in case of small farms to 3.17 ha in case of large farms in Samastipur district. The total average production was estimated at 74.32 qtl. in Bhagalpur, 100.24 qtl in East Champaran and 95.30 qtl in Samastipur districts. In Bhagalpur district, out of total average production 3.21 qtl (4.32%) was used for family consumption, 3.58 qtl (4.82%) for labour payment, 2.89 qtl (3.85%) for miscellaneous consumption and 2.27 qtl (3.05%) wastage in orchards before selling it. This way the total average consumption was calculated at 11.95 qtl (16.08%) and the net marketed surplus of the fruits was about 83.92 per cent (62.37 qtl). Similarly in East Champaran district, out of the total average production 100.24, about 13.58 per cent was the consumptions on different accounts and the net marketed surplus was 86.63 per cent (86.63 qtl). In Samastipur district, the net marketed surplus was 82.83 per cent (78.93 qtl) out of its total average production of 95.30 qtl. It showed that the net marketed surplus on total farms was 82 to 86 per cent across the sample districts. Thus, unlike other agricultural produce, the net marketed surplus of litchi is quite high. It is due to low shelf-life of fruits in general and litchi in particular.

Table No. 4.14: Marketed Surplus of Litchi by Average Size of Holding of Selected Farms

S N	Particulars	Bhagalpur				East Champaran				Samastipur			
		Small	Med	Large	All	Small	Med	Large	All	Small	Med	Large	All
1.	Litchi Area (ha)	0.68	1.42	2.68	1.36	0.53	1.29	2.92	1.56	0.53	1.57	3.17	1.53
2.	Production (In Qtls)	21.26	81.40	176.32	7432 (100.00)	24.70	79.40	202.38	100.24 (100.00)	21.23	96.37	220.58	95.30 (100.00)
3.	Family Consumption (In qtls)	1.62	2.23	8.46	3.21 (4.32)	2.88	3.16	6.42	4.14 (4.13)	2.12	3.34	8.90	4.15 (4.35)
4.	Payment in kind of Labour (qtls)	1.17	3.79	8.41	3.58 (4.82)	2.11	5.70	10.17	5.87 (5.86)	2.02	4.88	10.11	4.96 (5.20)
5.	Miscellaneous (qtls)	0.72	3.17	7.10	2.89 (3.89)	0.56	1.12	2.38	1.33 (1.33)	1.41	2.17	4.22	2.34 (2.46)
6.	Total Waste of Fruit in Orchards before selling to PHC/WS (qtls)	0.58	1.93	6.53	2.27 (3.05)	0.70	2.13	4.08	2.26 (2.25)	0.98	5.12	11.37	4.92 (5.16)
7.	Total Consumption (qtls) (3 to 6)	4.09	11.12	30.50	11.95 (16.08)	6.25	12.11	23.05	13.61 (13.58)	5.53	15.51	22.60	16.37 (17.17)
8.	Marketed Surplus (qtls) (2 to 7)	17.17	70.28	145.82	62.37 (83.92)	18.45	67.29	179.33	86.63 (86.42)	15.70	80.86	191.98	78.93 (82.82)

Source: Primary Survey.

In parenthesis percentage figure is shown.

4.11 Perishability at different stages of Marketing

Post-harvest losses are the major problem in the supply chain of fruits and vegetables sector in India. There are huge amount of losses in the supply chain of perishable food in reaching to the main market, processing units etc. Around 30-40 per cent of total food produce gets wasted in India. Huge amount of losses incurred during transportation and storage of fresh food produce. Post-harvest losses are high in India because of lack of cold chain facilities, poor logistics connectivity in the hilly areas etc. *(Negi & Anand, 2015).* MoFPI, Government of India (2007) also says that without storage and dependable cold-chain, a vital sector like fruits and vegetables processing industry, which is based mostly on perishable products, cannot survive and grow. Even at current level of production, wastage in fruits and vegetables is estimated at 35 per cent, major reasons being inadequate storage, transportation, cold chain facilities and other infrastructural facilities. According to the vision 2050 report prepared by Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana in 2013, approximately 18 per cent of the country's fruits and vegetables, worth INR 133 billion go to waste annually because of lack of cold storage facilities, India wastes more fruits and vegetables than any other food product in the country India, mostly due to inadequate cold storages and inefficient handling. In quantity terms, the CIPHET has estimated that out of the total production of fruits & vegetables in 2009, the wastage was 29.95 per cent, which declined to 17.98 per cent in 2010. Moreover, Indian Institute of Horticultural Research, an ICAR Institute at Bengaluru, has also compiled post-harvest losses in selected fruits and vegetables in India. It reveals that the harvest and post harvest total losses in farm operations (harvesting, collection, sorting/grading, packaging and transportation) of 8 major fruits (apple, banana, citrus, grapes, guava, mango, papaya & sapata) ranges from 4.31 per cent to 11.06 per cent.

As of now, the major mode of marketing of litchi in India is through Inter-state trade. While marketing of litchi to big markets, from Bihar in general and north-Bihar in particular, it perishes at different stages of marketing. It is due to lack of skilled handling of fruits from the orchards to the retail markets. The volume of perished litchi incurs huge loss, which is usually compensated by the high market value. Table 4.15 depicts the data relating to perishability of litchi at different stage of marketing. There are mainly five stages of perishing/wastage before selling it to the consumers. These stages are between plucking and packaging, during transportation between loading and unloading, between unloading and sale in wholesale market, sale in wholesale and retail market. The data showed that the litchi is perished from 16.25 per cent to 19.50 per cent of the total marketable surplus during plucking to sale in retail market across the sample districts. It was higher in East Champaran district (19.50%) and lower in Bhagalpur district (16.25%).

Table No. 4.15: Perishability of Litchi at different Stage of Marketing (In %)

SN	Stage of Litchi	Bhagalpur	East Champaran	Samastipur
i.	Between plucking and packaging	3.50	4.00	2.50
ii.	In transportation between loading and unloading	2.25	2.50	1.50
iii.	Between unloading and sale in wholesale market	2.00	1.50	1.25
iv.	Between sale in wholesale and retail market	8.50	11.50	12.00
v.	Between plucking and sale in retail market	16.25	19.50	17.25

Source: Primary survey

4.12 Disposal of Litchi and Possible Supply Chains

Marketing channels/supply chains are routes through which products more from the point of production to the point of consumption. These are alternative paths and the chain of intermediaries through which litchi fruits pass from producers to consumers. A substantial amount of litchi produced in the country is consumed locally. Litchi being highly perishable is available for very short duration. In Bihar marketing of fruits is done in different forms. Producers rent their orchards to pre-harvest contractors, who in turn harvest early and sell to local markets. Due to increased numbers of middlemen in marketing channels reduces the share of producers in the price of produce paid by the consumers. Farmers directly sell their produce to the middlemen. The fruit is sold through a post-harvest contractor to the wholesale market through commission agent, who do harvesting and packing, in addition to transporting the produce to the market. According to one estimate *(Singh et. al, 2011)* more than 65 per cent of the litchi growers prefer sale through post-harvest contractor and about 20 per cent undertake self-marketing. In a few cases, the crop is leased-out to pre-harvest contractors (PHCs) for more than one year. The crop contractors negotiate and settle the price with the producers in their own terms and conditions for payment to the producers. Most of the produce is sold through this mode. The PHCs have a clear picture in their mind of the yield potential of the orchard based on whole and performance level of individual trees in

the orchard. The price offered on a per tree basis varies with age category i.e., a tree in its prime stage (10 to 30 years). Harvesting of fruits is done by the PHCs. Usually the farmers receive 50 per cent or so of the settled price in advance just to firming up the deal and the remaining is paid at the time of harvest. Harvesting, sorting, packaging are done in farms by the contractors. Loading, the truck (for transport) to distant city markets is done at the farm gate itself. The pre-harvest contract system largely prevailing in the state has an impact on the health and life. Some common marketing channels for marketing of litchi have been identified as follows in across the sample districts:

Channel I: *Growers ---PHC---Wholesale Buyers--- Retail Traders--- Consumers (G-PHC-WB-RT-C)*

Channel II: *Growers--- Wholesale Buyers--- Retail Traders--- Consumer (G-WB-RT-C)*

Channel III: *Growers--- PHC--- Wholesale Buyers (Through CA) --- Retail Traders--- Consumer (G-PHC-WB-RT-C)*

Channel IV: *Growers---PHC--- Commission Agents--- Retail Traders--- Consumer (G-PHC-CA-RT-C)*

Channel V: *Growers--- PHC--- Middlemen--- Export Merchants (G-PHC-MM-EM)*

Channel VI: *Growers---PHC---Processing Industry (G-PHC-PI)*

Channel VII: *Growers---Processing Industry (G-PI)*

Disposal of litchi by different size of farms household of the total, first four channels are major and common in litchi marketing and remaining three channels (V, VI & VII) are for export and processing purposes. Though there is chain of intermediaries. But about 85 per cent of the litchi fruits pass through the PHCs and only about 15 per cent pass through other intermediaries that too in case of channel II & VII only. So PHCs play a dominant role in marketing of litchi across the different group of farmers. These different marketing channels are presented in table 4.16. Table 4.16 indicates that the total litchi was disposed by all the sample household was 6812.53 quintals. Out of it the share of small farm households was just 9.02 per cent, medium farms by 32.09 per cent and large farms by 58.89 per cent. The disposal was higher in Samastipur district (34.37%) and lower in Bhagalpur district (27.47%). The table further indicates that the overall litchi sold through different channels during the reference year was 2928.70 quintals (42.99%), 759.59 quintals (11.15%), 1301.88 qtls (19.11%), 976.24 qtls (14.33%), 542.28 qtls (7.96%), 108.32 qtls (1.59%) and 195.52 qtls (2.87%) in channels I, II, III, IV, V, VI & VII respectively. The prominent marketing channels were – I, III, IV & II at all farms. The district wise analysis reveals that the most prominent channel was channel No. I through which 36 to 53 per cent of litchi was disposed. The first four channels were meant for raw sale of litchi through different market functionaries from growers to consumers, while

channel – V was sale of litchi for exports, accounting for only 7.96 per cent and channels VI & VII sale of litchi were for processing industries, accounting for 4.46 per cent. Across the sample districts, no sale was found either to exporters or processing industries in Bhagalpur district, because of the litchi cultivated here is not of exportable quality and complete absence of processing units in the area respectively. Since most of processing units and exporters of litchi fruits are localized in north-Bihar, so in East Champaran and Samastipur about 13 per cent and 9 per cent respectively of the litchi were marketed through the channel No. – V and a lump-sum 5 per cent to 8 per cent of litchi were disposed through the channel No. VI & VII in East Champaran and Samastipur districts for exports and processing units respectively.

Table No. 4.16: Disposal of Litchi through Different Marketing Channels (quality in qtls)

Farm sizes	No.	Channel -I	Channel-II	Channel-III	Channel-IV	Channel-V	Channel-VI	Channel-VII	Total
Bhagalpur District									
Small	13	98.30	28.11	46.24	50.56	---	---	---	223.21 (11.93)
Medium	11	417.05	80.56	81.35	194.12	---	---	---	773.08 (41.31)
Large	06	473.34	135.62	193.59	72.37	---	---	---	874.92 (46.76)
Total	30	988.69 (52.84)	244.29 (13.06)	321.18 (17.16)	317.05 (16.94)	---	---	---	1871.21 (100.00)
East Champaran District									
Small	11	74.25	20.17	50.29	26.15	---	14.02	17.92	202.80 (7.80)
Medium	09	184.27	125.91	129.03	70.02	86.20	8.07	---	603.50 (23.22)
Large	10	673.28	143.66	469.78	172.98	243.50	17.02	73.08	1793.30 (68.98)
Total	30	931.80 (35.85)	289.74 (11.15)	649.10 (24.96)	269.15 (10.36)	329.70 (12.68)	39.11 (1.50)	91.00 (3.50)	2599.60 (100.00)
Samastipur District									
Small	12	62.12	40.04	30.81	11.02	28.19	4.27	11.94	188.40 (8.05)
Medium	11	317.49	120.11	91.35	110.17	79.10	22.15	69.09	809.46
Large	07	628.59	65.41	209.44	268.85	105.29	42.79	23.49	1343.86 (57.38)
Total	30	1008.21 (43.05)	225.56 (9.63)	331.60 (14.15)	390.04 (16.65)	212.58 (9.08)	69.21 (2.96)	104.52 (4.48)	2341.72 (100.00)
All Districts									
Small	36	234.68	88.32	127.34	87.73	28.19	18.29	29.86	614.41 (9.02)
Medium	31	918.81	326.58	301.73	374.31	165.30	30.22	69.09	2186.04 (32.09)
Large	23	1775.21	344.69	872.81	514.20	348.79	59.81	96.57	4012.08 (58.89)
All	90	2928.70 (42.99)	759.59 (11.15)	1301.88 (19.11)	976.24 (14.33)	542.28 (7.96)	108.32 (1.59)	195.52 (2.87)	6812.53 (100.00)

Source: Primary data.
In parenthesis percentage figure is shown.

4.13 Price Spread

Market functionaries move the commodities from the producers to consumers. In the marketing of agricultural or horticultural produces/commodities, the difference between the price paid by the consumer and price received by the producer for an equivalent quantity of produce/commodity is often known as price spread. The difference between the price at the producer's level and consumer's price in a perfectly competitive market situation (to ensure that the profits of the middlemen are only nominal) consists of marketing costs and margins are an indicator of the

efficiency of the marketing system. The higher the difference, the lower the efficiency and vice-versa. The absolute value of marketing costs and margins varies from channel to channel, market to market and time to time. Therefore, in this context litchi marketing costs are margins were studied, for they reveal many facets of marketing and the price spread in each channel of distribution as well as efficiency of the system is reported in table 4.17.

It is apparent from table 4.17 that in channel-I *(Growers-Pre-harvest Contractor-Wholesale Buyers-Retail Traders-Consumers),* the overall average producer's share in consumer's rupee was only 26.39 per cent. The average components of price spread like cost incurred by PHC was 4 per cent per 1000 litchi and a net margin retained by the PHC in this channel was 18.72 per cent (Rs. 168.50) of consumer's price. The cost incurred by the wholesalers was 5.11 per cent (Rs. 46) and a net margin retained by the wholesalers was 11.55 per cent (Rs. 104) of consumer's price. Wholesaler's sale price was calculated at Rs. 592 per thousand piece of litchi. The cost incurred by the retailers was 8.56 per cent (Rs. 77) of consumer's price and the net margin of the retailers was 25.67 per cent (Rs. 231). The consumer's price was Rs.900 per thousand litchi. It reveals that the net margin of the retailers was almost equal to the net price received by the producer.

In channel-II *(Growers---Wholesale Buyers---Retail traders--- Consumers),* the overall average producer's share in consumer's rupee was 50.54 per cent (Rs. 447.75). In this channel producers sell their produce to the wholesalers who incurred a cost by 7.40 per cent (Rs. 65.60). A net margin of 12.31 per cent (Rs. 109.10) of the consumer's price was retained by the wholesalers. The cost incurred by the retailers was 10.72 per cent (Rs. 95) and a net margin of the retailers was 19.03 per cent (Rs. 168.55). The consumer's price was Rs. 886. Hence the producer's share was higher in this channel compared to other channels of litchi marketing.

In channel-III *(Growers---PHC---Wholesale Buyers (through CA) --- Retail Traders---Consumer),* the producer's share was higher compared to channel-I. In this channel, the producer's share in consumer's rupee was 35.02 per cent (Rs. 265). Producers sell their produce to PHC, who incurred a cost of 5.55 per cent (Rs. 42) of consumer's rupee and a net margin retailed by the PHC was 14.47 per cent (Rs. 109.50) of consumer's rupee. The cost incurred by wholesale buyers was 6.47 per cent (Rs. 49) and a net margin retained by the wholesalers was 8.59 per cent (Rs. 65) of consumer's price. The cost incurred by the retailers was 11 per cent (Rs. 84) of consumer's price and a net margin was 18.80 per cent (Rs. 142.30). It is evident in this channel that wherein PHC is one of intermediaries, the net margin of the producer is lower.

In Channel –IV *(Growers---PHC ---CA --- Retail traders --- Consumer),* the overall average producer's share in consumer's rupee was 43.63 per cent (Rs. 361.75). The average components of price spread like cost incurred by the PHC was 6.63 per cent (Rs. 55) and a net margin retained by the PHC in this channel was 11.49 per cent (Rs. 95.25). The PHC sold the produce to the retailers through the commission agents (CA). In this channel the produce does not enter into the wholesale market rather CA facilitates the sale directly to the retailers. Thus, the cost incurred by CA was 6.15 per cent (Rs. 51) and a net margin was retained by CA was 6.88 per cent (Rs. 57). It clearly reveals that the CA's cost and margin both were lower compared to the wholesalers, who used to trade in channels I, II & III. The cost incurred by the retailers and the net margin of the retailers in this channel were also lower compared to channel Nos. I, II & III. This is due to selling of the produce mainly is local market. However, through this channel at the overall level only 7.96 per cent of the marketed surplus of litchi was disposed.

In Channel – V *(Growers --- PHC --- Middlemen--- Export Merchants --- Wholesaler --- Retailer --- Consumer),* the path of litchi marketing is producer to exporters through PHC & Middlemen and then to consumer through wholesaler and retailer. The producr's share in Export merchant's price was 42.44 per cent (Rs. 448). It is higher compared to four preceding channels. It is also to clear here that this channel is meant for export of litchi, accounting for 1.59 per cent of the total disposed/marketed volume, general of 'A' grade litchi.

Generally for the domestic market, litchi is packed in 10kg boxes or baskets having a lining of litchi leaves. Considerable importance is given to the packing of litchi for niche domestic markets. Now litchi is packed in 2 to 2.5 kg boxes and transported in cool chain. In the last few years, serious attempts have been made to export litchi from India. Test consignments were initially sent by air and the technology for sea transport has also been perfected. The exportable litchi is packed in 2 to 2.5 kg or 5 to 6 kg boxes after sulpher treatment. Quality standard are managed as per the standard developed by APEDA.

The average components of price spread in this channel like cost incurred by PHC was 2.66 per cent (Rs. 23) and a net margin retained by the PHC was 12.94 per cent (Rs. 112) of the Export merchant's price. PHC sold the produce to the Export merchants through the CA and the cost incurred by the CA was 1.62 per cent (Rs. 14). The cost incurred by the Export merchant like; packaging and transporting was 9.01 per cent (Rs. 78) and a net margin was retained by the export merchant was 17.29 per cent (Rs. 149). The overall export merchant's sale price was Rs. 865.50, who

sends the consignment to abroad for selling it to the consumers either through his/her brand name or the brand of others.

Channel Nos. VI & VII are meant for marketing of 'B' or 'C' grade litchi to the processers either though PHC or by selling directly to the processors. In channel VI on overall the producer gets 41.07 per cent (Rs. 232) of the processor's price whereas in VII it was 47.93 per cent (Rs. 239). Producer get higher share of processor's price in channel – VII compared to channel – VI mainly due to absence of any intermediate market functionaries between the producer and processors. In channel-VI producer sold their produce to PHC, who incurred a cost of 6.19 per cent of the processor's price and a net margin was retained by the PHC was 9.74 per cent (Rs. 55). The cost of processing was 23 per cent (Rs. 130) of the processor's price and retained a margin by the processors was 20.00 per cent (Rs. 113). This way the processor gets the raw fruits of litchi from the producers for its processing. In channel – VII the share of cost and the margin of the processor was a bit higher compared to the channel-VI. But in channel – VII, producer gets higher share of the processor's price. In both the channels processors after processing into various products like, canned fruits/juices, squash, jam, jelly, drinks etc. sold through its distributors (outside Bihar) spread in big cities are of the country. But it is to be pointed out here that litchi is negligibly exploited at the post-harvest level for processing and value addition of fruits. In recent days consumer prefer fruits in raw form compared to value added products. The study also found that at the overall level less than 5 per cent of total disposed quantity was sold through these two channels. Actually, processing has become compulsory for use of B and C grade litchi, which are not liked to consume in raw form.

Table No. 4.17: Price Spread of Litchi through different Marketing Channels *(In Rs.)*

SN	Particulars	Channel-I	Channel-II	Channel-III	Channel-IV
1.	Net price received by the producer	237.50 (26.39)	447.75 (50.54)	265.00 (35.02)	361.75 (43.63)
2.	Producer's sale/PHC' purchase price	237.50	447.75	265.00	361.75
3.	Cost incurred by PHC	36.00 (4.00)	---	42.00 (5.55)	55.00 (6.63)
4.	PHC's Net margin	168.50 (18.72)	---	109.50 (14.47)	95.25 (11.49)
5.	PHC's Sale price	442.00	---	416.50	512.00
6.	Cost incurred by wholesaler's/mm	46.00 (5.11)	65.60 (7.40)	49.00 (6.47)	51.00 (6.15)
7.	Wholesaler's /MM net margin	104.00 (11.55)	109.10 (12.31)	65.00 (8.59)	57.00 (6.88)
8.	Wholesaler's/MM sale price/retailer's purchase price	592.00	622.45	530.50	620.00
9.	Cost incurred by retailers	77.00 (8.56)	95.00 (10.72)	84.00 (11.10)	72.00 (8.68)
10.	Retailers net margin	231.00 (25.67)	168.55 (19.03)	142.30 (18.80)	137.00 (16.54)
11.	Retailer's price/Consumer's price	900.00 (100.00)	886.00 (100.00)	756.80 (100.00)	829.00 (100.00)

Source: Primary data.
In parenthesis percentage figure is shown.

Table No. 4.17 *(Continued):* **Price Spread of Litchi through different Marketing Channels** *(In Rs.)*

SN	Particulars	Channel-V	SN	Particulars	Channel-VI	Channel-VII
1.	Net price received by the Producer	48.00 (51.76)	1.	Net price received by the Producer	232.00 (41.07)	239.00 (47.93)
2.	Producer's sale price/PHC's purchase price	448.00	2.	Producer's sale price/PHC's purchase price	232.00	---
3.	Cost incurred by PHC	23.00 (2.66)	3.	Cost incurred by PHC	35.00 (6.19)	---
4.	PHC's net margin	112.00 (12.94)	4.	PHC's net margin	55.00 (9.74)	---
5.	PHC's Sale Price	583.00	5.	PHC's Sale Price Purchase price of processing industries	322.00	239.00
6.	Cost incurred by middlemen (MM)	14.00 (1.62)				
7.	MM's net margin	41.00 (4.74)	6.	Cost of processing industries	130.00 (23.00)	142.00 (28.47)
8.	MM's sale price/Export merchant's (EM) purchase price	638.00	7.	Net margin of the processors	113.00 (20.00)	117.70 (23.60)
9.	Cost incurred by EM	78.00 (9.01)	8.	Processor's sale price	565.00 (100.00)	498.70 (100.00)
10.	Margin of EM	149.50 (17.27)				
11.	EM's sale price	865.50 (100.00)				

Source: Primary data.
In parenthesis percentage figure is shown.

4.14 Marketing Efficiency

A comparison of marketing efficiency measures as worked out by three different methods is given in table 4.18. The conventional method (E) suggests that channel-I is more efficient than III, II & IV. It is to be noted here that price received by the producer in channel – I is lowest. Hence, this method is not suitable.

If marketing margins are not included as a part of marketing cost, the Shephered's method (ME) suggests that channel – I is more efficient than the channel Nos. II, IV & III. The limitation of this method, as mentioned earlier, is that it does not take into consideration the price received by the producer.

The limitations of both these methods are taken care by the modified method suggested by Acharya. According to Acharya's method (MME), Channel-II is more efficient than channel-IV, III & I. Acharya's measure of marketing efficiency can be also be stated as

$$MME = [RP \div (MC+MM)] -1$$
$$RP = FP + MC + MM$$

Table No. 4.18: Marketing Efficiency of Litchi under different channels (In Rs. '000 pieces)

SN	Particulars	Channel - I	Channel - II	Channel - III	Channel - IV
1.	Retailer's sale price or consumer's purchase price (RP)	900.00	886.00	756.80	829.00
2.	Total marketing costs (MC)	159.00	160.60	175.00	178.00
3.	Total net margins of intermediaries (MM)	503.50	277.65	316.80	289.25
4.	Net price received by producers (FP)	237.50	447.75	265.00	361.75
5.	Value added (1-4)	662.50	438.25	491.80	467.25
6.	**Index of Marketing Efficiency**				
a.	Conventional method (5÷2) (E)	**4.17**	2.73	2.81	2.63
b.	Shepherd's method (1÷2) (ME)	**5.66**	5.52	4.32	4.66
c.	Acharya's method (4 ÷ {2+3}) (MME)	0.36	**1.02**	0.54	0.77

Source: Calculated on the basis of Acharya & Agrawal, 1999 on Agricultural Marketing in India, Oxford & IBM publishing Co. Pvt. Ltd., New Delhi.

4.15 Constraints Perceived by the Farmers

4.15.1 Production Level

In order to produce quality litchi and optimum output of litchi from the orchards, there are various factors which require for maintaining microclimatic conditions (light, water, relative humidity and temperature), edaphic factors (mineral nutrition and quality of irrigation) and biotic factors (insects-pests etc) and other infrastructural and promotional support. In course of the study, several constraints relating to production have been perceived by the sample households. The respondents across the sample districts were asked to rank the constraints according to their preferences. Table 4.19 highlights the Garret's ranking, which helps to know the order of constraints. Among the constraints, lack of quality insecticide/pesticide got the first rank at the overall level followed by poor electric supply with low voltage, lack of moisture in the orchard due to wide function in temperature, lack of quality manure/fertilizer/bio-fertilizer, lack of skilled labour, lack of promotional support from the government, lack of irrigational facilities, older orchards, complexities in availing institutional credit and lack of technical guidance. Across the sample districts, lack of quality insecticide/pesticide, poor electric supply with low voltage and lack of moisture in the orchard due to wide fluctuation in temperature got first, second and third rank respectively in Bhagalpur district; whereas lack of moisture in the orchard due to wide fluctuation in temperature, lack of quality manure/fertilizer/bio-fertilizer and lack of promotional support respectively in East Champaran district and lack of quality insecticide/pesticide, poor electric supply with low voltage and lack of moisture in the orchard due to wide fluctuation in temperature respectively in Samastipur district.

Table 4.19: Constraints perceived by the Farmers in Production of Litchi

SN	Constraints	Garret's Rank			
		Bhagalpur	East Champaran	Samastipur	All
1.	Lack of skilled labour	V	VII	III	V
2.	Lack of quality manure/Fertilizer/bio-fertilizer	IV	II	II	IV
3.	Lack of quality insecticide/pesticide	I	V	VI	I
4.	Lack of moisture in the orchard due to wide fluctuation in temperature	III	I	I	III
5.	Complexities in availing institutional credit	IX	IV	V	IX
6.	Poor electric supply with low voltage	II	VIII	VIII	II
7.	Lack of technical guidance	X	X	VII	X
8.	Old orchards	VIII	IX	X	VIII
9.	Lack of Irrigational facilities	VII	VI	IX	VII
10.	Lack of promotional support from the Govt.(Soil test, insurance, rejuvenation of orchards, save orchard programme, etc.)	VI	III	IV	VI

Source: Primary Survey

Above analysis reveals that lack of quality insecticide, pesticide, manure, fertilizer, bio-fertilizer and temperature constraint are one of the major limiting factors in its successful production of temperate fruits. Estimates of yield losses caused by pests and diseases attack range from 10 to 30 per cent. Unlike agricultural crops, litchi is grown as monoculture, the pest and disease problems are entirely different and complex in nature. Such pest and disease situations have led to repeated and excessive use of chemical pesticides.

4.15.2 Marketing Level

Marketing has a challenging task and key role to play in litchi production, growth and development. Big economic fortunes are now being made only in marketing which largely determine the volume of production via remunerative prices paid to farmers. Production technology can only sow the seeds and bring forth the fruit but marketing alone can pluck and deliver the output to the point where it is required after payment of fair prices to the farmers. Table 4.20 show problems perceived by the sample farmers in marketing of litchi. These problems are severe in case of highly perishable fruit trade like litchi, which come once a year in bulk or glut in marketing season. The traders make full use of helplessness of litchi orchardists in the market. Among the constraints; presence of exploitative middlemen/gaddidar (in wholesale market) got the Garret's first rank at the overall level as well as in Bhagalpur and Samastipur districts both. Un-remunerative price received by the growers got the second rank at the overall level followed by high transportation charges by road, lack of cool chain, lack of storage facility, forced sell to pre-harvest

contractor due to absence of market, variation in commission in local/regional wholesale market, lack of security, lack of producers' syndicate for marketing (like Uttarakhand) and lack of skilled labour for post-harvest operations. Across the districts, the exploitative behavior of middlemen/gaddidar prominently figured constraint particularly when bulk fruits arrived in the market.

Table 4.20: Constraints perceived by the Farmers in Marketing of Litchi

SN	Constraints	Garret's Rank			
		Bhagalpur	East Champaran	Samastipur	All
1.	Forced sell to Pre-harvest Contractor due to absence of market	VI	VI	VII	VI
2.	Un-remunerative Price	IV	V	III	II
3.	Lack of Security	III	IX	X	VIII
4.	Lack of Cool Chain	VIII	I	IV	IV
5.	Lack of Storage Facility	VII	III	V	V
6.	Lack of Skilled Labour for Post-harvest Operations	IX	VIII	IX	X
7.	Presence of Exploitative Middlemen /Gaddidar	I	II	I	I
8.	High Charges of Transportation by Road	V	IV	II	III
9.	Commission in Local/Regional Wholesale Market Varies	II	X	VI	VII
10.	Lack of Producers' Syndicate for Marketing	X	VII	VIII	IX

Source: Primary Survey

4.16 Pre-harvest Contractors (PHCs)

Pre-harvest contractors (PHCs) are the most important players in the existing marketing channel of litchi. In all the three sampled districts covered during the survey, PHCs are an integral part of the system and about 85.98 per cent of litchi is marketed through them. 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. Most of APMC markets were located at far off places from the orchards and there were no local mandis to facilitate the marketing.

The PHCs can be categorized as small, medium and large based on the volume handled and location. Smaller PHC's are mostly located at interior villages, take smaller orchard on contract and for a year or two, while medium ones are relatively closer to mandis, and take medium orchard on contract. Most of the large PHCs play multiple roles as farmers, PHC's and as traders.

PHCs start surveying the litchi orchards from November-December every year and start purchasing the orchards on contract, which is usually informal, as 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 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.

Generally the lease is for one year but in some cases the lease duration could be up to 2-3 years. Besides, PHCs are those individuals who take title of the produce they handle. They buy the orchards and sell the produce through different intermediaries after harvesting on their own and gain or lose, depending on the difference in the sale and purchase prices. They may moreover, suffer loss with a fall in the prices of the produce. Many times, they also face the problem of availability of credit, which they usually obtain from the informal sources at higher charges i.e., 5-10 per cent per month. 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. Additionally, the awareness level of the farmers is very low on other marketing methods that could be adopted for marketing or any sort of value addition that could be undertaken at the farm level. The selected PHCs details are depicted in table 4.21

Table No. 4.21: A Brief Profile of the Selected PHCs

SN	Particulars	Bhagalpur	East Champaran	Samastipur	All
A.	Social Category				
	General	1	2	---	3
	SC	---	---	---	---
	ST	---	---	---	---
	OBC	2	1	3	6
B.	Avg. Size of Family (In persons)	8.67	7.33	6.67	7.56
C.	Primary Occupation				
	Agriculture	3	2	1	6
	Service	---	---	---	---
	Business/Trade	---	1	2	3
D.	Educational Qls				
	Illiterate/Literate	---	---	---	---
	Up to Primary level	1	---	---	1
	Secondary level	2	2	1	5
	Matriculation	---	1	2	3
	Graduation	---	---	---	---
	Others	---	---	---	---

Source: Primary survey.

4.16.1 Litchi Sold through the PHCs

The data presented in table No. 4.22 reveals that out of total disposal (6812.53 qtls) of litchi made through different marketing channels in the sample districts, 5857.42 qtls (85.98%) of litchi was marketed through the PHCs. And out of the total volume of litchi marketed by the PHCs, the share in East Champaran district (37.88%) was larger followed by Samastipur (34.34%) and Bhagalpur (27.78%). The table further

reveals that across the districts, the PHCs have marketed the litchi at around 85 to 86 per cent of the total volume of disposal.

Table 4.22: Volume of Litchi Sold through the PHCs.

SN	Districts	Qty (In qtls)	In %	Total Disposal by Sample Households (In qtls)	% of sale through PHCs against the total dispersal
1.	Bhagalpur	1626.92	27.78	1871.21	86.94
2.	East Champaran	2218.86	37.88	2599.60	85.35
3.	Samastipur	2011.64	34.34	2341.72	85.90
	Total	5857.42	100.00	6812.53	85.98

Source: Primary survey.

Constraints Faced by the PHCs

- Lack of capital
- Monopoly of Gaddidar/Commission Agent in getting the fancy prices of the produce.
- Frequent cheating by the input agents providing services in the rural areas
- Lack of Common Facility Centre (CFC) especially for technical and marketing guidance.
- Demand of Extortion (In Bhagalpur district particularly).

Suggestions

- Availability of capital at low rates of interest.
- Transportation of the produce may be arranged through Railways.
- Delivery of quality inputs may be arranged.
- Establishment of Common Facility Centre (CFC).
- During litchi season, deployment of RAF may be made in litchi concentration area.

4.17 Wholesalers

Wholesalers are one of the important market functionaries in marketing of litchi in Bihar. Wholesalers are those merchant middlemen who buy and sell litchi in large quantities. They buy litchi either directly from farmers or from other wholesalers. They sell either in same local market or in other markets. They sell to retailers, other wholesalers and processors. They do not sell significant quantities to ultimate consumers. Since litchi is highly perishable horticultural produce, so storage of the fruits is not made by them. Wholesalers perform the functions of assembling, to some extent grading, regulation of flow of the produce in the markets and need based financing to a few farmers and village traders/merchants. They assess the demand of prospective buyers and processors from time to time, and plan the movement of litchi over space and time.

In the surveyed area, most of the wholesalers are found working/engaged in the local city and regional mandis/markets. They used to act in the market through the commission agents of the respective markets. In the prevailing marketing channels, wholesalers were found involved in channel Nos. I, II & III. Through these channels, about 73.24 per cent of the total disposal of the produce at the overall level was marketed by the wholesalers. So, they play a significant role in marketing of litchi in Bihar. The district wise analysis reveals that 83.06 per cent, 71.96 per cent and 66.85 per cent of the total disposal of produce in the respective districts of Bhagalpur, East Champaran and Samastipur are marketed through the wholesalers. The wholesalers' net margin was estimated at 6.88 per cent to 12.31 per cent of the consumer's price across the existing marketing channels.

4.18 Retailers

Retailers buy litchi from wholesalers and sell them to the consumers in small quantities. They are personal representatives to consumers. Retailers are closest to consumers in the existing marketing channels. In the surveyed districts, out of seven existing marketing channels, retailers perform their functions in the first four channels. In Bhagalpur district, the total disposed volume of litchi was marketed through them, where as that in East Champaran and Samastipur districts were about 82.32 per cent and 83.48 through the retailers. At the overall level, about 87.58 per cent of the total quantity of disposal was marketed through the retailers. As regards the margin of the retailers is concerned, it was 16.54 per cent to 25.67 per cent of the consumer's price across the identified marketing channels.

4.19 Transportation

Litchi being a highly perishable fruit, its marketing should be done as quickly as possible. Poor transport conditions are major bottleneck not only in Bihar but in Asia. The main limitations are: rough roads, lack of refrigeration and poor truck suspension, which are beyond the control of growers. One of the major blunders conventionally followed during long distant transportation for marketing is covering of trucks (carrying litchi fruits) with tarpaulin keeping the black surface exposed to the sun and white surface inside. Also ventilations are kept even in wooden boxes. In CFB boxes, the vent holes are provided on the top, and while stacking all these are perfectly blocked, hence no benefit of these were obtained, as reported by the growers and other stakeholders in marketing of litchi. Actually harvesting of litchi fruits was done from 6 am to 5 pm. It was also learnt that only after 3rd day of packing at any places in Bihar, the litchi fruits could reach Delhi and it takes 5 days to Mumbai/Pune and other southern cities. About 40 per cent of litchi fruits lose their freshness in the form of decolourization of peel while marketed in Delhi and 40-50 per cent of marketable form of litchi reached Mumbai/Pune markets. However, this huge loss in compensated by high marketed value of the produce.

Despite high demand in nearby markets, the traders do not send their produce with the fear of sudden fall of price due to glut, if sent in one or two markets. Next to it, the other major concern to traders and growers is the exorbitantly high rates charged by truck operators for transporting litchi. Taking advantage of very short shelf life, truck operators, sometimes, demand double the normal freight charges. According to some progressive farmers, trucks used to charge Rs. 35,000 for carrying 500 boxes of litchi from Bhagalpur to Delhi/Jaipur as against Rs. 25,000 charged for transporting other goods. Similarly the truck used to charge Rs. 25,000 to Rs. 30,000 from Muzaffarpur/Samastipur to Delhi as against Rs. 15,000 to Rs. 20,000 for other goods. The railways do not provide facilities for transporting litchi by attaching goods wagon for this specific purpose to Delhi/Mumbai bounds trains from Bhagalpur. According to some growers in Bhagalpur district, railways had given one bogie at Bihpur Railway Station (Bhagalpur district), but later on it was withdrawn. They wanted attachment of at least two bogies for Delhi, Gorakhpur, Varanasi etc. in respective trains on daily basis during the litchi season. In Muzaffarpur, the railways provide facilities for transporting litchi by attaching bogies to Delhi bound trains on daily basis, but the desired impact of its initiative is yet to be felt at the field level, for want of loading facilities at Muzaffarpur railway station. So, keeping in view the high perishability of litchi fruits, railways should provide the facilities of attaching one or two bogies from those railway stations, where the concentration of litchi is higher in Bihar. This will be a big help to the growers of litchi in terms of fancy prices for the fancy and pride horticultural produce of Bihar.

4.20 Case Studies of Processors

As per data made available by the Directorate of Food Processing, Department of Industries, Government of Bihar, there were 14 food processing units in Bihar till September, 2014. Out of them, 12 units were under commercial production. These units are mostly located in North-Bihar. In case of present study, 06 litchi processors (5 registered and 1 unregistered) have been captured as case studies. While discussing with them on the working of these units several comparative examples were brought into notice, which are self-explanatory relating to the state of affairs of litchi processing in Bihar. Litchi processors claimed that they prepare raw materials for litchi juice, jam, seedless whole litchi for ice-cream, squash, drink, honey and some final products like litchi drink, litchi rasogolla, candies etc. worth Rs. 5 crore annually. They narrated that India is next to China in terms of production of fruits and vegetables in the world and claimed that India can compete with China in Litchi production, trade and industry if the government provides some common facilities to growers and entrepreneurs. In fact Chinese government has set-up a number of 'common facilities centres' along highways in litchi producing areas near Xamin city

under Gnangzhou province where all sorts of facilities are available to farmers and traders at the same place. Besides, bank rates are high as 15 per cent in India, whereas it is only 4 per cent in China. China is providing AC containers for transportation of litchi from one place to another there is no such facilities from government side in Bihar so far. Litchi processors entirely depend on a single tin plate factory located at Jamshedpur (Jharkhand) for packaging purposes, while China has 3500 tin plate factories for helping packaging of processed fruits. Since Bihar is leading state in terms of area and production of litchi in the country, so litchi processors should be encouraged by policy incentives in terms of machines, infrastructure, credit, skilled labour, tax relief etc. Moreover, interactions with the selected litchi processor have been presented as case studies in following boxes:

1. Sahi Fresh Foods India Ltd, Samastipur (Bihar)

Sudhanshu Kumar *(sudhanshu5506@gmail.com)*, 52 years, M A (History) from Delhi University in 1986; a resident of Nayanagar village and Panchayat as well in Hasanpur Block of Samastipur district in Bihar. After completing his education, he served in a Tata Tea Garden, at Monaar, Kerala for a short period, and subsequently, opted 'Agriculture' as vocation and continuing for last 28 years. He owes approx. 30 hectares of land including about 7 hectares of orchards having litchi and mango fruits. Of the total litchi plants, 60.00 per cent constitutes Sahi and 40.00 per cent China varieties, which produces about 60 MT annually.

It has owned machinery bank with servicing and maintenance facilities and a small dairy farm, poly house etc. He is well recognized 'Innovative Farmer' in terms of use of production technology, efficient use of water for irrigation, balancing the climatic stress etc.

Attended and participated various training and workshop like; Strengthening Agricultural Marketing System under the Cochran Fellowship Programme by US Department of Agriculture in 2012, Agricultural Marketing and Cold Chain Workshop at California (USA) in 2012, India (ICAR) --- ASEAN-Exchange Visit Programme for Young Farmers between Malaysia & India in 2013 etc. Also received many national awards, citation etc. like; Jagjivan Ram Kisan Puraskar (2009), Mahindra Samridh India Agri. Award (2014), National Farm Innovators' Meet (2010), SDSH best Mango Award at CISH (Lucknow), Role Model Award (2011) of ICCD--- MSET, conferred a title of 'A Progressive Farmer' at IARI (2013), Samman Patra (2012) by Samastipur District Administration, Udyan Ratan (2009) for use and promotion of technology in Litchi, Kisan Bhushan by Government of Bihar, a citation for the use of new technologies in agriculture by KVK (2002), Begusarai (Bihar), a citation for the best variety of 'Sukul Mango' and 2nd best for 'Malda Mango' by RAU (2006), Special prize for Litchi fruit at State level Litchi Exhibition (2005), Gram Gaurav Samman for Litchi in Bihar etc.

Also several national & international publications are to his credit. Appreciation by Dr. Swaminathan, holding membership of various forums of regional, national & international bodies, Resource Person of NRC-Litchi (ICAR), ATR, Government of Bihar, etc. A documentary on his success story has been made by BAMETI, Government of Bihar. He is the Mukhia of his Panchayat continuously for the last 3 terms.

In 2012, he formed a firm, namely; 'Sahi Fresh Foods India Limited' with its head office at Patna and started a 'Pack House' business with a capacity of 30 MT for raw mango and litchi produce. Out of his own production of litchi, he exported to Dubai in 2012 and marketed to Bangalore and Wasi (Mumbai) Terminal Markets through the traders. Before marketing to the produce, manual sorting and grading were made at his pack house; packaging cost was Rs. 13 per 2 kg of box. The average transportation and marketing cost was Rs. 60/kg for exporting the produce to Dubai and Rs. 25/kg for marketing the produce to Bangalore and Wasi (Mumbai). The net return was approximately 5 to 6 times over the costs of production at the orchard level plus marketing costs.

But, he was found disgusted with the policies and facilities available to the litchi growers, as well as processors in Bihar. The main constraints as he enumerated are difficulties to assess policy benefits due to procedural bottlenecks, low supply (avg. 10 hours) of electricity with low voltage, lack of cool-chains in Bihar either at the airports or railway stations, non-transparency in credit facility, reducing amount of subsidy on refrigerated van (as he has no ref. van and used to avail such facility on hiring basis from Patli Fresh, Patna, the only organization, which provides this facility in Bihar).

On line/e-route submission of application for obtaining the benefit of the schemes/policies, and thereof monitoring and tracking by the sponsoring/nodal agencies of the scheme was his main suggestion; so that no harassment could be made by the implementing agencies of the scheme.

He narrated his anxiety related to one of his pending projects of Rs. 3.2 crores before the bank for his proposed processing unit of litchi and other fresh fruits since last one year.

2. R K Impex Pvt. Ltd., Muzaffarpur (Bihar)

Alok Kedia (rki@kediafresh.com), 45 years approx. graduated from Muzaffarpur (Bihar), Director, M/s R K Impex Pvt Ltd. Muzaaffarpur, Corporate office at Pitampura, New Delhi, working with the leaders in the food service sector providing them solutions in the form of 'ready to use' fruits & vegetables. The type of business is exporter/supplier/trading company and his firm is popularly known as Kedia group. The firm started in 1967 with cold storage business. In 1972, his father exported litchi to England (UK) in collaboration with State Trading Corporation. But it could not continue in later years due to temperature reason. In 1994, NAFED stored 3 trucks of potato in Kedia's Cold storage, which rewarded him; Kedia said. In subsequent year (1995-96), export of litchi rejected due to emergence of 'Banomel' fungicide by Quarantine Department. In 1997-98 litchi exported to Europe through ship consignment. Three containers of litchi were also exported in 1998 in collaboration of Mother Dairy. In 2001, he was compelled to enter into processing of litchi business as a result of 70-75 of procured litchi was of 3rd grade, which was not allowed for export. The catchment area for procurement of litchi is in 70 km radius to Muzaffarpur town. But the procurement was not enough because it requires huge capital. The firm processes litchi into pulp and concentrates. Besides mango catch up, ginger paste and pulping of blackberry (Jamun) & pineapple are also produced by the firm. The firm processed about 12,000 MT of fresh litchi valued at Rs. 30 crores value during the last year. Out of the total volume 85.00 per cent were processed for litchi pulp and 15.00 per cent for litchi concentrates. The firm does not produce in the form of final products rather produces in the form of raw materials for corporate buyer houses, which are engaged in drink businesses. The firm processed 4,500 MT of litchi pulp and 700 MT litchi concentrates. Procurement of litchi is made on year to year basis through the local agents/PHCs. These people are financed and helped in terms of fertilizer, medicine, knowhow, training, sprayer machines, irrigation tools etc. for extending assistance to the cultivators/PHCs for ensuring the supply to the firm. The average cost of assistance was estimated at Rs. 100/tree. The firm holds FSSAI license and Food & Safety Standard Certificate—22000 of the World standard. Marketing of litchi processed items is made through direct contact. There is no dearth of demand of the products due to limited supply. The buyers are Pepsi, Dabur, ITC, Patanjali, etc. The firm has deep freezers with a capacity of 30,000 MT at Muzaffarpur plant and 1,000 MT at Delhi on hired basis. It uses to hire ref. van for transporting the produce from Muzaffarpur to Mumbai and Delhi, which costs about Rs. 50 to 70 thousand with loading capacity of 12-12.5 MT.

The marketing costs is around Rs. 20-25/kg of the produce, consisting of transportation charges for Rs. 6/kg-12/kg, packaging @ Rs. 9/kg, storage @ Rs. 2/kg/month and labour charges @ Rs. 3-4/kg.

The total capital investment of the firm is about Rs. 25 crores. Out of it, an assistance of Rs. 4 crores has been given by the state government. The present turnover is approx Rs. 40 crores. The firm provides employment to 60 persons throughout the year and additional 150 persons for two months only. The cost of producing one kg of litchi pulp or concentrate is about Rs. 70-80 and the gross return is Rs. 100. The net return stands at Rs. 20-30 i.e., 20-25 per cent of costs.

Kedia wishes to expand the size of firm into a big food processing unit based on foreign technology and for that a big help is required from the state or central government. He suggested promoting for establishing tetra pack units in and around Muzaffarpur like Jaipur, Pune & Mumbai cities. It will ease the marketing and processing issues of litchi products.

3. Litchika International, Bela, Muzaffarpur (Bihar)

Litchika International (www.litchicainternational.in) and e-mails (mfp@litchica_international.in, delhi@litchicainternational.in) is one of the oldest primary processing units of litchi, located at Phase – I, Industrial Area, Bela, Muzaffarpur, Bihar. It has 20,000 sq. feet of plant area. Mr. K P Thakur is Managing Director of the firm, who resides at Mumbai, where final products of litchi are prepared. It functions seasonally (May-June) and locally managed by his brother Mr. S N Thakur (55 yrs) and cousin Mr. by Prashant Thakur (35 yrs). The business profile of the firm is limited to litchi processing only in the form of litchi squash, pulp, canned litchi (whole litchi dipped in sugar syrup) and confectioneries in the brand name of 'Litchica' since 1985. During the last year (2013) about 20,000 MT of fresh litchi was processed. The firm procures litchi locally in a radius of 40-50 kms. During 2013, the procurement was not adequate mainly due to low quality produce and high involvement of agents/middlemen.

Its plant is semi-automatic but full automation process is going-on. Though, it requires huge capital. Since the firm is engaged in only litchi activity, so it undertakes primary processing here of that much of quantity of fresh litchi into litchi pulp and juice, which have its annual requirements as raw materials for final processed items.

The firm enters into (verbal) contact with large sized cultivators directly and indirectly through PHCs & middlemen for securing the required volume of fresh litchi. The plant load capacity is 500 MT of fresh litchi per day. To procure litchi, some assistance to the cultivators, PHCs & middlemen are required in the forms of plastic carrets and inputs like; medicines, sprayers, irrigation tools etc. and to some extent, cash advance to them also. It has FAO & FSSAI licenses.

The marketing of final processed items is made from Mumbai based office through it distributors spread over Mumbai, Delhi, Pune, Jaipur etc. Supply of processed items is also made to Military & Railway canteens. Mr. Thakur said that there is no dearth of demand of final processed items. But, the firm is not involved in marketing of these processed items in Bihar. The firm has its' own pre-cooling chamber of 50-100 MT and a storage capacity of 100 MT. The annual turnover is around Rs. 25 crores. During the season, it employs about 150 labourers, who are brought from in and around the city. Women labourers are largely employed for sorting, grading and deskinning of litchi fruit.

The firm has a cash credit facility of Rs. 24.50 lakh, obtained from local branch of SBI. But, Mr. Thakur is afraid of the future of litchi processing due to sporadic upcoming of petty processors at the village level, who are locally and seasonally engaged in primary activities of litchi in an unhygienic conditions and unscientific manner despite litchi pulp and juice being highly susceptible to health. Besides, low concentration of litchi processors and non-trained technicians, chemists and laboures are main constraints in operating the unit. The firm brought skilled persons from Mumbai and other places at high remuneration and assurance of providing other facilities to those labourers during the season.

4. M/s Shyama Agro Foods & Exports, Muzaffarpur (Bihar)

Keshav Nandan (53 yrs) P/o M/s Shyama Agro-Foods & Exports, village & P.O – Ratwara (30 km east to Muzaffarpur city), Muzaffarpur (Bihar), after doing B. Com (Hons.) from BHU was inspired to opt a mix of agriculture and processing as vocation and established processing unit of litchi in 1994 at Ratwara itself, as a result of his dream. He is the Ex-President & Secretary of LGA (Litchi Growers' Association) and farmer member of management committee of National Research Centre for Litchi (NRCL), an ICAR Institute, at Mushari Farm, Muzaffarpur. He has 11 acres of plant area and owns 500 litchi trees in the campus of the factory. The plant load capacity is 5 MT/hour of processed items. The storage capacity is 200 MT at normal temperature in the factory campus itself.

During the last year, 350 MT of litchi was procured from the traders, who reside in and around the factory premises in a radius of 20-25 kms. The procurement was insufficient mainly due to increasing demand of fresh/table fruit, decline in quality of fresh fruit, slashing period of gestation (harvesting) by 18-20 days, lack of organized litchi market etc. Out of the procured volume of litchi, the firm produced 125 MT of litchi pulp (sulphitated) for the buyers, like: Himachal Pradesh Marketing Corporation (HPMC), Gurujee Thandaie (Sonipat, Haryana), Banke Bihari Fruits (Delhi) etc. Out of which, 15 MT were in canned and 5 MT in squash forms.

The average cost of production of litchi pulp, juice, etc is Rs. 55-Rs. 58 per litre and per litre average return is Rs. 64 to Rs. 65. The marketing cost is estimated at Rs. 18 to Rs. 25 per litre. The firm's turn over during the last year was Rs. 1 crore. It employs 200-300 labourers in the season and most of the works are under contract system/basis.

The firm has a facility of cash credit (amount not disclosed) from BoI. It has benefitted the entrepreneur in purchase of 1,500 fruit handling carrets (@ Rs. 350 each) at 25 per cent subsidies under a scheme of NHB 2004-05.

Having been distracted by scientific researches, which failed to bring innovations meant for cultivation and post-harvest practices, increase in shelf-life, communications, skill development etc. Mr. Nandan was not much enthusiastic towards the activity. Institutional factors, like; very poor extension back-up, scattered & lack of policy and programme support to the processors meant for basic infrastructural facilities like primary collection centre etc. were also noted as factors responsible for such dismaying scenario. These all have resulted into unfavourable economics of production and processing as well. Perhaps, these are the reasons which have prompted to be absentee growers and paved the way for growing influence of PHCs and middlemen in marketing of fresh fruits.

Suggested to form 'Litchi Hub' in Muzaffarpur, growers syndicate (as it is in Uttarakhand), construction of control and non-temperature control pack houses, innovations for climatic resistant varieties, favourable attitude of the govt. and govt. functionaries, and providing basic infrastructure (roads, transport, power), friendly law & order etc. Otherwise, the future of the globally recognized, the pride fruit of Bihar will face the fate of extinction on for which we all will be answerable to the generations to come.

5. M/s Suman Vatika Food Products, Vaishali (Bihar)

M/s Suman Vatika Food Products (info@sumanvatika.com, sumanvatika@rediffmail.com), located At & P.O: Dayalpur, District – Vaishali (Bihar), 6 kilometres away from Industrial Area, Hazipur, Vaishali, is a partnership concern, established in 1997. The plant area is spread in 2.5 acres. It is jointly governed and managed by Smt. Kiran Ranjan (45 yrs), Graduate and Mr. Prabhat Ranjan (prabhat@sumanvatika.com), MBA, Secretary & MD respectively of the firm. It functions in processing of multiple items like; mango, litchi, pineapple, tomato, sweet corn etc., and produces mango squash, litchi pulp and juice, canned litchi, litchi drink, tomato puri/catch-up etc. The utilization capacity of the plant is 20 MT/day of litchi pulp and juice and 8000-10000 canned litchi. During the last year, it processed about 500 MT of litchi. The volume of procurement for processing was as per its requirement, but its fell short of sale in fresh form to big markets mainly due to availability of poor quality of litchi for last three years. The firm produced to 200 MT of litchi pulp and juice and 120 MT Canned litchi (1,30,000 canes). The firm procured litchi from 30-40 litchi growers, who are continuously associated with the firm. The firm provides them cash advance facility, technological help, spraying materials and sometimes, small irrigational tools. It prefers for organic cultivation of litchi, for which 'Chetna' brand of spraying materials (powder/liquid) of Patanjali Yoga Peeth are available. The firm also maintains the quality specifications of FAO & FSSAI. It has the licenses of both issued in 1997 and 2011 respectively.

For marketing of the primary processed and final processed items of litchi, it has developed website. Fresh fruits are also sold in big city markets like: Bangaluru, Pune, Hyderabad etc. Main buyers of fresh fruits are Adani, Reliance Groups etc. Final processed items are marketed in the brand name of 'Suman Vatika.' The firm has sold 54 MTs of fresh litchi in 2013, which were transported through 6 containers. It has about a dozen of distributors for marketing the final processed products across big cities, like, 4 in Bangaluru, 3 in Hyderabad, 4 in Pune etc. Canned litchi products are mainly sold through a canned products' Indian giant, namely Golden Crown. But, there is supply constraint despite big orders.

It has pre-cooling chamber (2^0C - 3^0C) of 30 MTs and the storage capacity of 300 MT. The total turnover during 2014-15 was Rs. 2.65 crores, which is expected to increase by 50.00 per cent during the next season/year. The total capital investment is about Rs. 2.5 crores. It provides employment to about 500 women workers for litchi and 300 workers for mango and other fruits.

The firm has not yet been benefitted under any of the government programmes and schemes. The main constraints are: climatic pressure on litchi cultivation, low shelf-life, non-availability of a variety of horticultural produces in the region to run the factory round the year, illegal practices of a few petty village level primary processors of litchi, who are feeders to big processors in the region, etc. and thus, suggestions for devising direct policy and programme benefits to the litchi processors and growers of Kisan Clubs formed by NABARD and other agencies etc. were given. Marketing efforts in these lines will fulfill the dream of the Chief Minister, Nitish Kumar that there should be the products of Bihar in each plate (meals) in the country.

6. Daroga Prasad, Jamalabad, Muzaffarpur (Bihar)

Daroga Prasad (72 yrs), Vill & PO : Jamalabad, block-Mushari, Dist.-Muzaffarpur (Bihar), after retirement from the defense services in 1974, got engaged in cultivation and litchi trade as pre-harvest contractor (PHC). He has 20 acres of litchi area. After a few years, his son namely, Mr. Birendra Prasad Kushwaha also joined him in litchi trade. In 2008, he entered into primary processing business of litchi pulp honey. Besides litchi, jamun *(blackberry)* juice is also extracted by him. His firm is semi-mechanized with an investment of Rs 10 lakh only comprising Rs. 5 lakh owned capital and Rs. 5 lakh as borrowed amount from the money lenders @ Rs. 4-5/Rs. 100/month. During 2013 & 2014, the quantums of procurement of litchi (c grade) are 125 MTs and 60 MTs respectively. Procurement of fresh litchi is not a problem for him because he is already a PHC and litchi trader as well. His firm is unlicensed and working as a small and cottage industry. Out of the total investment, a tinned roof semi pucca shed (40′ x 25′) has been constructed at a cost of Rs. 1 lakh approx and a sum of Rs. 2 lakh was invested on purchase of semi-automatic machines. The firm employs 200 workers during the season. The firm works for R K Impex Pvt. Ltd., Muzaffarpur, M D Fresh; Aligrh, S Rathore; Jaipur, Shashi Kumar & Avinash Singh of Rajasthan & Litchica International, Muzaffarpur as feeder of raw pulp and juice. The main constraints faced by the firm are: lack of markets, influence of middlemen in the existing informal markets, lack of skilled technicians & adequate capital. Mr. Prasad wished to declare Muzaffarpur division as a 'Litchi Zone' for production and processing as well so that some special policy and programme related benefits could be provided by the concerned department, mainly for small growers and processor, who are in a good number in the area. He chanted that 'there is no dearth of entrepreneurs; rather they are directionless in the vocations.

4.21 Unorganized Processing

This study could cover only one unorganized litchi processing unit owned by Dargo Prasad so far. However, as per available information, there are very few such units in the field of litchi processing and those who are working in this field have multi product's units like tomato ketchup, extraction of juice from Jamun (blackberry), honey etc. They used to work for local big litchi processors. These units have no required infrastructure, capital, skilled manpower etc. They operate in illegal manner. These units sometimes also operate as pre-harvest contractors, wholesalers, retailers etc. They do whatever they could do alone. Thus, their role is very limited. They do mainly one-farm processing jobs without keeping hygiene in mind.

Overall Constraints Faced by Litchi Processors ***(As perceived by the Sample Processors)***

Climatic

- Growing temperature pressure on litchi cultivation
- Low shelf-life
- Lack of climatic resistant varieties

Marketing

- Lack of cool-chains either at Airport or Railway Stations
- Lack of producers' as well as processors' syndicate
- Absence of information network to keep track of raw materials prices and availability

Technical

- Untrained labourers, technicians and chemists
- Lack of technical knowledge of primary processors at village level for litchi, as litchi is highly susceptible to health hazards

Infrastructural

- Low supply of electricity (avg. 10 hrs.) with low voltage
- Shortage of capital
- High hiring charges for Ref. Van
- Lack of markets for procurement of litchi, resulted to growing role of middlemen
- Lack of control and non-temperature control pack houses

Others

- Difficulties to assess policy benefits due to procedural bottlenecks
- Non-transparency in credit facilities
- Reducing amount of subsidy on Ref. Van
- Low concentration of litchi processors
- Sporadic upcoming of petty processors at the village level
- Non-availability of a variety of horticultural produces in the region to run the factories round the year
- Illegal practices of petty village level primary processors of litchi

CHAPTER – V

CONCLUDING REMARKS AND POLICY RECOMMENDATIONS

5.1 Introduction

Litchi is restricted to very few countries in the world with a total area of about 8 lakh ha and production of about 24 lakh MT. India and China account for 91.00 per cent of the world litchi production. According to NHB database (2013), about 580.10 thousand MT of litchi is produced annually from 82.70 thousand ha of land in our country. The climatic requirements of this crop are exacting in nature, therefore, making production limited to few states like; Bihar, West Bengal, Uttarakhand, Assam and Jharkhand and to a smaller extent in Tripura, Punjab and Orissa. Litchi accounts for around 1.00 per cent of the total area under fruits in the country, but it has a definite economic significance in its growing areas. As per quantum of produce, India is the second largest producer of litchi in the world next to China. Globally, the countries of southern hemisphere such as South Africa, Madagescar, Australia and Brazil harvest litchi during October to March whereas in northern hemisphere, the fruits are harvested between April to August. Approximately 90.00 per cent of the litchi produce is utilized as fresh, of which at least 25.00 per cent is subjected to post harvest losses at various stages. Usually, there is glut of fresh fruits in the market during harvesting season, which is of very short span of 15-20 days at one place. The litchi maturity in our country starts from Tripura followed by West Bengal, Jharkhand, Bihar, Uttar Pradesh, Uttarakhand, Punjab and Himachal Pradesh. A meager quantity is exported, though, there is great demand and has lot of scope to increase the quantum of export, since the harvesting season is quite different in other parts of the world.

Litchi occupies an important place in the Horticulture landscape of Bihar owing to its geographic confinement and the magnitude of its share to the overall production in the country. The soil and the climatic conditions of north Bihar (almost 27 districts of the state) favour high yields with quality fruits of litchi. During the last five years (2009-10 to 2013-14), the area under total fruits was around 290-300 thousand hectares, which is about 5.50 to 6.00 per cent of net sown area Litchi is the third largest fruit next to Mango and Banana in terms of area and production. It occupies about 10-11 per cent of total fruits' area and around 6.00 per cent of total fruit production. During 2013-14, the total production of litchi was 234.20 thousand MT from the area of 31.48 thousand hectare. The compound annual growth rate (CAGR) of litchi production during the last five years was 2.02 per cent whereas that

of total fruit 1.56 per cent. Shahi, China, Desi and Manraji litchi are ruling commercial varieties in Bihar.

Litchi is a delicious fruit of excellent quality. The fruit has high sugar content varies from 10.00 to 22.00 per cent due to cultivar and climatic conditions. Besides, it is of about 65.00 per cent juice, 8.00 per cent pulp, 19.00 per cent seed and 13.00 per cent rind. It contains 0.7 per cent protein, 0.3 per cent fat, 0.7 per cent minerals (particularly calcium and phosphorus) and vitamin C (64 mg/100gm pulp), vitamin A_1B_1 & B_2 also present in considerable amount.

The litchi is prone to attack by pests and diseases, which are one of the major limiting factors in its successful production of temperate fruits. Estimates of yield losses caused by pests and diseases attack range from 10 to 30 per cent. Unlike agricultural crops, litchi is grown as monoculture, the pest and disease problems are entirely different and complex in nature. Such pest and disease situations have led to repeated and excessive use of chemical pesticides. This has resulted in development of resistance in the pest species, contamination of fruits, environmental pollution as well as rejection of export produce. In Bihar, pests and diseases are mainly foliar disease and pest however; sometimes soil borne disease/nematode and termites may affect the nursery plants.

Moreover, it is to be appropriate to mention here that in Bihar, about 25-30 per cent of the total area under litchi cultivation is under old senile orchards, which are highly uneconomical and act as source of pest and disease infestation.

About 80 per cent of litchi produced in the state is marketed out of the state. Major markets are Delhi, Lucknow, Kanpur, Varanasi, Mumbai, Chandigarh, Kolkata and Bangalore. Around 30 MT of fresh produce is also exported from the state to Nepal, UAE etc; which accounts for only 18.00 per cent of the total volume of litchi exported out of the country. Marketing of fruits is done in different forms. Growers rent their orchards to contractors (PHCs), who in turn harvest early and sell to local markets. Due to increased numbers of middlemen in marketing channels reduces the share of growers in the price of produce paid by the consumers. Farmers directly sell their produce to the middlemen. The fruit is sold through post-harvest contractor to the wholesale or commission agents, who do harvesting and packing, in addition to transporting the produce to the market. Majority of the litchi is sold through pre-harvest contractor and about 10 – 20 per cent growers undertake self-marketing. In certain cases, the crop is leased out (orally) to pre harvest contractors (PHCs) for 1-3 years. The PHCs negotiate and settle the price with the growers in their own terms and conditions for payment to the growers. Most of the produce is sold through this

mode. The PHCs have a clear picture in their mind of the yield potential of the orchard based on whole and performance level of individual trees in the orchard. The price offered on a per tree varies with age category i.e., a tree in its prime bearing stage (10 to 30 years) with an annual yield of 100 kg fetches Rs. 500-1000 per year from pre harvest contract whereas the rate for trees in early bearing period (5 to 10 years) is Rs. 300-500 per tree per year. Harvesting of fruits is done by the contractor. The farmers usually receive 50.00 per cent of the settled price in advance just to firming up the deal and the rest is paid at the time of harvest. Harvesting, sorting, packaging are done in the farms by the contractors. Loading the truck (for transport) to distant cities is done at the farm gate itself. The pre-harvest contract system prevailing in the state has an impact on the health and life of the litchi orchards.

Moreover, the Indian and world markets for litchi are fast expanding. During the Indian litchi season (May to July), good quality of litchi is not available from other parts of the world except from Thailand (May & June) and Israel (July). In spite of these advantages, India has negligible share (< 1%) in the world trade with exports of 795 MT valued of Rs. 1.18 crore during 2012-13.

The value addition to fruits and vegetables through processing is as low as 7.00 per cent in India as against 23.00 per cent in China and 88.00 per cent in United Kingdom. In case of litchi it is less than 2.00 per cent of total litchi produced in India is processed. Litchi is negligibly exploited at post-harvest level for processing and value addition of fruits. Nevertheless fresh litchi dominates over dried and canned fruits. The produce is mostly marketed fresh with negligible processing and value addition. In Bihar as per the available information of Government of Bihar, there are only 45.00 per cent licensed fruits and vegetable processing units. Most of these units are engaged in the manufacture of fruit juices, fruit pulps, squashes, pickles, ketchup, sauce, Jam/Jelly etc.

In Bihar, the number of litchi processors is mainly found in DME category of industries and may be enumerated on fingers. Since litchi is highly perishable and susceptible to browning and rotting so it's processing in unorganized sector is almost not found.

Generally processing is made of degraded (C grade) litchi. About 20-25 thousand MT pulp, 5 thousand MT concentrates, 50 MT Canned, 25 MT squash etc. are being produced in the state. These DME, are mainly located in Muzaffarpur, Samastipur, East Champaran, Vaishali and Patna districts of Bihar. Besides, the region has 5 pack houses, which are operated by private litchi processors. Around 1,600-1,700 MT of

produce, is handled by them annually. The pack houses handle fresh as well as processed litchi where about 500-600 MT of fresh litchi is traded and around 25 thousand MT is processed into pulp, juices etc. The pack houses have facility for pre-cooling and cold storage. Mostly the pre-coolers are of 4-10 MT capacity and their maintenance is far from being satisfactory. The cold stores are used by pack house operators to store litchi for 10-15 days only and thus for transit purpose alone. Around 50-60 per cent of fresh litchi is transported through reefer vans/trucks as its availability is of a huge concern. Some of the pack house operators also hire reefer vans/trucks for Delhi, Pune, Kolkata and Patna. Rest of the produce is transported through normal trucks. The installed capacity of pulping units in around 7 MT/hour and the pulped products are stored in deep freezers at (-) 18° to (-) 25° Celsius. Other products manufactured by them include litchi shreds/whole in sugar syrup.

Focusing on just the processing of food grains in Bihar is like addressing the tip of iceberg. The processing of fruits and vegetables needs as much attention, if not more. The produce is mostly marketed fresh with negligible processing and value addition. Only a handful of processing facilities and that too are mainly in fruits-- litchi and mangoes are present and operational. Litchi, being a highly temperature sensitive and delicate fruit, the access to market is constrained by unavailability of cool chains to transport it to distant markets. It is important to reach the produce to distant locations at ambiet temperature within 24-36 hours after plucking, in order to retain its desired colour. The supply chain from farm to find consumers outside the state market is not so efficient to maintain the timings. This is often cited as one of the major bottlenecks in marketing of litchi in Bihar. Also, the current processing capacity is insufficient to cater to the value added market and prolonging the shelf life. In this regard, an old Chinese proverb described, "*Once litchi fruits are detached from the tree, off colour happens in the first day, off fragrance in the second, off flavor in the third and all gone after 4 to 5 days.*" In fact fruits' post harvest life is not an issue where fruit is rapidly consumed at the local level, but in commercial production environments where fruits are to be transported to distant markets or the rate of consumption does not match the supply, appropriate post harvest management is critical to successful marketing. Ideally, fruits should be shipped on the day of harvest.

The processing segment is marked by a complete absence of cold chain along the value chain resulting in quality deterioration and degradation of the fruits. Similarly, even after processing, the products are kept under minimal refrigeration or no refrigeration. Units which are engaged in processing are mainly working on work order basis for larger chains and as such find that the operating margins being

thin leave no scope of either technology upgradation or expansion. This study could studied only two Firms in the state which are engaged in producing value added products of litchi like; litchi drink/juice, litchi whole *(Rasagolla)* and litchi squash in the state itself in the brand names of litchika international and suman-vatika. Besides, there are 4 to 5 processors which are found working in preparation of litchi pulp and concentrates. The major constraints in processing are lack of capital, skilled technicians/manpower, technology, uncertainly in production, high cost of production due to poor technology, lack of processors' syndicate etc.

5.2 Objectives of the Study

i. *To study acreage, production and productivity of litchi in important states of India.*
ii. *To assess exports and export potential of litchi from India.*
iii. *To study the cost of production of litchi of alternate varieties in different production environment of the region.*
iv. *To study efficiency in post harvest operations of litchi in different market channel (local, national, international, processed litchi or litchi juice).*
v. *To study the role of institutions in production, marketing and exports of litchi.*
vi. *To identify constraints in efficient production, marketing and processing of litchi.*

5.3 Method, Sample and Coverage

The study is based on secondary and primary information and has adopted a multi-stage stratified random sampling technique to choose 90 sample farmers across the three sample districts i.e., Bhagalpur, Samastipur and East Champaran (Motihari).

Pre-harvest contractors (PHCs) are the most important players in the existing marketing channel of litchi. In all the three districts covered during the survey PHCs are an integral part of the system and more than 75.00 per cent of the litchi is marketed through them. They were identified in each of the selected districts with the help of litchi growers. Of them, 3 in each district were chosen for interrogation with the help of an interview schedule. Besides, 3 each wholesalers and retailers from each of the selected districts were also chosen.

Analytical technique uses different technique to measure different concepts of marketing used in the study. The concepts used are based on measuring price spread, market margin, market efficiency, etc. Ranking of Problems of respondents have been worked out by Garret's method.

5.4 Major Findings

- Out of selected 90 litchi growing households in the state, 36 (40.00%) were small farmers with operational holdings less than 2 hectares, 31 (34.44%) were medium farmers with operational area of 2-5 hectares; and rest 23 (25.56%) were large farmers operating above 5 hectares of land. The social classification of the sample households was 54.44 per cent from general castes followed by 43.33 per cent from OBCs and only 2.23 per cent from SCs. No STs were reported among the sample. On the educational status 28.89 per cent were graduate followed by 26.67 per cent matriculate, 20.00 per cent literate, 15.56 per cent intermediate, 5.56 per cent post-graduate and 3.00 per cent illiterate at the overall level. On an average, household size was 5.81 members and it was lowest (5.67) in East Champaran and highest (6.07) in Samastipur. More than 75.00 per cent of the selected households at the overall level primarily belonged to farming alone. The other occupations like service (12.22%) and business/trade (11.11%).

- As regards the income at the overall level, about 67.16 was earned from the cultivation of crops including the litchi orchards followed by 14.03 per cent from other sources i.e., service (private and public sectors) and pensions; 7.47 per cent from the livestock sector; 7.46 per cent from off-farm sector; 2.68 per cent from non-farm sector and 1.20 per cent from remittances out of migration of their family members. It reveals that crop cultivation was the major source of earnings of the sample households at the overall level. Across the sample districts, crop cultivation was also the major source of income.

- The employment pattern of the sample households was almost similar to the income pattern. It was largely from the crop cultivation (44.33%) followed by non-farm sector (15.60%), livestock (10.68%), others (10.02%), off-farm (9.85%) and migration (9.52%). Across the districts, the crop cultivation was the largest source of employment of household members.

- Among the crops grown by the selected farmers at the overall level, the proportion of different crops show that cereals (paddy+maize+wheat) contributed largely in East Champaran (52.45%) followed by Samastipur (44.63%) and Bhagalpur (36.27%) of the gross cropped area. Except in Bhagalpur, litchi orchard occupied next position with 38.16 per cent in Samastipur, 31.84 per cent in East Champaran and 41.08 per cent in Bhagalpur. It is interesting to know that across the all farm sizes concentration on horticultural crops was high compared to kharif and rabi crops. It is perhaps due to high cost of crop cultivation compared to

horticultural crops, wherein there is little operational costs because of increased role of pre-harvest contractors (PHCs) and middlemen.

- At the total farmers, per household credit was measured at Rs. 8922 , Rs. 12341 and Rs. 17583 in Samastipur, Bhagalpur and East Champaran districts that varied from Rs. 4167 in case of small farm households in Samastipur district to Rs. 25661 in case of large farm households in East Champaran district. Among different sources of credit, institutional credit constituted the major amount around 80 to 84 per cent and non-institutional had only 16-20 per cent. Among the non-institutional sources moneylenders occupied the largest share among different categories of farm households. Whereas large farm households had around 85-93 per cent credit from the institutional sources, marginal farmers were lesser ones who had 50-67 per cent except one exception in East Champaran district, share from the institutional sources. Examining the credit taken by purpose, it was observed that a major part of the loans were spent in productive activities like farming. However, while the large farm households used proportionately higher amounts of loans for productive purposes, the small and medium farm households were found spending proportionately higher amount of non-productive purposes like daily consumption, illness, social and family ceremonies.

- Out of 3 selected districts, Shahi and China varieties are grown in Samastipur and East Champaran districts whereas Manraji and Desi varieties are grown in Bhagalpur district. Among Small farms, on an average 0.53 hectare of area is under litchi crop in Samastipur & East Champaran districts. Per household area under litchi in the case of medium and large farm households are 1.29 ha & 2.92 ha and 1.57 ha & 3.17 ha in East Champaran and Samastipur districts. On overall basis, 1.36 hectares of area are under litchi in Bhagalpur, 1.56 hectares and 1.53 hectares are in East Champaran and Samastipur districts. The variety wise cost and return analysis on cultivation of litchi are as below:

- Shahi is the most popular cultivar of north Bihar particularly in Tirhut and Darbhanga divisions of Bihar. On average, per hectare cost of cultivation of shahi litchi was measured at Rs. 22638 and Rs. 24232 in East Champaran and Samastipur districts respectively. Out of the total costs, labour cost was 45.74 per cent in Samastipur and 50.40 per cent in East Chamaparan district. It was followed by cost on watch & guard (18 to 19%), materials (16 to 18%), irrigation (9 to 11%) and tillage of orchard (about 5%). Across the farm size categories except watch and guard small farmers incurred higher amount on tillage, materials, labour and irrigation whereas medium and large farmers

had better in terms of cost in both the districts. Besides, the total cost was lower on small farmers compared to medium and large farmers. It had almost increasing trend except one exception in Samastipur district. Thus, it is difficult to conclude any specific category of farmers having advantage in cultivation of Shahi variety of litchi over the other categories. Looking at the profitability per hectare, the total and net revenue/return obtained by the farmers by selling their fruit exceeded the total cost among all categories of farmers without any exception. However, these were lower on small farms compared to medium and large farmers. The cost benefit ratio had also not definite trend across the farms. But it was more than three times across all the farms.

- China is also one of the best cultivar of litchi in north Bihar. Its shape and size is comparatively better than shahi variety but in terms of aroma, it is next to shahi. Per hectare total cost was Rs. 17948 and Rs. 21019 in East Champaran and Samastipur districts respectively. On total farms the share of labour cost (50 to 53%) was larger followed by expenses on materials (17%) and watch & guard (14 to 18%), irrigation (9 to 10%) and tillage of orchard (5 to 6 %). The expenses on labour component were in increasing trend as according to farm sizes in Samastipur district whereas that of decreasing in East Champaran district. In fact, there was no definite trend in terms of expenses made on different items for cultivation of china variety of litchi across the farmers. The net returns from china variety of litchi turned out Rs. 82192 in Samastipur and that of Rs. 59133 in East Champaran districts. It had increasing trend across the farms with the increase of its sizes. The profitability ratio per hectare was measured at 1:3.91 in Samastipur and 1:3.29 in East Champaran districts. Across the farm it varied but it was more than 3 to 4 times over the total cost of production.

- Manraji is one of the cultivar of litchi in north-eastern region of Bihar particularly in Bhagalpur region. It bears alternatively. Its colour is deep pink and of medium size with medium level of fragrance. The major component of the cost was laour across all size groups of the farmers, which accounted for 48 to 49 per cent of the total cost of cultivation per hectare. Materials cost was found to be the second major item, which accounted for about 24 to 26 per cent. Watch & Gurad, orchard tillage and irrigational costs were next to labour and material components of the total variable cost. The labour cost was as low as Rs. 7124 per hectare in case of small farmers whereas it was Rs. 9456 per hectare in case of large farms and Rs. 9556 per ha in case of medium farms. The total cost of cultivation was measured at Rs.

17429 per ha. It was as high as Rs. 19612 per ha for large farmers whereas it was Rs. 14686 per ha for small farmers. Among the categories of farmers, the highest net returns of Rs. 68502 per hectare were realized by large farmers and the lowest Rs. 55452 per hectare was obtained by the marginal farmers. The medium farmers made net returns of Rs. 59882 per hectare. But the net returns on cultivation of shahi & china varieties of litchi were higher compared to the net returns on cultivation of manraji variety of litchi.

- Desi is an indigenous variety of litchi cultivated extensively in Bhagalpur region. It bears every year. The total cost incurred towards the cultivation of desi variety of litchi per hectare was Rs. 16205 at the aggregate level. Across the farmers, it was found increasing with the increase of farm sizes. The highest total cost towards the cultivation of desi litchi was incurred by the large farmers, which accounted for Rs. 18729 per hectare whereas the lowest cost to the tune of Rs. 13838 per hectare was incurred by the small farms. The share of labour cost was highest in the total cost at the aggregate level which accounted for 50.67 per cent followed similar share as was the case of other varieties of litchi. The net return was calculated at Rs. 61062 at the aggregate level. It was higher at large farmers (Rs. 69992) and lower in case of marginal farmers (Rs. 64568) and small farmers (Rs. 53973).

- About 26 to 33 per cent of the sample households at aggregate level was received technological guidance through the extension workers of the state agriculture department i.e., Kisan Salahkar. The private agencies like; input dealers and KVK scientists also provided technological backup to the sample households at the aggregate level by about 26 to 33 per cent and 23 per cent respectively across the sample districts. Progressive farmers had equally played a significant role in providing technological knowledge to the sample households. They provided help to 20 to 30 per cent of the sample farmers. Relatives/friends were next to progressive farmers for technical backstopping to the sample farmers. The role of state agriculture officers does not appear significant. It is interesting to clear here that there was not a single source, which provided technological back to more than one third of sample litchi growers.

- There are three different stages between inflorescence to maturity of perishability of litchi fruits. It was observed that between inflorescence and flowering, which usually becomes during February-March months, litchi perished between 7.75 to 9.50 per cent due to pest and biotic pressure and between 3.25 to 5.50 per cent due to temperature and biotic pressure across

the sample districts. Similarly between flowering and fruit bearing stage, the larger the volume of production was perished due to heat waves and winds (Easterly winds) i.e., 8.75 to 11.75 per cent across the sample districts. Between fruit bearing and maturity stage (in the month of May), temperature i.e., long stretch of westerly winds (6 to 8.25 %) caused main factor for perishability of the fruit. It is to be noted here that heat waves and winds (Easterly & Westerly during February & April-May respectively) are the major reasons for larger perishability of litchi fruit.

- The prices' trend during 24th May to 21st June (27 days) period in local and regional market as well during 2014 reveal that the prices of shahi litchi was higher since the start of season to the end of the season compared to other varieties of litchi in local and regional markets both. During the peak marketing period, it was Rs. 90 to 100 per hundred piece of litchi, subsequently the price rose to Rs. 110 per hundred in and around 14th June and its price at departure time was Rs. 150/- hundred. The price of other varieties of litchi was found lower to shahi litchi. The availability of litchi is suddenly vanishes from the market after 21-22 June. During its glut, the prices are not abruptly high.

- The total average production was estimated at 74.32 qtl. in Bhagalpur, 100.24 qtl in East Champaran and 95.30 qtl in Samastipur districts. In Bhagalpur district, out of total average production 3.21 qtl (4.32%) was used for family consumption, 3.58 qtl (4.82%) for labour payment, 2.89 qtl (3.85%) for miscellaneous consumption and 2.27 qtl (3.05%) wastage in orchards before selling it. This way the total average consumption was calculated at 11.95 qtl (16.08%) and the net marketed surplus of the fruits was about 83.92 per cent (62.37 qtl). Similarly in East Champaran district, out of the total average production 100.24, about 13.58 per cent was the consumptions on different accounts and the net marketed surplus was 86.63 per cent (86.63 qtl). In Samastipur district, the net marketed surplus was 82.83 per cent (78.93 qtl) out of its total average production of 95.30 qtl. It showed that the net marketed surplus on total farms was 82 to 86 per cent across the sample districts. Thus, unlike other agricultural produce, the net marketed surplus of litchi is quite high. It is due to low shelf-life of fruits in general and litchi in particular.

- There are mainly five stages of perishing/wastage before selling it to the consumers. These stages are between plucking and packaging, during transportation between loading and unloading, between unloading and sale

in wholesale market, sale in wholesale and retail market. The data showed that the litchi is perished from 16.25 per cent to 19.50 per cent of the total marketable surplus during plucking to sale in retail market across the sample districts. It was higher in East Champaran district (19.50%) and lower in Bhagalpur district (16.25%).

- Some common marketing channels for marketing of litchi have been identified as follows in across the sample districts:

Channel I: *Growers ---PHC---Wholesale Buyers--- Retail Traders--- Consumers (G-PHC-WB-RT-C)*

Channel II: *Growers--- Wholesale Buyers--- Retail Traders--- Consumer (G-WB-RT-C)*

Channel III: *Growers--- PHC--- Wholesale Buyers (Through CA) --- Retail Traders--- Consumer (G-PHC-WB-RT-C)*

Channel IV: *Growers---PHC--- Commission Agents--- Retail Traders--- Consumer (G-PHC-CA-RT-C)*

Channel V: *Growers--- PHC--- Middlemen--- Export Merchants (G-PHC-MM-EM)*

Channel VI: *Growers---PHC---Processing Industry (G-PHC-PI)*

Channel VII: *Growers---Processing Industry (G-PI)*

Disposal of litchi by different size of farms household of the total, first four channels are major and common in litchi marketing and remaining three channels (V, VI & VII) are for export and processing purposes. The total litchi was disposed by all the sample household was 6812.53 quintals. Out of it the share of small farm households was just 9.02 per cent, medium farms by 32.09 per cent and large farms by 58.89 per cent. The disposal was higher in Samastipur district (34.37%) and lower in Bhagalpur district (27.47%). The table further indicates that the overall litchi sold through different channels during the reference year was 2928.70 quintals (42.99%), 759.59 quintals (11.15%), 1301.88 qtls (19.11%), 976.24 qtls (14.33%), 542.28 qtls (7.96%), 108.32 qtls (1.59%) and 195.52 qtls (2.87%) in channels I, II, III, IV, V, VI & VII respectively. The prominent marketing channels were – I, III, IV & II at all farms. The district wise analysis reveals that the most prominent channel was channel No. I through which 36 to 53 per cent of litchi was disposed. The first four channels were meant for raw sale of litchi through different market functionaries from growers to consumers, while channel – V was sale of litchi for exports, accounting for only 7.96 per cent and channels VI & VII sale of litchi were for processing industries, accounting for 4.46 per cent. Across the sample districts, no sale was found either to exporters or processing industries in Bhagalpur district, because of the litchi cultivated here is not of exportable quality and complete absence of processing units in the area respectively. Since most of processing units and exporters of litchi fruits

are localized in north-Bihar, so in East Champaran and Samastipur about 13 per cent and 9 per cent respectively of the litchi were marketed through the channel No. – V and a lump-sum 5 per cent to 8 per cent of litchi were disposed through the channel No. VI & VII in East Champaran and Samastipur districts for exports and processing units respectively.

- As regard the price spread in channel-I *(Growers-Pre-harvest Contractor-Wholesale Buyers-Retail Traders-Consumers),* the overall average producer's share in consumer's rupee was only 26.39 per cent. The average components of price spread like cost incurred by PHC was 4 per cent per 1000 litchi and a net margin retained by the PHC in this channel was 18.72 per cent (Rs. 168.50) of consumer's price. The cost incurred by the wholesalers was 5.11 per cent (Rs. 46) and a net margin retained by the wholesalers was 11.55 per cent (Rs. 104) of consumer's price. Wholesaler's sale price was calculated at Rs. 592 per thousand piece of litchi. The cost incurred by the retailers was 8.56 per cent (Rs. 77) of consumer's price and the net margin of the retailers was 25.67 per cent (Rs. 231). The consumer's price was Rs.900 per thousand litchi. It reveals that the net margin of the retailers was almost equal to the net price received by the producer.

  In channel-II *(Growers---Wholesale Buyers---Retail traders--- Consumers),* the overall average producer's share in consumer's rupee was 50.54 per cent (447.75). In this channel producers sell their produce to the wholesalers who incurred a cost by 7.40 per cent (Rs. 65.60). A net margin of 12.31 per cent (Rs. 109.10) of the consumer's price was retained by the wholesalers. The cost incurred by the retailers was 10.72 per cent (Rs. 95) and a net margin of the retailers was 19.03 per cent (Rs. 168.55). The consumer's price was Rs. 886. Hence the producer's share was higher in this channel compared to other channels of litchi marketing.

  In channel-III *(Growers---PHC---Wholesale Buyers (through CA) --- Retail Traders--- Consumer),* the producer's share was higher compared to channel-I. In this channel, the producer's share in consumer's rupee was 35.02 per cent (Rs. 265). Producers sell their produce to PHC, who incurred a cost of 5.55 per cent (Rs. 42) of consumer's rupee and a net margin retailed by the PHC was 14.47 per cent (Rs. 109.50) of consumer's rupee. The cost incurred by wholesale buyers was 6.47 per cent (Rs. 49) and a net margin retained by the wholesalers was 8.59 per cent (Rs. 65) of consumer's price. The cost incurred by the retailers was 11 per cent (Rs. 84) of consumer's price and a net margin

was 18.80 per cent (Rs. 142.30). It is evident in this channel that wherein PHC is one of intermediaries, the net margin of the producer is lower.

In Channel –IV *(Growers---PHC ---CA --- Retail traders --- Consumer),* the overall average producer's share in consumer's rupee was 43.63 per cent (Rs. 361.75). The average components of price spread like cost incurred by the PHC was 6.63 per cent (Rs. 55) and a net margin retained by the PHC in this channel was 11.49 per cent (Rs. 95.25). The PHC sold the produce to the retailers through the commission agents (CA). In this channel the produce does not enter into the wholesale market rather CA facilitates the sale directly to the retailers. Thus, the cost incurred by CA was 6.15 per cent (Rs. 51) and a net margin was retained by CA was 6.88 per cent (Rs. 57). It clearly reveals that the CA's cost and margin both were lower compared to the wholesalers, who used to trade in channels I, II & III. The cost incurred by the retailers and the net margin of the retailers in this channel were also lower compared to channel Nos. I, II & III. This is due to selling of the produce mainly is local market. However, through this channel at the overall level only 7.96 per cent of the marketed surplus of litchi was disposed.

In Channel – V *(Growers --- PHC --- Middlemen--- Export Merchants --- Wholesaler --- Retailer --- Consumer),* the path of litchi marketing is producer to exporters through PHC & Middlemen and then to consumer through wholesaler and retailer. The producr's share in Export merchant's price was 42.44 per cent (Rs. 448). It is higher compared to four preceding channels. It is also to clear here that this channel is meant for export of litchi, accounting for 1.59 per cent of the total disposed/marketed volume, general of 'A' grade litchi. The average components of price spread in this channel like cost incurred by PHC was 2.66 per cent (Rs. 23) and a net margin retained by the PHC was 12.94 per cent (Rs. 112) of the Export merchant's price. PHC sold the produce to the Export merchants through the CA and the cost incurred by the CA was 1.62 per cent (Rs. 14). The cost incurred by the Export merchant like; packaging and transporting was 9.01 per cent (Rs. 78) and a net margin was retained by the export merchant was 17.29 per cent (Rs. 149). The overall export merchant's sale price was Rs. 865.50, who sends the consignment to abroad for selling it to the consumers either through his/her brand name or the brand of others.

Channel Nos. VI & VII are meant for marketing of 'B' or 'C' grade litchi to the processers either though PHC or by selling directly to the processors. In channel VI on overall the producer gets 41.07 per cent (Rs. 232) of the

processor's price whereas in VII it was 47.93 per cent (Rs. 239). Producer get higher share of processor's price in channel – VII compared to channel – VI mainly due to absence of any intermediate market functionaries between the producer and processors. In channel-VI producer sold their produce to PHC, who incurred a cost of 6.19 per cent of the processor's price and a net margin was retained by the PHC was 9.74 per cent (Rs. 55). The cost of processing was 23 per cent (Rs. 130) of the processor's price and retained a margin by the processors was 20.00 per cent (Rs. 113). This way the processor gets the raw fruits of litchi from the producers for its processing. In channel – VII the share of cost and the margin of the processor was a bit higher compared to the channel-VI. But in channel – VII, producer gets higher share of the processor's price. In both the channels processors after processing into various products like, canned fruits/juices, squash, jam, jelly, drinks etc. sold through its distributors (outside Bihar) spread in big cities are of the country. But it is to be pointed out here that litchi is negligibly exploited at the post-harvest level for processing and value addition of fruits. In recent days consumer prefer fruits in raw form compared to value added products. The study also found that at the overall level less than 5 per cent of total disposed quantity was sold through these two channels. Actually, processing has become compulsory for use of B and C grade litchi, which are not liked to consume in raw form.

- A comparison of marketing efficiency measures as worked out by three different methods. The conventional method (E) suggests that channel-I is more efficient than III, II & IV. It is to be noted here that price received by the producer in channel – I is lowest. Hence, this method is not suitable. If marketing margins are not included as a part of marketing cost, the Shephered's method (ME) suggests that channel – I is more efficient than the channel Nos. II, IV & III. The limitation of this method, as mentioned earlier, is that it does not take into consideration the price received by the producer. The limitations of both these methods are taken care by the modified method suggested by Acharya. According to Acharya's method (MME), Channel-II is more efficient than channel-IV, III & I.

- Among the production constraints as according to Garret's ranking; lack of quality insecticide/pesticide got the first rank at the overall level followed by poor electric supply with low voltage, lack of moisture in the orchard due to wide function in temperature, lack of quality manure/fertilizer/bio-fertilizer, lack of skilled labour, lack of promotional support from the government, lack of irrigational facilities, older orchards, complexities in availing institutional

credit and lack of technical guidance. Across the sample districts, lack of quality insecticide/pesticide, poor electric supply with low voltage and lack of moisture in the orchard due to wide fluctuation in temperature got first, second and third rank respectively in Bhagalpur district; whereas lack of moisture in the orchard due to wide fluctuation in temperature, lack of quality manure/fertilizer/bio-fertilizer and lack of promotional support respectively in East Champaran district and lack of quality insecticide/pesticide, poor electric supply with low voltage and lack of moisture in the orchard due to wide fluctuation in temperature respectively in Samastipur district.

- As according to Garret's ranking the problems perceived by the sample farmers in marketing of litchi, presence of exploitative middlemen/gaddidar (in wholesale market) got the Garret's first rank at the overall level as well as in Bhagalpur and Samastipur districts both. Un-remunerative price received by the growers got the second rank at the overall level followed by high transportation charges by road, lack of cool chain, lack of storage facility, forced sell to pre-harvest contractor due to absence of market, variation in commission in local/regional wholesale market, lack of security, lack of producers' syndicate for marketing (like; Uttarakhand) and lack of skilled labour for post-harvest operations. Across the districts, the exploitative behavior of middlemen/gaddidar prominently figured constraint particularly when bulk fruits arrived in the market.

- In all the three sampled districts covered during the survey, PHCs are an integral part of the system and about 85.98 per cent of litchi is marketed through them. Out of total disposal (6812.53 qtls) of litchi made through different marketing channels in the sample districts, 5857.42 qtls (85.98%) of litchi was marketed through the PHCs. And out of the total volume of litchi marketed by the PHCs, the share in East Champaran district (37.88%) was larger followed by Samastipur (34.34%) and Bhagalpur (27.78%). The data further reveals that across the districts, the PHCs have marketed the litchi at around 85 to 86 per cent of the total volume of disposal.

- Wholesalers are one of the important market functionaries in marketing of litchi in Bihar. In the surveyed area, most of the wholesalers are found working/engaged in the local city and regional mandis/markets. They used to act in the market through the commission agents of the respective markets. In the prevailing marketing channels, wholesalers were found involved in channel Nos. I, II & III. Through these channels, about 73.24 per cent of the

total disposal of the produce at the overall level was marketed by the wholesalers. So, they play a significant role in marketing of litchi in Bihar. The district wise analysis reveals that 83.06 per cent, 71.96 per cent and 66.85 per cent of the total disposal of produce in the respective districts of Bhagalpur, East Champaran and Samastipur are marketed through the wholesalers. The wholesalers' net margin was estimated at 6.88 per cent to 12.31 per cent of the consumer's price across the existing marketing channels.

- Retailers buy litchi from wholesalers and sell them to the consumers in small quantities. They are personal representatives to consumers. Retailers are closest to consumers in the existing marketing channels. In the surveyed districts, out of seven existing marketing channels, retailers perform their functions in the first four channels. In Bhagalpur district, the total disposed volume of litchi was marketed through them, where as that in East Champaran and Samastipur districts were about 82.32 per cent and 83.48 through the retailers. At the overall level, about 87.58 per cent of the total quantity of disposal was marketed through the retailers. As regards the margin of the retailers is concerned, it was 16.54 per cent to 25.67 per cent of the consumer's price across the identified marketing channels.

- Poor transport conditions are major bottleneck not only in Bihar but in Asia. The main limitations are: rough roads, lack of refrigeration and poor truck suspension, which are beyond the control of growers. About 40 per cent of litchi fruits lose their freshness in the form of decolourization of peel while marketed in Delhi and 40-50 per cent of marketable form of litchi reached Mumbai/Pune markets. According to some progressive farmers, trucks used to charge Rs. 35,000 for carrying 500 boxes of litchi from Bhagalpur to Delhi/Jaipur as against Rs. 25,000 charged for transporting other goods. Similarly the truck used to charge Rs. 25,000 to Rs. 30,000 from Muzaffarpur/Samastipur to Delhi as against Rs. 15,000 to Rs. 20,000 for other goods. The railways do not provide facilities for transporting litchi by attaching goods wagon for this specific purpose to Delhi/Mumbai bounds trains from Bhagalpur. According to some growers in Bhagalpur district, railways had given one bogie at Bihpur Railway Station (Bhagalpur district), but later on it was withdrawn. They wanted attachment of at least two bogies for Delhi, Gorakhpur, Varanasi etc. in respective trains on daily basis during the litchi season. In Muzaffarpur, the railways provide facilities for transporting litchi by attaching bogies to Delhi bound trains on daily basis, but the desired impact of its initiative is yet to be felt at the field level, for want of loading facilities at Muzaffarpur railway station. So, keeping in view

the high perishability of litchi fruits, railways should provide the facilities of attaching one or two bogies from those railway stations, where the concentration of litchi is higher in Bihar. This will be a big help to the growers of litchi in terms of fancy prices for the fancy and pride horticultural produce of Bihar.

- The overall constraints as perceived by the sample processors (covered as six Case Studies) are mainly **Climatic;** Growing temperature pressure on litchi cultivation, Low shelf-life, Lack of climatic resistant varieties etc. **Marketing;** Lack of cool-chains either at Airport or Railway Stations**,** Lack of producers' as well as processors' syndicate, Absence of information network to keep track of raw materials prices and availability, etc. **Technical;** Untrained labourers, technicians and chemists, Lack of technical knowledge of primary processors at village level for litchi, as litchi is highly susceptible to health hazards etc. **Infrastructural;** Low supply of electricity (avg. 10 hrs.) with low voltage, Shortage of capital**,** High hiring charges for Ref. Van. Lack of markets for procurement of litchi, resulted to growing role of middlemen, Lack of control and non-temperature control pack houses etc. **Others;** Difficulties to assess policy benefits due to procedural bottlenecks, Non-transparency in credit facilities, Reducing amount of subsidy on Ref. Van, Low concentration of litchi processors, Sporadic upcoming of petty processors at the village level, Non-availability of a variety of horticultural produces in the region to run the factories round the year**,** Illegal practices of petty village level primary processors of litchi etc.

5.5 Recommendations

The study recognizes the immense scope for development in production and productivity, marketing and processing of litchi in Bihar in general and in the sample districts in particular to take the advantage of favourable agro-climatic conditions unique to litchi cultivation. A lot of emphasis is given to the information dissemination and awareness on technical aspects pertaining to cultivation and post harvest practices considering the exacting nature of the produce. Also, an attempt has been made on the basis of field survey to suggest possible interventions and policy implications relevant at this juncture. The following are few pointers towards potential areas for interventions:

5..5.1 Production

- ✓ Efforts for improvement of cultivars through traditional and modern tools (bio-tech, bio-informatics, genetic engineering) for higher quality production and productivity may be synchronized.
- ✓ Improved integrated management system for nutrients, water, insect pests and disease should be promoted/encouraged.
- ✓ Dissemination of information for elimination of skepticism about adaptation of recommended practices for cultivation of litchi.
- ✓ Strengthening of extension mechanism in order to educate orchardists as well as PHCs on best package of practices.
- ✓ Organise field visits for orchard owners into groups for making headway in terms of technology adaptation and scientific orchard management.
- ✓ Skill upgradation of labours in pre-harvest management.
- ✓ Facilities for soil testing and other lab analysis should be extended to all litchi growers.
- ✓ In place of prevailing procedural complexities in availing institutional credit an inviting and transparent system may be explored.
- ✓ Rejuvenation of old orchards should be taken on priority basis.
- ✓ Insurance coverage of the orchards and compensation to the damage of the crops due to natural calamities may be extended.
- ✓ Sale of quality inputs with reasonable price tag should be ensured.
- ✓ Since litchi occupies an important place in the horticulture landscape of Bihar owing to its 'geographic confinement' with primary locations of Muzaffarpur, Samastipur, Vaishali, East Champaran & West Champaran, so a 'Litchi Hub' comprising these locations may be declared/created with suitable package for enhancing the production and productivity.
- ✓ Formation of grower's syndicate (as it is in Uttarakhand) may be encouraged.

5.5.2 Marketing

- ✓ Awareness campaigns should be organized to disseminate information on the distant markets, export markets with product specifications.
- ✓ Skill upgradation of labours in post-harvest management for better sorting, grading, packaging etc. should be arranged.
- ✓ Pack houses with pre-cooling chambers at few major production clusters may be established to ensure first cooling within 5-6 hours of harvest.
- ✓ Cool chain facilities should be established.
- ✓ In free unregulated market for agricultural and horticultural produce multipurpose markets should be encouraged where farmers can sell their produce and also get other production and post production related facilities.

- ✓ Other infrastructural facilities like fair roads, transport (road, rail, air and cargo), electricity etc. may be strengthened.
- ✓ Intensification of Police Patrol should be ensured during litchi season in the area of its concentration (particularly in Bhagalpur region).

5.5.3 Processing

- ✓ Timely availability of finance and incentives, dovetailing with on-going schemes are the need of hour for entrepreneurs venturing into specific interventions like refer vans, pack houses, processing facilities etc and its tracking may be made on-line/e-route.
- ✓ The success stories at various levels for example successful farmers, PHCs, traders; processors etc. should be documented in order to evoke a sense of pride within the stakeholders.
- ✓ Skill upgradation programme for local technicians/chemists may be launched.
- ✓ Illegal practices of primary processing units generally found at village level should be stopped because these units don't follow the HACCP, SPS & TQM norms to ensure quality for high degree of confidence in national and international markets.
- ✓ Establishment of Tetra pack units (TPUs) may be promoted in and around Muzaffarpur & Vaishali regions like Jaipur, Pune & Mumbai. This will ease the marketing and processing issues of litchi products.

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Annexure – I

Review of Report on 'Supply Chain of Litchi Marketing and Processing in Bihar'

I. Author	:	Ranjan Kumar Sinha
II. Institutional Affiliation	:	AERC for Bihar & Jharkhand, Bhagalpur
III. Date of Receipt of Report	**:**	**October 5, 2015**
IV. Date of Dispatch of comments:		**October 15, 2015**

V. General Comments: Though litchi in Bihar in recent decade has increased concerns of researchers and policy makers, some questions related to litchi production and processing remains. To address some of these questions the present study was undertaken. The coordinator of study has sent research proposal, questionnaires, likely chapter details and table formats related to the above study. The report to some extent adheres to these details. The draft report after one and half years of initiation of study also addresses few of these questions. However the comments below are in the nature of increasing presentation of the existing report.

VI. Comments on Draft Report

6a. Some of texts presented in the report are not referred adequately.

It appears that report is benefited from studies like Report of Good Management Practices in Litchi (Singh et al. 2011), Vision 2030 (NRC on litchi, Mzpur), etc.. If the report under review is taking more than seven lines of any of these publications, please give due credit to these authors by referring their publications.

6b. Some information presented in report as text or tables does not mention source (litchi is negligibly exploited in post harvest operation in page no.11, etc.), sometimes not even context (64% of litchi from Muzaffarpur in the country in page no. 41).

6c. Some references written in the texts are not presented in Reference, towards the end of the report, for example Shephard (1965), Acharya & Agarwal (2001), Woodworth (1969), etc..

6d. Some figures in tables and trends are not explained adequately. Examples are following:

It appears from Table 3.3 that importance of litchi orchards in cropping pattern of farmers is decreasing according to the size group of farmers.

In Table 3.7, a positive relationship between farm size and return is evident. Return across districts in the report is significantly different.

Similarly in Table 3.16, how different size group of farmers are choosing different marketing channels?

In relation to perishability (Table 3.15) figures in report appear downward in relation to widely perceived belief based on various studies about wastage of fruits. Please review and explain.

6e. The most of constraints faced by different market functionaries (PHCs, processors, etc.) are written with minimum words. These constraints need to be explained adequately to understand exactly constraints of functionaries in your study area / Bihar.

6f. In section on constraints, quality related to unorganized processing has become important but any discussion about unorganized processing is lacking in the report. Though, its growth in the light of dearth of organized manufacturing is not unexpected.

6g. Kindly note that title of report contains 'processing' the report under review is weak on processing. In fact your centre's research study no. 26 on Understanding the growth and prospects of agro-processing industries in Bihar by Jha, Sinha and Mishra is very useful in the present context. Updating some of information, tables will be useful for the study.

In the existing report chapter on conclusion and policy direction has to be brief. There is no need to describe study area, sampling details etc. in the chapter on conclusions. Similarly, length of findings has to be reduced substantially in the chapter to make it brief.

Though report is well written, some of editing problems creeps in any report. A glance after some interval may reduce many of editing related problems in report. The investigator may note that the length of paragraph should not exceed beyond 14 lines.

The above points may be noted while finalizing the report under review.

Dated: 15.10.2015

Brajesh Jha
IEG, Delhi

Annexure – II

Action Taken Report (ATR)

I.	Title of the Study	:	Supply Chain of Litchi Marketing and Processing in Bihar
II.	Date of Dispatch of the Draft Report	:	19 Sept., 2015
III.	Date of Receipt of the Comments	:	16 October, 2015

IV. The draft study design along with 5 sets of questionnaire/interview schedule was discussed and finalized with the MoFPI, Government of India on 07/04/2014 at New Delhi. In June-July, 2014 field work initiated. In April, 2015 the Centre received the likely structure of the report along with table design etc. The draft report submitted within 05 months after the receipt of structure of the report etc. Briefly addresses all of the questions mentioned.

V. Actions taken on the comments on Draft Report:

6 (a) Incorporated in the 'Reference.'
6 (b) Reference incorporated.
6 (c) Incorporated in the 'Reference.'
6 (d) Incorporated in section 4.3

Return across districts is significantly different mainly because of differences in varieties, which have been separately discussed in sections in 4.6.1, 4.6.2, 4.6.3, and; 4.6.4

In relation to perishability, some studies have been reviewed and explained in section 4.11.

6 (e) Incorporated in section 4.16 & 4.20.
6 (f) Discussed briefly in section 4.21.
6 (g) A new chapter entitled "Status of Food Processing Industries in Bihar" has been added as Chapter – II.

Briefly reduced.

Ranjan Kumar Sinha
Research Officer-Cum-Project Leader

AER Centre
Bhagalpur,
BIHAR
07/11/2015

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