

EXECUTIVE SUMMARY

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, Madagascar, 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 A₁B₁ & B₂ 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 is 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 ambient temperature within 24-36 hours after plucking, in order to retain its desired colour. The supply chain from farm to final 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, uncertainty in production, high cost of production due to poor technology, lack of processors' syndicate etc.

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.*

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.

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 retained 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 producer'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 clear here that this channel is meant for export of litchi, accounting for 1.59 per cent of the total disposed/marked 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 processors either through 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 Shepherd'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 fluctuation 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 bound 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.

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:

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.

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).

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.
