Analyzing the Potential of Increase in Acreage for Kinnow, Maize, Wood, Turmeric and Moong as per the Draft Agriculture Policy for Punjab-2013

“The farmer is the only man in our economy who buys everything at retail, sells everything at wholesale, and pays the freight both ways.” --- John F. Kennedy

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Research Team at MIGM (ISB)

Principle Investigator: Prof. ManMohan S. Sodhi
Prof. Sodhi is the former executive director of MIGM. He is Professor of Operations and Supply Chain Management at Cass Business School, City University London. Professor Sodhi can be contacted at: M.Sodhi@city.ac.uk

Project Coordinator: Mr. Sukhmeet Singh
Sukhmeet is working as Associate Director at ISB (MIGM). He has done his Post Graduate Programme in Management (PGP) from ISB. He can be contacted at: sukhmeet_singh@isb.edu (+91-8146659318)

Research Team: Ms. Arvinder Walia, Ms. Jasmine Sharma and Mr. Preetinder Singh
Foreword

In view of agriculture sector crisis in Punjab, the importance of research in the realm of ecologically sound farming practices is foremost. While ecological sustainability is important, the economic viability for the farmer needs to be taken into account. In this context, Punjab Mandi Board commissioned Indian School of Business to undertake a research study analyzing the potential of increase in the production of selected five commodities as mentioned in the Agriculture Policy for Punjab-2013 (Draft) in terms of their existing markets and the potential to expand in the wake of proposed area expansion under alternate crops. Given the nature and magnitude of crisis in the farm sector in the state, this research is a pioneering attempt to critically analyze the diversification strategy recommended as per the Draft Policy.

I am greatly encouraged that this report will be of practical use to the policy makers looking at ways to better understand how the government can best implement the diversification strategy. I would like to congratulate the research team at MIGM, Indian School of Business for making an excellent start.

Dr. Deepinder Singh, IAS,
Secretary,
Punjab Mandi Board.
Executive Summary

Presently, the agricultural supply chain of kinnow, maize, turmeric, moong and wood is highly fragmented and inefficient due to low research & development, extension & training services, poor infrastructure for post-harvest management, underdeveloped distribution & marketing channels for farmers in having a direct access with the potential buyers. Besides this, for long- gestation commodities like wood and kinnow funding is a problem. Also there is a lack of consumer awareness for local varieties of commodities such as kinnow, maize’s use-based products, turmeric etc. As a result, farmers in Punjab have preferred the cultivation of paddy and wheat which have a well-developed value chain and minimum support price. Area expansion as proposed by the Agriculture Policy for Punjab-2013 (Draft) without addressing these constraints will be highly unsuccessful as it would prove to be an unprofitable venture for the farmers especially the small and marginal holders. Therefore this report analyses the possibility of expanding area under kinnow, maize, turmeric, moong and wood by looking at the demand and supply-side constraints.

For kinnow demand increase must be prioritized through active promotion based campaigns at a national level. The supply and production can be streamlined by providing adequate research and extension services besides fine-tuning the post-harvest management infrastructure through the augmentation of grading & waxing facilities and setting up processing facilities. Replication of citrus estates within Punjab will be important. Also exploring and promoting the alternate/processed products of kinnow is likely to increase demand.

For maize research and development across the value chain right from seeds to machinery need to be prioritized with adequate government support. Training on alternate cropping systems like wheat-maize-moong must be imparted as this system is water-saving and more profitable than wheat-paddy rotation. Besides farmer training on intercropping practices, there is a need to develop consumer awareness for maize varieties such as baby corn, popcorn and sweet corn. Further post-harvest management would require setting up of medium-sized facilities for drying and grading. Such facilities can be set up in common for few villages (say 10-20), for instance establishing maize estate on lines of a citrus estate on lines of a cooperative.
For wood there are no constraints on the demand side. However concerted efforts need to be made on the research and development front since awareness on intercropping methods and use of better quality planting materials is essential for better yield, production and returns. This can be done by imparting training and awareness on intercropping methods while ensuring the provision of quality seeds and raw materials at a subsidized rate. Initiatives by the state government through the Forest Department in collaboration with academic institutions will be very useful. Besides this, perennial crop loans for wood cultivation must be made available on easier terms to ensure economic certainty. Steps need to be taken to reduce the power of middlemen.

For turmeric post-harvest processing facilities need to provided for value addition/ processing of intermediates. This would ensure better returns by smoothing demand and reducing price volatility. With an increase in production; models such as FAPRO need to be expanded further across the state besides the establishment of turmeric estates to look into the entire value chain of turmeric. Also mobile boiling machines need to be set up in villages, as this would reduce farmers cost of transportation in getting his raw produce to the boiling facilities which are presently within the FAPRO premises only.

For moong the demand can be increased by establishing marketing channels for direct outsourcing by private players and provision for bulk procurement. Well-established market players such as MARKFED and Agriculture Technology Management Agency (ATMA) can ensure better procurement by providing an alternate marketing channel. The kisan hut model can be replicated across the state. On the supply side, research and development on improved/ high yield (disease resistant) seed variety and raw materials is required along with promotion of summer moong cultivation as a complimentary crop. For post-harvest; grinding, sorting and packaging facilities must be provided at all the mandis and even at a pre-mandi level (10-20 villages aggregated together).

Due to similar constraints being faced across commodities, a consistent approach is required instead of commodity-specific solutions. In view of this, multi-commodity aggregation of the produce at a pre-mandi level similar to citrus estates can offer common solutions. This can serve as an intermediation point between a village and a mandi for say 10-20 villages. This pre-mandi aggregation setting can be an extension of citrus estates and AgriMart with features such as
training & extension programmes, Punjab and even district-specific research on seed varieties, fertilizers and pesticides and common PHM infrastructure for multiple commodities. To ensure direct participation of the farmer in selling; buyers such as retailers, brokers and manufactures can also be attracted to these aggregation points by clustering the produce. Funding for the farmer can be facilitated by allying up with cooperative financial institutions supported by NABARD. Self help groups can also use these facilities for value addition and sale of products.
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1. INTRODUCTION

Punjab is under immense pressure as agriculture has started to slow down. With approximately 71 percent of the total gross cultivated area under wheat and rice only,\(^1\) there has been intensive land use leading to soil degradation and depletion of ground water. Besides exploitation of water resources, increased electricity consumption has strained the state exchequer to meet the cost of free power supply to the farm sector. At farmer level, imbalances in soil fertility have resulted in higher usage of inputs to maintain productivity levels. Such excessive application of chemicals has distorted the physical characteristics of soil resulting in massive degradation (Singh, 2012).\(^2\) Besides the environmental threats posed by the pre-dominant wheat-rice system; substantial marketing support from the government has worsened the current situation further. Hence pressures are being felt at both the state as well as the farmer level.

For the promotion of faster and sustainable agriculture growth in Punjab it is important to shift area under alternate crops such as fruits, vegetables and other food grains, namely maize, pulses and oilseeds, which would ensure economic competitiveness and optimal use of land and water. Such a policy effort is seen as extremely crucial in the current context wherein as a result of increasing per-capita income levels, demand for items such as dairy products, fruits and vegetables is increasing at a higher rate than demand for cereals and coarse grains.

A major step in this direction has been taken by the Punjab government to shift a major chunk (almost 40 percent) of its cultivable area under paddy to maize, oilseeds, pulses, fruits and vegetables over a time span of 5-7 years. The roadmap chalked out as regards diversification aims at diverting 12 lakh hectares of the area under paddy by bringing 4 lakh hectares under maize, 2 lakh hectares under cotton, 2 lakh hectares under basmati, 1.7 lakh hectares under sugarcane and 80,000 hectares under fruits and vegetables. The recommendations of Committee for Formulation of Agriculture Policy for Punjab in March 2013 named as Agriculture Policy for Punjab-2013 (APP-2013 Draft) has proposed alternate crop choices.

This report considers the implication of APP-2013 Draft and studies the constraints on kinnow, maize, wood, turmeric and maize. Our major findings are that the agricultural supply chain of these crops are highly fragmented and inefficient due to dearth of research and development, low

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\(^1\) [http://www.himalmag.com/component/content/article/1893-Paddy-wheat-and-Punjab-state.html](http://www.himalmag.com/component/content/article/1893-Paddy-wheat-and-Punjab-state.html)

extension/training services, inadequate post-harvest infrastructure and underdeveloped marketing channels. Therefore we recommend revisiting the entire value chain from the provision of research and extension services to providing adequate post-harvest management infrastructure to establishing well developed marketing and distribution channels.

Due to similar constraints being faced across commodities, a consistent approach is required instead of commodity-specific solutions. In view of this, multi-commodity aggregation of the produce at a pre-mandi level similar to citrus estates can offer common solutions. This can serve as an intermediation point between a village and a mandi for say 10-20 villages. This pre-mandi aggregation setting can be an extension of citrus estates and AgriMart with features such as training & extension programmes, Punjab and even district-specific research on seed varieties, fertilizers and pesticides and common PHM infrastructure for multiple commodities. To ensure direct participation of the farmer in selling; buyers such as retailers, brokers and manufactures can also be attracted to these aggregation points by clustering the produce. Funding for the farmer can be facilitated by allying up with cooperative financial institutions supported by NABARD. Self help groups can also use these facilities for value addition and sale of products.
2. BACKGROUND

Cultivation of wheat and paddy has resulted in large-scale depletion of ground water in Punjab with a very low water-use efficiency amounting to 3.7 per mm. As the cultivation of paddy increased from 3.9 lakh hectare in 1970-71 to 28.2 lakh hectare in 2011-12; the ground water level in a span of 30 years (1980-2010) has declined by more than 16 meters in central areas of Punjab while 8-12 meters in other pockets of Punjab (Sekhri, 2013). These agriculture practices have led to a continuous decline in agriculture growth rate in recent years whereby agriculture sector in Punjab has grown by a meager 1.7 percent on average from 2005-06 to 2011-12 with a negative growth rate of 0.05 percent in 2011-12. While neighboring states like Uttar Pradesh and Haryana have registered growth rates at 3.22 percent and 5.08 percent respectively in the same year (2011-12).³

This situation is largely due to the wheat-paddy cropping focus in the state which can be observed from the huge percentage (amounting to 95 percent) of reserved area under cereal production of which 97 percent of the area is under paddy and wheat cultivation only. Accordingly, the area under cultivation is miniscule for other cereals (Figure 2.1). Importantly, Punjab has not attained self-sufficiency in pulses and oilseeds with the changing consumption patterns of the population in favour of fruits and vegetables.

Figure 2.1: Total area under cultivation for alternate crops in Punjab: 2000-2010

![Graph showing area under cultivation for different crops](http://planningcommission.nic.in/data/datatable/2504/databook_44.pdf)

Source: Economic Adviser to Government of Punjab, various issues

³ [http://planningcommission.nic.in/data/datatable/2504/databook_44.pdf](http://planningcommission.nic.in/data/datatable/2504/databook_44.pdf)
Diversification in Punjab is also important because most of the rice consuming states in Eastern India have attained self-sufficiency for rice production. Moreover, as also highlighted by Economic Times Bureau in 2013:

“Shifting the area under cultivation to alternate crops for instance maize, mustard and cotton will help revive Punjab’s depleting water table, which is sinking by 33 centimeters annually.”

The agriculture diversification plan’s success or failure will largely depend upon how well is it accepted by the farmer in Punjab. There are two critical factors for this: Firstly, he will adopt the diversification plan only if it is more remunerative. As noted by Ashish Bahuguna, Agriculture Secretary of India:

“We will motivate farmers to go for alternative crops like maize, mustard and cotton. But for that we need to make them equally remunerative.”

According to the Chief Minister of Punjab, Prakash Singh Badal:

“Despite all the talk about diversification, nothing was being done to help the farmer to diversify. Farmers must be ensured remunerative prices and assured market for the alternate crops. Initiatives must be taken to promote agricultural-based industry, especially food, vegetable and fruit processing that can bring about diversification.”

Secondly, area diversification involves substantial price and income risk and is essential to provide economic support to the resource constrained farmers, who are in majority in the state (Table 2.1).

<table>
<thead>
<tr>
<th>Table 2.1: Size of landholdings in Punjab</th>
<th>2005-06</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small landholdings (1-2 hectares)</td>
<td>1.80 lakh</td>
<td>1.95 lakh</td>
</tr>
<tr>
<td>Marginal landholdings (upto 1 hectare)</td>
<td>1.34 lakh</td>
<td>1.64 lakh</td>
</tr>
<tr>
<td>Large landholdings (10 hectares and above)</td>
<td>70960</td>
<td>68642</td>
</tr>
</tbody>
</table>

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6 [http://ageconsearch.umn.edu/bitstream/57776/2/DrJogindersingh.pdf](http://ageconsearch.umn.edu/bitstream/57776/2/DrJogindersingh.pdf)
Area diversification plan however would have high rate of adoption only if it would ensure both lower income risk and higher levels of profits. This trade-off between certainty of income and profitability on a general scale can be understood by means of four alternatives:

Channel A (existing): High price risk with low profitability
Channel B: Low price risk with high profitability
Channel C: Low price risk with low profitability
Channel D: High price risk with high profitability.

Most efficient augmentation of existing channel would be a movement from channel A to B that ensures the satisfaction of the primary objectives of the farmer: higher profitability along with lower income uncertainty (Figure 2.2).

**Figure 2.2: Trade-off between certainty of income and profitability**

where  Channel B ensures higher income certainty with higher profits; Channel C ensures more stability in income but a compromise upon higher profitability; Channel D ensures higher profitability but without any income certainty.

Table 2.2 explains the risk-return trade-off between paddy and five proposed commodities under the diversification plan. The results reveal stability in the crop yield of wheat-paddy cycle in Punjab due to the existing minimum support price fixed by the Central Government on its procurement. In contrast, price instability in kinnow, turmeric and moong cycle is much higher in comparison to the paddy cycle. Amongst the proposed crops the monoculture in agricultural system of Punjab can be broken if we adopt: maize, wheat & summer moong cycle and/or wood
cycle (numbers for price risk of wood not shown in the figure above)\(^7\). As these are the only crops that ensure both lower price risk and greater profitability making it comparable to paddy’s zero price risk.

Table 2.2: Price risk and income risk for the proposed crop combinations

<table>
<thead>
<tr>
<th>Crop Cycle</th>
<th>Revenues (Rs per acre per year)</th>
<th>Cost (Rs per acre per year)</th>
<th>Profit (Rs per acre per year)</th>
<th>Assumed prices per quintal (Rs)</th>
<th>Price-Risk(^*) (Rs/Quintal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat + Paddy</td>
<td>68050</td>
<td>14390</td>
<td>53660</td>
<td>1350, 1250</td>
<td>No Risk - MSP</td>
</tr>
<tr>
<td>Paddy + Wheat + Summer Moong</td>
<td>88050</td>
<td>18910</td>
<td>69140</td>
<td>1250, 1350, 4000</td>
<td>Summer Moong Risk</td>
</tr>
<tr>
<td>Maize + Wheat + Summer Moong</td>
<td>71900</td>
<td>14370</td>
<td>57530</td>
<td>1200, 1350, 4000</td>
<td>175.32 (Maize)</td>
</tr>
<tr>
<td>Kinnow</td>
<td>50600</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>334.95 (Kinnow)</td>
</tr>
<tr>
<td>Moong + Wheat + Maize (Spring)</td>
<td>79900</td>
<td>14370</td>
<td>65530</td>
<td>4000, 1350, 1200</td>
<td>989.74 (Moong)</td>
</tr>
<tr>
<td>Turmeric</td>
<td>130000***</td>
<td>66400</td>
<td>63600***</td>
<td>10000</td>
<td>1056.87** (Turmeric)</td>
</tr>
<tr>
<td>Wood</td>
<td>63333</td>
<td>3333</td>
<td>60000</td>
<td>633</td>
<td>Data Not Available</td>
</tr>
<tr>
<td>Agro-Forestry: Wood + Intercropping</td>
<td>80000</td>
<td>6667</td>
<td>73333</td>
<td>NA</td>
<td>Data Not Available</td>
</tr>
</tbody>
</table>

where * represents Price Risk calculated from the standard deviation of 2012 prices in Punjab, data from Agmark; ** represents Price Risk calculated from All India data; and *** represents figures that vary a lot due to large fluctuations in turmeric prices

Finding the right value chains that will increase income and reduce, point towards more research and extension activities besides improving the post-harvest infrastructure and marketing system for the proposed crops.

In the value chain for different commodities, there is a need to study whether or not the demand is actually there – using existing and new channels – for increased production of commodities targeted for growth by policy makers otherwise increased production may result in crashed prices or unsold inventory. Ensuring ecological sustainability is of foremost concern besides providing economic standing of the farmer. Punjab Mandi Board in this context commissioned Indian School of Business to undertake a research study to analyze the potential of increase in the production of selected five commodities namely kinnow, maize, moong, turmeric and wood as mentioned in the APP-2013 (Draft) in terms of existing and new markets.

\(^7\) Due to the unavailability of the price numbers for wood in Punjab.
3. METHODOLOGY

This report analyzes five crops viz. kinnow, maize, moong, turmeric and wood from the proposed alternate crops on the basis of demand-supply dynamics to strike a balance between income and price risk. The methodology involves identification of the appropriate supply chain(s) followed by a critical analysis of the current situation in terms of the constraints (present on the demand and supply side) on the profitable absorption of increased production in the market.

**Figure 3.1: Broad framework for the study**

[Diagram showing the framework for the study]

We carried out a detailed study of the five agriculture commodities with special emphasis on understanding the existing supply chain as regards constraints on the growth of demand as well as of supply (Figure 3.1) using primary and secondary information collection methods (Figure 3.2).

**Figure 3.2: Flowchart of primary and secondary information collection methods**

[Diagram showing the flowchart]

In order to reach out to the important stakeholders for their insights and viewpoints, primary information was collected through focused interactions/interviews. We made commodity specific field visits to:
- Kinnow: Farmers and traders in the kinnow belt (Abohar) and *mandis*, citrus estates (Abohar) & Punjab Agro-Juice Limited
- Maize: Farmers, cattle feed manufacturers, starch manufactures (Sukhjeet and Namdhari), processing capacities, maize drying plant (Saila Khurd, Garshankar) & *mandis*
- Wood: Farmers and Balachaur *mandi*
- Turmeric: Farmers and Farmers Produce Promotion Society (FAPRO)
- Moong: Farmers, distributors and traders.

Apart from the primary field visits, we had structured interviews with subject experts.

- Kinnow: Joint Director Horticulture, Director of Citrus Estates (Abohar) & Punjab Agro-Juice Limited (PAJL)
- Maize: Team Leader (RSD) at Borlaug Institute for South Asia, Experts at the Punjab Agriculture University and the Directorate of Maize Research
- Wood: WIMCO & Deputy Conservator of Forests, Department of Forests & Wildlife Preservation, Punjab
- Turmeric: Farmer’s Produce Promotion Society (FAPRO) Officials, Secretary of *Mandi* Board (Garshankar), Agricultural Officer (Hoshiarpur)
- Moong: Joint Director (Pulses).

We also used secondary inputs from a range of information sources both national and international; reports; articles; newspaper clippings and research papers of various organizations in India and other documents, reports, and statistics. Information collected included general sector (agriculture) and commodity-specific (horticulture/ cereals and pulses) profile data, overview of the production trends and supply chain practices with their inefficiencies.
4. KINNOW

As per the APP-2013 (Draft) for Punjab the area under kinnow cultivation needs to be increased from 40,000 hectares to 80,000 hectares within a time span of 5-7 years. Looking specifically at the prospects of increasing area under kinnow cultivation; it is important to look into the possibilities of most profitable absorption of increasing production amongst the existing supply channels and overcoming the constraints therein.

4.1 BACKGROUND

India has a total annual production of the horticulture crops touching over 149 million tonnes and is the second largest producer of fruit and vegetables in the world. The climatic variability and favorable physio-geographical conditions make India an ideal destination for horticulture-led “sustainable” agriculture growth. Horticulture crops have been identified as a means for diversification for optimum utilization of natural resources in the late 20th century given that its cultivation is an ideal method of achieving sustainability of smallholdings, increasing employment, improving environment, providing enormous export potential and above all, achieving nutritional security (Hall et al., 2001).

As per the National Horticulture Board; the important horticulture crops are being grown on about 2, 69,000 hectares of land with an annual production of 5.1 million tonnes in Punjab. The total area under fruit cultivation is 70,000 hectares with the production of 14, 14,000 tonnes. Among the citrus group most of the processable varieties are grown in the state wherein under Punjab mandarin, kinnow is the most prevalent variety covering an area of 40,000 hectares with a production of 0.84 million tonnes, contributing 65 percent of the total fruit production of Punjab. Punjab’s geographical positioning brings it in the category of highest productivity per unit area of citrus fruit in the world, complimented by favorable soil and climatic conditions.

8 http://www.nhrdf.com/contentPage.asp?sub_section_code=103
9 http://planningcommission.nic.in/aboutus/committee/wrkgrp/horticulture.pdf
11 Estimated assuming yield as 21.06 tonnes/hectares
Within Punjab kinnow is primarily grown in Firozpur, Muktsar, Bhatinda, Amritsar, Gurdaspur and Hoshiarpur. 12

Farmers also realize the importance of horticulture as a solution to threatened agriculture sustainability besides being equally remunerative; as quoted by a young kinnow grower from Fazilka who sees immense potential in kinnow cultivation:

"I see diversification as the only way to save the depleting water table of the state… I get Rs 50,000 to Rs 60,000 an acre from kinnows against Rs 25,000 to Rs 28,000 an acre from wheat-paddy."13

4.2 KINNOW SUPPLY CHAIN IN PUNJAB

The flow of kinnow from the farmer (producer) to the final consumer takes place in different steps (Figure 5.1). The steps involved from production to final consumption include processing in the form of grading and waxing besides converting it into juice and other concentrates. Processing is an essential step towards value addition for kinnow. After being processed, kinnow requires adequate cold storage before it is sold either directly or through mandis.

Figure 4.1: Steps between producer and consumer

The final sale takes place through mandis catering to the customers within and outside Punjab and also outside India through exports. Since there is sufficient in-state production to meet the consumption within Punjab, there are no imports14 for the same: mandi arrivals are almost equal to the total consumption in Punjab). With the total production of kinnow amounting to 0.84 million metric tonnes (assuming average yield of 21.06 tonnes per hectare and area under cultivation as 40,000 hectares), about 10 percent flows to the mandi’s in Punjab (i.e. 86,157 MT) and the remaining 90 percent (i.e. 7, 56,000 MT) is the market surplus. Out of this market

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12 National Horticulture Mission 2005-06
14 83000MT assuming 3 kg per person for a population of 277.04 lakh
surplus, 99 percent (i.e. 7, 48,000 MT) goes outside Punjab and the remaining 1 percent (i.e. 7,560 MT) of the graded and waxed variety comes to the local mandi’s. For the details of how product flows through these channels we have identified an supply chain ending with customer locations within Punjab, outside Punjab and overseas (Figure 4.2).

Figure 4.2: Kinnow Supply Chain in Punjab

1. Total Production (2012) in Punjab = 842000 MT (assuming yield = 21.06 Tons/Ha and Area under Cultivation = 0.4 Lakh Ha)
2. Arrivals = 86000 MT (10% of total produce)
3. Consumption = 83000 MT (assuming 3 kg per person for 1 year for a population of 277.04 Lakh)
4. Market Surplus = 755000 MT (90% of total produce)
5a. Outflow of Graded/Waxed Kinnow = 748000 MT (99% of market surplus)
5b. Gradec/Waxed Kinnow to Mandi = 7560 MT (1% of market surplus)
6. Consumption = 1800,000 MT (assuming 1.5 kg per person for 1 year for non-Punjabi population of 12100 Lakh)

Source: Interviews and newspaper articles

In the local supply chain (i.e. within Punjab) the farmer leases out his orchard to the thekedar (pre-harvest contractor) who then takes the produce to mandi where the arhitya acting as a wholesaler markets the produce to various retailers in Punjab from where it is taken to the final consumers. The farmer also takes his produce directly to the distributor from where it is taken to the arhityas, who in turn markets the produce to the various retailers in Punjab from where it is taken to the final consumers. Further there is a juice processing supply chain(s) where either the farmer directly or via thekedar takes his produce to the distributor from where it is taken to the

grading plants after which kinnows of a particular grade are sent to the juice processing plants for extracting juice concentrate. For kinnow supplied outside Punjab, the produce flows either from the farmer to pre-harvest contractor or from the farmer to the distributor where the distributor is responsible for grading/waxing. The distributor then supplies kinnows to the traders outside Punjab from whom the retailers purchase the produce. There is an export channel too, where the flow of kinnow takes place from the farmer to the distributors to the traders outside Punjab who in turn export the produce to nearby countries namely Bangladesh, Bhutan and Nepal.

Looking at the profit numbers relative to the wheat-paddy cycle, there is a deterioration of 5.7 percent in the profit structure if the farmer adopts kinnow cultivation instead of his preferred wheat-paddy cycle whereby he earns a profit of Rs 53660 per acre per year from latter and Rs 50600 per acre per year from the former. Besides economic viability the factors which hinder the horticulture-led diversification are explored in the subsequent sections due to which the farmer would not diversify his area under cultivation.

4.3 DEMAND-SIDE CONSTRAINTS

As per our analysis the price-quantity (arrivals)\textsuperscript{16} relationship indicated that the prices are inelastic to market arrivals; in other words if the arrivals of kinnow are doubled then the prices may reduce by 10 percent (Figure 4.3). This suggests that increased production can be absorbed but by reducing the price by about 10 percent.

\textbf{Figure 4.3: Price-quantity relationship for kinnow (2008-2012)}

![Price-quantity relationship for kinnow (2008-2012)](image)

\textit{Source: Research team and data from AGMARK}

\textsuperscript{16} 2012 monthly data taken from www.agmark.nic.in
I. **Lack of awareness:**
A 10 percent drop in the prices when production is doubled implies that the increased production will be absorbed at lower prices as the local demand is more or less fixed. This fixed demand is primarily because of lack of awareness about the fruit and because of this fixed demand processing alternates such as concentrate jams and squashes, cosmetic purposes like face peel and cream has largely remained untapped. Hence farmer would fail to attract new customers for its products to purchase his increased produce.

II. **Competition from Nagpur mandarin:**
Tough competition from Nagpur mandarin\(^\text{17}\) has resulted in bringing down the national market price as a result of which the local Punjabi farmer receives a low price for their produce. In 2011 the average price was Rs 20 per kg which in 2012 has fallen to Rs 7-8 per kg. As quoted by Dr Lajwinder Singh Brar, Director Department of Horticulture Mission:

"The increase in orange and mausami cultivation in Nagpur is the reason behind the low prices for kinnow’s in Punjab. This fruit has no other market except the consumers in Punjab."\(^\text{18}\)

III. **Shrinking export markets:**
During 1990s Punjab used to export kinnows to distant markets like the UK, Mauritius, Sri Lanka, Netherlands, Dubai but since then export to these markets has not taken place on account of substandard quality of the produce. Poor post-harvest management infrastructure, low research in development of new (seedless) varieties and international competition is the main reason behind losing these export markets. Also as noted by a kinnow grower:

“Certainly, there is still an export market for kinnow in Middle East countries but higher transportation cost is a big barrier in its export to these countries.”\(^\text{19}\)

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4.4 SUPPLY-SIDE CONSTRAINTS

We identified the following issues in understanding the supply-side constraints on increasing production: *lack of research and development, inadequate post-harvest infrastructure and economic non-viability.*

**I. Lack of research on seedless varieties:**
There is lack of research and advancements on seedless varieties of kinnow, which are in huge demand overseas as about 61 percent of total world exports of oranges and mandarins are seedless varieties. But due to absence of research breakthroughs, Punjab has lost its international market.

**II. Lack of adequate storage facilities and inadequate transport facilities:**
Kinnnow being a highly perishable commodity has a limited shelf life offering only a limited time between the harvesting and final sale, thereby requiring adequate cold storages. At present the number of cold storages in Punjab are 465 out of which 80 percent of the capacities are being used for potatoes alone, hence lack of adequate post-harvest management facilities leads to significant loss of the fruit.

Substantial post-harvest losses are seen due to inadequate refrigerated transport facilities resulting from poor handling of the produce during transit especially to the distant markets. Losses during transportation are found to be within 15-20 percent of the total produce mainly due to high loading/stacking, unsuitable transport containers and improper handling of the produce.

“Due to huge post harvest losses albeit huge transportation costs on account of transportation to distant markets; a section of farmers have for long been demanding a direct train from Abohar to West Bengal and Gujarat, where the produce at present goes by road at high transport costs.”

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20 As per National Horticulture Mission 2013
21 http://agmarknet.nic.in/preface-mandarin.pdf
III. Inadequate grading and waxing facilities:

There are more than 45 grading and waxing plants with a capacity of 4-5 tonnes per hour in Punjab at present. However, as per the interactions with farmers, arhityas, distributors and agro-processors, the prospects of profitable absorption of increased produce will be constrained by inadequate processing and dearth of grading and waxing facilities. Also there are no mechanical graders, and grading and analyzing laboratories in the mandis located in the kinnow growing areas. As a result farmers especially the small and marginal ones will face a lack of direct access to value-addition facilities.

IV. Unsuitable business model for processing:

The two state-of-the-art processing plants in Punjab have only been able to process trivial volume. For instance in 2010 the Hoshiarpur unit has processed a total of 100 tonnes of kinnow that is capable of processing 20 tonnes of fruit an hour. At Abohar the situation is even worse since the factory has received only a small order for processing mangoes in the winter season of 2012-13, making the operations economically infeasible.

Direct procurement from farmers, i.e. direct dealing with farmers, is a problem area between the government and large private players like Pepsi which has hampered the prospects of sustainable plant operations in the long run. The failed expensive processing experiments in the past have further restrained the farmers (Box 4.1).

Box 4.1: Punjab’s experiments with processing

In 2007 Punjab Government established two state-of-the-art multi-fruit processing plants in Hoshiarpur and Abohar. PepsiCo signed a MoU with Punjab Agro Juices Ltd (PAJL) and used the Hoshiarpur plant for few years to produce kinnow concentrate to be used in Tropicana range of juices. For this purpose the company intended to purchase around 6,000 MT of mature kinnow fruit mostly from small to medium farmers. However this ambitious ultra modern kinnow juice unit at Hoshiarpur has been marred with problems since its inception, the biggest being that it could not be made fully functional in time causing loss to the farmers. The factories which came up at a cost of Rs 84 crore have been lying idle for years. In the first year of operation in February 2008 the Hoshiarpur unit processed 4,000 tonnes kinnow for Tropicana. The next year Tropicana did not evince interest saying kinnows from Pakistan were cheaper.

24 Input from primary interaction
and farmers in Punjab did not sell any fruit at the lower price. In 2010 the Hoshiarpur unit processed 100 tonnes kinnow, not even a day’s job for the factory that is capable of processing 20 tonne fruit an hour. Pepsi was expecting PAJL to source raw material from farmers but failed to source the right raw material as per the specifications of its product. Pepsi therefore proposed a lease model to the government which would give control of manufacturing and plant operations to it for a certain period. Government didn’t accept the lease model because Pepsi was offering very minimal lease fee.

Farmers in Punjab have felt cheated as one of the officials from the horticulture department stated “had the juice unit been made operational, farmers could have made some profit.” The similar state-of-the-art plant set up in Abohar has presented an equally dismal picture wherein the factory got only a small order for processing mangoes this season.

Evidently there has been a massive under-utilization of vast capacity on account of absence of direct linkages between farmers and procurement agencies which has left the kinnow growers in a state of hopelessness. Clearly lessons need to be learnt for future…. 

Source: Interviews and newspaper articles25, 26

V. Lack of aggregation facilities at appropriate level:

Dearth of aggregation at the pre-mandi level is a factor responsible for low prices at the farmer’s end. As a result of which D and E grades (primarily used for processing) also go to the mandis and due to glut of all varieties the price of high/table varieties is also negatively impacted thereby resulting in the farmer getting locked into a low price. The primary reason for low aggregation is due to the absence of grading facilities at a pre-mandi level. Whatever minimal aggregation that is taking place is by the middleman which dilutes the margin the farmer gets.

VI. Lack of direct participation by the farmer:

Farmers are unsure about the eventual price of their produce as a result of which they lease their orchards to pre-harvest contractors to avoid the risk of price fluctuations. Strong presence of middlemen in the value chain of kinnow has further discouraged the farmer from participating directly. For instance, some farmers feel that arhityas buy only selected quality produce and delay payment. Also the preference by commission agent for traders than farmers for auctioning their produce is a major hurdle faced by the kinnow farmers.27 Hence the choice for advance

contract even at a low price is a preferred option by the farmer. He wants assured income from his produce and lands up with lower economic returns by involving middlemen rather than directly participating in the value chain. An orchard owner voiced similar opinion:

"Though over 80 per cent farmers still give their orchards on contract, one can double the returns by harvesting and marketing it on their own. After seven years, I realised I was losing about Rs 10 lakh by not marketing myself!"\textsuperscript{28}

Also sporadic exports of kinnow from Punjab to Bangladesh via Kolkata have led to massive price fluctuations. Bangladesh presently imports kinnows through the Kolkata market. Chief Minister Parkash Singh Badal has urged the Bangladesh High Commissioner Tariq A. Karim to directly import kinnows from Punjab which would mutually benefit both the economies with the elimination of middlemen.\textsuperscript{29}

\textbf{VII. Economically unviable for the smallholder:} Kinnow has a three-to-four year cycle. Due to such a long gestation period, the returns from the crop are realized after a long interval thereby disrupting the continuous flow of income for the farmer. Apart from a discontinuous flow of income, the income realized from its cultivation (Rs. 50,600 per acre) is less lucrative as compared to Rs. 53,660 per acre from wheat-paddy cycle.

\textsuperscript{28} Anil Setia; http://www.indianexpress.com/news/punjab-farmers-reap-windfall-from-kinnow/400265/2\#sthash.vJbIL2ui.dpuf
\textsuperscript{29} http://indiatoday.intoday.in/story/Buy+kinnow+from+us,+Punjab+to+B'desh/1/70077.html
5. MAIZE

The APP-2013 (Draft) is looking at a four fold increase in maize acreage from 1.3 lakh hectares to 5.5 lakh hectares within a time span of five to seven years. The agricultural policy reflects the potential maize has as the future crop of Punjab becoming the most suitable replacement for paddy. This increase is likely to result in production increase from 0.5 million tonnes to 2 million tonnes.

5.1 BACKGROUND

Maize (*Zea mays*) is one of the most important cereal crops worldwide; not only for human consumption but also for animal consumption. The crop is an important staple food for more than 1.2 billion people in Sub-Saharan Africa and Latin America and a key feed crop in Asia. Globally what makes maize a popular crop from cultivation point of view is its versatility in terms of its suitability to diverse agro-climatic zones offering highest genetic yield potential amongst other cereals crops.

India as a whole accounts for 5 percent of corn acreage in 2010-11 and produces approximately 21.73 million tonnes with year-on-year growth of 30 percent, making maize the third most important food grain after wheat and rice. It contributes nearly 9 percent to the national food basket and more than Rs. 100 billion to the agricultural GDP besides generating employment to 100 million man-days in the farm and downstream agricultural and industrial sectors. Maize is used for myriad purposes ranging from both human and animal consumption to industrial use (Figure 5.1).

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30 http://dbtbiosafety.nic.in/guidelines/maize.pdf
Figure 5.1: Diversified uses of maize in India

Source: ICAR Vision 2025 and author; where A & B grades of maize go into animal & poultry feed industry while C & D grade of maize go into starch & brewery industry

Punjab unlike the rest of India had traditionally been a maize growing state until rice became popular. Area under maize cultivation declined since 2006-07 with little improvement in the yield (Figure 5.2). Within Punjab the primary maize producing areas are Nawashahr, Kapurthala, Ropar and Amritsar.

Figure 5.2: Area, yield and production in Punjab

Source: Dacnet and PunjabStat

Its cultivation saves 90 percent of water and 70 percent of power required as compared to paddy besides raising their economic returns. Also highlighted by Ashok Gulati, Chairman of Commission for Agriculture Costs and Prices:
“Maize and soyabean have the potential to break the water-intensive rice cropping cycle in Punjab and Haryana thereby promoting the Government’s drive for crop diversification….”

By following the kharif maize cycle and spring maize cycle a farmer increases his economic returns by 7 percent and 22 percent respectively (Table 5.1). However to realize the full potential from maize cultivation there is a need to set up extensive infrastructure across the two ends of the value chain to ensure efficiency and cost-effectiveness.

Table 5.1: Illustrative profit calculations for maize cultivation

<table>
<thead>
<tr>
<th>Crop Cycle</th>
<th>Revenues (Rs per acre per year)</th>
<th>Cost (Rs per acre per year)</th>
<th>Profit (Rs per acre per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat + Paddy</td>
<td>68050</td>
<td>14390</td>
<td>53660</td>
</tr>
<tr>
<td>Maize (Kharif) + Wheat + Summer Moong</td>
<td>71900</td>
<td>14370</td>
<td>57530</td>
</tr>
<tr>
<td>Moong + Wheat + Maize (Spring)</td>
<td>79900</td>
<td>14370</td>
<td>65530</td>
</tr>
</tbody>
</table>

Source: Research Team

5.2 MAIZE SUPPLY CHAIN IN PUNJAB

We have identified that the flow of maize from the farmer (producer) to final consumer takes place in different steps (Figure 5.3). The steps involved from production to consumption include processing in the form of grading, drying and milling. Maize can be either consumed directly or processed through wet and dry milling industries for human consumption. During dry milling process, maize is processed into flour and wet milling process includes extraction of starch from maize. After being processed, maize requires suitable warehouses for storage before it is sold either directly or through mandis catering to the consumers (within and outside) Punjab and outside India.

Figure 5.3: Steps between producer and consumer

We have identified the product flow through various supply channels varying in terms of customer location have been identified within Punjab, outside Punjab and overseas (Figure 5.4). We have identified different supply chains for maize linking the primary producer on one end with the intermediaries as silo owners (who store maize), traders/brokers (who sell maize to various consumers and processing industries), processors which includes millers and feed manufacturers (who convert maize into usable form); to the consumers on the other end.

With the total production of maize amounting to 4,91,000 MT in Punjab in FY 2010-11 about 14 percent of the total flows into the local market supply chain (i.e. within Punjab) where the primary producer sells the produce to the traders who further takes it to the local mandis. These mandis sell maize in the form of chhalli, popcorn, seeds and babycorn from where three routes follow; firstly through arhityas (acting as wholesalers) who market the produce to various retailers in Punjab, secondly through retailers directly from where it is finally supplied to the end consumers, and thirdly through the end consumers who directly buy maize from the mandis. Remaining 86 percent of the total produce flows from traders to the various processing industries that convert maize into different usable forms like starch, flour and feed. In some supply chains maize comes from outside Punjab from where it is supplied to silos. Silo owners further sell it to the traders in Punjab from where it is sold to the various processing industries. From processing units, it is supplied to the wholesalers and retailers within and outside Punjab and India.
Within the supply chains the following constraints are identified on the supply/production side and the demand side.

### 5.3 DEMAND-SIDE CONSTRAINTS

On the demand-side, Punjab has been unable to keep pace with its competitors mainly Pune and Bangalore in tapping the maize market. A major factor for this has been its climatic disadvantage which calls for the need for research on Punjab-specific seed varieties. Both Pune and Bangalore offer four production cycles for maize with favorable weather throughout the year whereas Punjab has only two cycles due to its extreme climatic conditions. This is also a supply side constraint.
Maize varieties for use-specific products such as popcorn and baby corn have not been explored. Despite of better economic returns and increasing demand in international market, the cultivation for baby corn has not become popular due to low processing facilities besides lack of sufficient availability of quality seeds.

Also the demand for locally grown corn for popping is not there as the imported ones are perceived to be of superior quality. Even in the future, the demand for these varieties will not increase since:

“On the one hand, advanced countries have low cost of production of these varieties owing to their developed post harvest infrastructure and as a result the imported maize is available at cheaper prices. On the other, fraudulent import by some importers had added to the misery of local farmers and traders.”

Besides the dearth of a consumer base, the marketing channels for use-specific varieties are underdeveloped as a result of which its market potential remains untapped. Some farmers in Punjab who are growing products like baby corn face problems in marketing their crop directly to retailers and earning profits due to dearth of direct marketing channels.

5.4 SUPPLY-SIDE CONSTRAINTS

On the supply-side, lack of research and development and post harvest infrastructure are the biggest bottlenecks. Farmers do not want to shift away from the profitable paddy cultivation towards maize because the entire value chain of maize is underdeveloped. Right from low R&D advancements in terms of an absence of better seed varieties, fertilizers and farm equipments to the issues in the post harvest infrastructure due to lack of grading, sorting, drying facilities and processing facilities.

I. Inadequate research on Punjab specific maize varieties:

Owing to the extreme conditions in Punjab, maize is exposed to risk due to its sensitivity to climatic conditions. The risk exposure is much more for maize cultivators than for the traditional crops. There are no hybrid varieties to be grown in the kharif (summer) season. Even the existing rabi season varieties are unsuitable to the current climatic conditions in Punjab. Also the farmers

have been objecting that though the vigor of the crop is good but pollination is a problem. At a temperature of 1-2 degree celsius the pollen dies rendering the land unproductive. In the absence of Punjab specific varieties that are resistant to its geographical conditions, the fear of crop failure and low yield has discouraged farmers from cultivating maize.34

II. Lack of mechanization:
Due to inadequate research and development, maize cultivation is impaired with technology, mechanical and quality fatigue. There is an acute shortage of equipments like nitrollers (to load/unload the produce) and disk platters. As maize is more labour intensive than wheat and paddy, due to low mechanization the labour cost is high resulting in higher cost of production and lower adoption by farmers for cultivation.35

Also due to a lack of mechanization, maize farmer is facing the problem of residual management and the residual feed keeps on standing and the farmer is forced to go in for environmentally inappropriate methods of waste disposal like residual burning (in order to get rid of the residual)36.

III. Inadequate grading and drying facilities:
Maize is susceptible to spoilage due to high moisture content. The ideal moisture content for storing maize is 13-14 percent but production has 30 percent moisture, which affects its saleability.37 In view of this there is a need for mechanical processers and dryers for maize that substantially reduce the moisture content in the crops, which at present are highly inadequate. At present there is only a single maize processing plant in Punjab with a capacity of 100Mt corn/day.38 Recently the State Government has also set up the first maize drying plant in Punjab at Saila Khurd, Garhshankar (Figure 5.5). But there are fundamental problems in its operations which have defeated the purpose of the plant benefitting the smallholder (Box 5.1).

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34 Interview with Mr. Raj Gupta, Borlaug Institute for South Asia, International Maize and Wheat Research Institute
35 Interview: Representative from PAU
36 Interview with Mr. Raj Gupta, Borlaug Institute for South Asia, International Maize and Wheat Research Institute
37 Interview with Sukhjeet Starch
38 http://hpagrisnet.gov.in/agriculture/PDF/maizeprocessingindustries.pdf
Box 5.1: On-site the maize drying plant in Garhshankar

The drying facility has been imported from Taiwan at a cost of 9 crores with a capacity of drying 160 quintals of maize in a single batch per dryer (with a total of 4 dryers). The cost of drying is minimal around Rs. 25-50 per quintal with a capacity to reduce the moisture content from 25 to 12-13 percent. Per se, this state of the art machinery looks quite impressive and does offer huge potential benefits but in the current scenario, there are issues that cannot be ignored:

*No benefit for the small farmer:* While it was expected that the farmers will themselves bring their produce to the dryer and then take it to the mandi, due to huge capacity requirement of the dryer (160 qtl in a single batch) instead arhitya (middlemen) bring the produce to the dryer and earn profits through huge price margins. On an average while maize (without drying) is sold at 400-500 per quintal, the same after being dried is sold at Rs. 900-1500 per quintal. This huge price benefit is being taken by the arhitya, making them a stronger lobby while the farming class is still at the same level of economic backwardness. Moreover the bundles that are dried in a single shift must have the same moisture content and such an arrangement can only be made by the arhitya.
Massive capacity under-utilization: With the capacity of 160 quintals of maize in a single batch per dryer, this drying facility is designed for huge volumes which are presently not coming even at the arhitya’s level. So the dryers are forced to be operated below the designed capacity and given the huge operating cost (since husk that is used as bio-fuel is not cheap either being priced at Rs.400-500 per quintal), this implies substantial costs. Moreover the drying plant at present is being used only for maize which owing to the seasonal character of maize is being operated only for 2-3 months and for paddy too (for a short while). The batch sizes that are being dried in the single shift need to have the same moisture content which again has been posing a challenge in the dryer’s operation.

IV. Lack of aggregation facilities at pre-mandi level:
Dearth of aggregation facilities at the pre-mandi level is a factor responsible for low prices for the produce. Aggregation at a pre-mandi level is hugely affected by the absence of grading and drying facilities at the direct disposal of the farmer/primary producer. This has resulted in low prices to the farmers.

V. Inadequate storage and transportation facilities:
Poor handling of the produce during transportation and storage needs to be fixed on an urgent basis. In the absence of storage and warehousing capacities farmers are forced to resort to distress selling and are unable to extract the benefits of price manipulation, leaving aside the massive wastages on account of the dearth of the same. Storage facilities in Punjab at present are not adequate in number or quality. Hence if the production increases as a result of area expansion under maize, there will be huge post harvest wastage because Punjab lacks in scientific grain storage facilities.

Lack of good transportation infrastructure has also affected the profitability of maize cultivation. Sweet corn that was being exported to the west has suffered a setback due to discontinuation of the direct flight to the UK:
“There is big demand for frozen sweetcorn and peas in west Asia, with exports at 1,000 to 1,500 tonnes annually but there is a huge disadvantage of sending the perishable stocks all the way to Delhi.”39

6. WOOD

The diversification plan proposed in the APP-2013 (Draft) is looking at more than twice the increase in the area under wood cultivation; from 1.3 lakh hectares to 3 lakh hectares in the next five to seven years. This will result in production increase from 15.6 million tons to 32 million tons.

6.1 BACKGROUND

Today the growing popularity of tree cultivation in shaping the rural and urban landscapes worldwide can be owed to environmental benefits it provides besides economic viability. The benefits that tree plantations involve range from increased household income and stability for small and marginal holders on one hand to the positive effect on soil fertility and water conservation on the other. According to the Michigan State University; a tree planted is worth Rs. 10628750 ($193,250) excluding the value of fruits or lumber derived. The value is indicative of economic value derived purely from pollution control, soil improvement, water recycle and ecological gains. This forms a strong pro-forestry argument in favour of expansion and encouragement of tree cultivation in India’s agriculture system.

In Punjab; there is a huge potential in expanding tree cultivation that must be tapped especially in the wake of ecological imbalances that pose a serious threat to its agriculture sustainability since “the introduction of high yielding variety crops has no doubt resulted in self sufficiency of food grains but its role in degrading the top-soil by increasing salinization due to faulty irrigation, loss of fertility and deposition of non-biodegradable agriculture chemicals in soil cannot be overlooked.” Exacerbating the severity of the situation, forest and wildlife preservation minister of Punjab, Surjit Kumar Jyani has stated:

"Punjab being a predominantly agricultural state has less than 7 per cent of its area under..."
forest/ tree cover, resulting in severe environmental and ecological degradation.”

In Punjab, the agro-forestry adoption process has rather been a gradual one; starting with a few farmers the system has expanded gradually. Once the farmers who were the first few experimenters earned good returns from the sale of these farm grown trees, other farmers also got interested in growing poplar and with passage of time more and more farmers joined in for poplar planting. Thus the total area under poplar has increased with central Punjab emerging as a poplar farming belt as 68 per cent tree growers are practicing poplar based agro-forestry system in this area.

Poplars are being grown on agricultural lands either in single rows along field/farm boundaries or even in block plantation at a spacing of 5 x 4m or 7 x 3m along with annual agricultural crops and fodder crops (Figure 6.1). Poplar being winter deciduous sheds its leaves during December so any rabi crop can be successfully grown under poplar. During the first two years, farmers are growing various kharif and rabi crops however crops like turmeric, sugarcane, ginger would be more suitable with poplar trees. In the later years rabi crops mainly wheat, oats, fodder (berseem), mustard, vegetables etc can be grown throughout the rotation. Some farmers do not grow kharif season crops owing to dense shade of poplars during later years although others continue cultivating fodders mainly pearl millet, sorghum, guinea grass etc.

Figure 6.1: Poplar based agro-forestry in Punjab under various crops

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44 http://www.nrcaf.ernet.in/aicrpaf/centres/pausuc.php
The poplar-based agro-forestry system in Punjab offers economical opportunities both which are partly tapped despite the prominent factors in favour of widespread adoption of agro-forestry practices in Punjab. Some of the factors are:

- Increased income levels of farmers practicing agro-forestry
- Enough demand for finished (manufactured) wood products with plywood and match industries as the biggest players in the wood market
- No dearth of saplings for plantation on the supply side
- Gradual development of processing infrastructure with recent steps taken by Punjab Government (like issuing of licenses to wood manufactures)
- Active interest by the Government in encouraging agro-forestry with initiatives like Greening Punjab Mission and Nanhisha Initiative
- Initiatives such as free-cost distribution of saplings and plantation on vacant lands
- Recent measures like waiving off the mandi fee and rural development fee for wood purchase within Punjab
- Establishment of three markets dedicated to the sale of log wood gathered from farmers who cultivate commercial trees on 20 acres of land in Dasuya, Punjab
- Mandate of the state industries department to immediately declare wood based industry as agro-based industry in Punjab as part of the diversification programme.

6.2 WOOD SUPPLY CHAIN IN PUNJAB

Since poplar is the most common species planted under agro-forestry accounting for about 70 percent of the area under wood cultivation, we have identified the flow of poplar from the farmer (producer) to the consumer in different steps in the value chain (Figure 6.2).
After being harvested poplar is stored at different points in the value chain wherein it can be stored for a maximum of six months. The plant that is sold to the end consumers is being used in different forms wherein 70 percent of the poplar wood is converted into ply board, about 20 percent for making matches and the remaining 10 percent for making pencils and paper. Initially poplar was introduced to meet the needs of match industry but later it began to be used extensively in making plywood. In the recent years, plywood industry has become the biggest consumer of poplar wood. Some proportion of poplar is also used in paper making though the amount is still very small unlike the developed countries. Various outlets such as mandis in Punjab (Figure 6.3), ply-board manufacturing units and large mandis such as Yamunanagar in Haryana are available to them to market their produce. The farmers also prefer to sell their produce through Yamunanagar mandi because of the higher price that they offer compared to the mandis in Punjab.45

Figure 6.3: Wood mandi in Punjab

Figure 6.4 shows three major supply chains for meeting wood’s demand for costumers within Punjab. The channel involves the farmer as the producer/supplier on the one end and costumers on the other with thekedar/contractor and arhityas/traders as the intermediaries. These market intermediaries further supply the wood to the manufacturers and wholesalers. Interestingly, the

45 Interview with WIMCO Seedlings
middlemen (*arhityas* and *thekedars*) play an important aggregation role in these local supply chains between the farmers and the manufacturers and wholesalers. Amongst these intermediaries, it’s the *thekedar* who is the most important middleman since the farmers take the services of these *thekedars* to harvest and transport their produce besides supplying the same to them. Further these *thekedars* make an estimate of the volume of standing crop before finalizing the deal with farmers and also play the role of commission agents in facilitating the sale of the produce by charging commission fee for their services i.e. between 5-7 per cent of the sale price. The produce is then sold to the *mandi arhityas* who buy the produce for resale purposes after charging 7 percent as market fee from where it goes to the wholesaler/manufacturer and finally to the consumer.

There are two channels through which wood demand for consumers outside Punjab is met, where in the farmer supplies raw wood either directly to the manufacturer from where the wholesaler/distributor makes it available to the consumer. Alternatively, *thekedars* can provide the raw wood to *arhityas* outside Punjab who take the produce to the manufacturers and then to the wholesalers/distributors outside Punjab.

**Figure 6.4: Wood supply chain in Punjab**

(Source: Primary Research)
6.3 DEMAND-SIDE CONSTRAINTS

On the demand side, there is no major bottleneck on the absorption of increased wood produce.\textsuperscript{46} In other words, the demand is enough to keep pace with the rising production.

6.4 SUPPLY-SIDE CONSTRAINTS

In understanding the constraints on increased production from economic viability perspective we have identified the following bottlenecks on the supply side - \textit{dearth of research and development, economic uncertainty and information asymmetry}. These issues are explained in the succeeding section of the report.

\textbf{I. \textit{Shortage of high yield varieties of planting material:}}

Access to high quality planting materials (saplings) remains a major hurdle for improving farm productivity. The critical requirement of genetically improved high quality planting stock must not be neglected as it adversely affects the productivity and quality of the plants\textsuperscript{47}. Low yield as a result of poor variety of saplings exerts an adverse impact on production and therefore returns to the farmers.

\textbf{II. \textit{Dearth of best cultivation practices, awareness and training:}}

Innovation in providing low cost and high quality inputs and services is a central element for smallholder development. However at present, the state has inadequate and outdated farming materials and methods due to low level of research and extension activities in the area of agroforestry especially when compared with the progressive agro-forestry practices by farmers in Haryana. This has resulted in the absence of advancements in developing new varieties that are suitable to the fields of Punjab. Besides this, for raising a poplar plant the sapling needs to be handled properly when it is uprooted from the nursery to be planted in the fields for the prevention of moisture loss but the farmers are ill-equipped and lack the use of better methods and adoption of best practices.

\textsuperscript{46} Primary survey  
\textsuperscript{47} http://www.fao.org/docrep/007/ae535e/ae535e06.htm
There is lack of awareness among farmers for complementary intercropping practices under poplar, be it the planting materials and methods or the profitability and marketing aspects of agro-forestry, as was told by a farmer. Interactions with the officials of the Forest Department further revealed that the small and marginal farmers are not aware about the economic benefits of the complementary crops are grown in the correct sequence. Therefore awareness on intercropping methods is a major constraint in expanding wood cultivation.

**III. Information asymmetry:**
Smallholders have no information about their buyers, the prevailing market prices, and government rules and procedures. They rarely bring their produce to the market and as a result end up getting a low price because they are completely in the hands of middleman. Due to the presence of a long chain of intermediaries a farmer is not able to receive the full cost of their crop and hence will not undertake tree cultivation. At present, they are charging market fees ranging from anywhere between 4 to 16 percent under different heads thereby squeezing farmer’s income and resulting in shrunken profits.\(^{48}\)

**IV. Blockage of funds for long period:**
One of the major bottlenecks in profitable absorption of increased wood production is the relatively long production period of most of the tree species. Since wood plantation produces economic returns in a few years into the future, smallholders find it difficult to divert resources from production to meet immediate needs for food. Hence wood cultivation is not an attractive option for them in the absence of an assured income flow.

\(^{48}\) Input from Primary Survey
7. TURMERIC

As per the Agriculture Policy for Punjab-2013 (Draft), it has been proposed that the area under cultivation for turmeric needs to be increased from 20,000 hectares to 50,000 hectares within a time span of 5-7 years. This 2.5 times increase in the area might lead to a production increase of 150 percent i.e. from 16,000 tons to 40,000 tons.

7.1 BACKGROUND

Turmeric (Curcuma Longa LINN) has unique anti-inflammatory, anti-viral and anti-fungal properties that rightfully make it the “miracle herb”. Comparative analysis of the compound production growth rates of Indian turmeric in the pre- and post-liberalization period suggest an overall increase of about 2.74 percent from 1974-75 to 2007-08. Presently with a total production of 9.7 lakh tone in 2012-13 Indian has emerged as the largest producer of turmeric worldwide. Indian turmeric wholly dominates the world production scenario thereby contributing to approximately 78 percent of the world’s total production, producing 12.47 lakh tonnes of the produce annually. The production of turmeric has shown a consistent increase over the past few decades in India.

A sufficiently large produce in excess of the local demand produces an export scenario. India dominates the supply of turmeric to the world with a share of about 78 percent in the total global output and 60 percent in the global trade with UAE (17%), USA (10%), Bangladesh (9%), Sri Lanka (7%), Japan (7%), Malaysia (6%) and UK (6%) as the key export destinations. Also the quality of Indian turmeric is unmatched across the world owing to its high curcumin content. At a disaggregate level, Andhra Pradesh is a leading producer of turmeric in India, followed by Karnataka, Orissa, Tamil Nadu and Maharashtra whereas Punjab merely produces one percent of the total production. As regards the demand in Punjab, NSSO survey suggests that the

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49 Spice Board of India
51 http://www.icexindia.com/profiles/turmeric_profile.pdf
52 Estimated from India’s number from Spice Board of India
53 http://www.crnindia.com/commodity/turmeric.html#p_countries
54 http://www.icexindia.com/profiles/turmeric_profile.pdf
55 In 2001-02, 2150 acres were under turmeric cultivation producing 12900 MT respectively
monthly per capita consumption of turmeric at the instate level for rural and urban segment is 69.962 gm and 80.953 gm respectively. Sample data on households suggest that the consumption of turmeric in Punjab is the highest as compared to other spices (Figure 7.1).

**Figure 7.1: Consumption trend for turmeric in Punjab (per capita annually)**

Despite of huge local demand and favourable topological conditions that support its cultivation, Punjabi farmers have refrained from actively adopting it, as a result of which the state presently imports 96 percent of its demand from other states\(^{57}\). But considering it’s a 9-10 months crop with minimal water requirement it can act as a rewarding cash crop therefore acting as an effective replacement of the water guzzling wheat-paddy rotation cycles.

### 7.2 TURMERIC SUPPLY CHAIN IN PUNJAB

The flow of turmeric from the farmer (producer) to final consumer takes place through the following steps (see Figure 7.2 below).

**Figure 7.2: Steps between producer and consumer**

After harvesting, turmeric requires processing within 2-3 days of harvesting through a sequence of steps which includes boiling, drying and hammer milling. The first step for post-harvest

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\(^{56}\) National Sample Survey, 66th round, July 2009-June 2010 (Household Consumption of Various goods and services in India)

\(^{57}\) Primary Input
processing includes boiling after which drying takes place using traditional (sun drying) and/or mechanized drying methods. Dry turmeric thus obtained after processing is polished or further processed to form powder. After being processed, the stock needs adequate storage facilities for dried and milled product. Finally, sale takes place through different points in the value chain from primary producer -- to the society (FAPRO) -- to the stockists (for instance Kisan Huts). Based upon the research the following channels for flow of turmeric from the farmer to the final consumer have been identified (Figure 7.3).

**Figure 7.3: Turmeric supply chain in Punjab**

Because of low adoption of this cash crop by the farmer and hence trivial production rates only two supply channels could be traced. In both of these the primary producer (farmer) takes his produce to the cooperative societies for processing to avoid spoilage since processing in case of turmeric must be quick, from where it is taken to the societies outlets for distribution either directly to the consumer(s) or consumer(s) via retailers. At present, the post-harvest operations in Punjab are only being undertaken by FAPRO, a cooperative of smallholders.

*Processing operations at the FAPRO premises:* Processing operations involves boiling, drying and milling of turmeric which are done at the premises of the society itself (Figure 7.4). Initially boiling of turmeric takes place in boilers. Each boiler has a processing capacity of 400 tons of fresh turmeric per day. After boiling, turmeric fingers are spread for sun drying. According to the experts, it takes 10-20 days for sun drying. The dried turmeric is then polished by mechanical rubbing in rotators followed by hammer milling to convert into a powder form. After which it is packed in different sizes manually to send it further to its retail outlets.
Figure 7.4: Processing operations at the FAPRO premises: some glimpses

From FAPRO outlets to consumers: From the FAPRO premises the produce is distributed and marketed through two channels i.e. FAPRO outlets (such as Kisan Huts) or small retailers (Figure 7.5). Out of the two the former channel i.e. through FAPRO outlets, is emerging as a prominent source of selling the produce indicated by their huge daily sales. As was stated by the store manager of a FAPRO outlet in Hoshiarpur:

“We do good business here. The daily sales revenue earned in our outlet is around Rs. 15000-16000 on an average.”

Figure 7.5: Glimpses of the FAPRO premises at Hoshiarpur and the FAPRO kisan hut
In light of the present scenario let us have a close look at the existing constraints both on the demand and the supply side in the following two sections.

### 7.3 DEMAND-SIDE CONSTRAINTS

On the demand-side, the major constraint is *fixed demand for local (Punjab) brand of turmeric*.

**Fixed demand for turmeric:**
Turmeric forms an essential part of the Punjabi cuisine and in absence of an immediate substitute for it, the chances for subdued growth in demand are minimal. Demand for turmeric is more or less fixed due to the consumption pattern and low price elasticity. Figure 7.6 depicts if arrivals are increased in tune of 2.5 times the present level there is a mere 3 percent fall in the price level. This shows that if market arrivals increase, demand remains almost unaffected.

![Figure 7.6: Price-quantity relationship for India in 2012](image)

Uncertainty in the demand-supply situation and lack of information about availability of turmeric causes huge price movements. Also the competition from Sangli and Erode markets for turmeric besides the uncertain price movements makes it difficult to build a consumer base for Punjab’s local brand.

### 7.4 SUPPLY-SIDE CONSTRAINTS

At present, there are 20,000 hectares under turmeric cultivation in Punjab with an average yield of 80-90 quintals per acre. Production rate for turmeric in Punjab is very low despite of its suitable soil and agro-climatic conditions for its production. In fact, its production is way low as compared to its per-capita consumption which is highest in Punjab among all other spices. It has
been observed that huge price volatility besides the necessary infrastructure and marketing support are the major challenges before the state government which restrict a farmer from diverting his area under cultivation to this crop. As also highlighted by Jaswinder Singh Dhaliwal, President, Farmers Produce Promotion Society (FAPRO):

“Total production in Punjab is just 1% of the total Rs. 300-crore worth demand whereby the major hindrance for a farmer was lack of adequate marketing support.”

In understanding the constraints on increasing production from viability perspective we have identified the following issues on the supply side: *inadequate post-harvest infrastructure, underdeveloped marketing mechanisms and economic non-viability for small and marginal farmers.*

I. **Inadequate post-harvest facilities:**
Post-harvest processing is an integral part of turmeric harvesting and lack of such facilities in the state results in huge post-harvest losses. At present, there are no such facilities for processing and value-addition besides FAPRO in the organized sector. Whatever few traditional facilities are available are also not time-efficient. In absence of post-harvest facilities in the state, it therefore becomes an unattractive option for a farmer to grow turmeric especially for the small and marginal one.

Recent estimates by Punjab Agriculture University suggest that at an intra state level production of turmeric has shown significant improvement in district Hoshiarpur producing 3000-4000 MT of turmeric on 450 acres. This has been done by the efforts of the local turmeric producers by forming associations for its processing and marketing. Therefore if processing facilities for the product are made available, the area under turmeric can increase to 1500 acres and that too in only one year. But no such facilities exist in the district in the organized sector, resulting in very low realization of the value. Processing facilities help in converting the produce into useable form and in absence of which farmers face difficulty in marketing also.

II. **Under-developed markets:**
Unlike wheat and paddy, turmeric is not being sold through *arhitya* in *mandis*. Due to low

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58 http://www.hindustantimes.com/StoryPage/Print/813779.aspx
59 Primary Interaction
60 http://hoshiarpur.nic.in/pdf/rssv/agriculture.PDF
production in the state, *mandi* commission agents are also not interested in trading the commodity and making it difficult to locate the traders for locally produced turmeric. The major reason for trader’s reluctance to buy the local produce is its low shelf-life which is primarily there because of lack of aggregation facilities in the state. Therefore selling turmeric in *mandis* forms a major roadblock for Punjab’s farmers growing turmeric.

Lack of organized markets for turmeric and lack of post-harvest facilities in turn restrict the increase in area under its cultivation, thereby making it difficult for the diversification plan to be successful. In this regard, farmers during our interactions revealed:

> “Punjab’s soil and climate is very suitable for turmeric cultivation with an average yield of 7.5–8 tonnes and Punjab’s consumption is much higher than the present supply therefore 2.5 times increase in the area under cultivation would not affect the demand if processing facilities and marketing channels are strengthened within the state.”

### III. **Economically unviable for small and marginal farmers:**

Turmeric crop is an annual crop which requires investment in seeds amounting to approximately Rs 30000–45000. Given huge uncertainty in the price of turmeric such investments prove very risky especially for small and marginal holders. As quoted by Mr. Dhaliwal, President, FAPRO:

> “Farmers bought high quality seed of turmeric at a price of Rs 5000 per quintal in the year 2011 which was not recovered due to significant fall in final price of the produce. Moreover turmeric is a one year crop thereby low price of the crop can result into loss of income for the entire year.”

As also highlighted by P K Deivasigamani, an office-bearer of Erode-based turmeric farmers council:

> “Turmeric market has become so volatile that prices are decided not by the cultivators but by cartels and interest groups.”

Also the fluctuation in turmeric prices at an all-India level can be ascertained from the fact that it was being traded at Rs 2500 per quintal in 2007 but due to low production and high demand,

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prices reached a record high of Rs 20000 per quintal in next two years. And due to such high returns when more and more farmers shifted to its production, prices fell and at present it is being traded at Rs 3500 per quintal. Further if prices are highly volatile in the national market, it cannot be expected to remain within tolerable limits in the local in-state markets as well and hence the risk of incurring losses is greater than realizing gains. These fluctuations in prices in turn aggravate the income risk thereby affecting the certainty in income to a huge extent. Hence farmer’s price risk is quite high in the short-run because of huge price volatility and in the long-run because of in-state demand being fixed. Also highlighted by Sukhvinder Singh, a representative from FAPRO:

“In 2007-08 turmeric market price touched a record high where fresh turmeric price rose to Rs 5000 per quintal and Rs 200 per kg for dry turmeric. At present its price has been slashed down to Rs 500 per quintal for the former and Rs 50 per kg for the latter.”

Although the cost-benefit analysis of turmeric cultivation support state’s initiative of turmeric as an economical and environmentally sustainable replacement to the predominant wheat-paddy system by giving 18.52 percent rise in the profit structure with the adoption of turmeric yet the constraints in its cultivation make it an unattractive option for the farmer to actively engage in its production.

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8. MOONG

As per the Agriculture Policy for Punjab-2013 (Draft), a three-fold area expansion under moong cultivation is envisaged from 0.2 lakh hectares to 0.6 lakh hectares in the next five to seven years. This is likely to result in increased production from 5,100 tonnes to 1,53,000 tonnes.

8.1 BACKGROUND

In India, moong is one of the most widely cultivated pulse crops grown over on an area of 3508 thousand hectares with a production of 1800 thousand tonnes as in 2010-2011. Despite of India being ranked amongst the largest producers of pulses, it doesn’t meet the demand of the country as the domestic consumption accounts for 27% of world’s pulses consumption. Therefore pulses form an important import liability; as in the financial year 2012-13, India bought pulses worth $2.34 billion from other countries. Therefore encouraging pulses cultivation by shifting the area away from food grains cultivation is a great opportunity for India since an increase in cultivation of pulses such as moong would not only narrow the widening current account deficit but it would also reduce the burden of food grain storage besides reducing the colossal food grain wastages. This leaves a tremendous scope for expansion of moong cultivation at an all India level. Amongst the states, Rajasthan has been the largest producer of green gram accounting for nearly 36.07 percent share of the total production followed by Andhra Pradesh, Bihar, Maharashtra and Gujarat (Figure 8.1). These five major states together had contributed about 77 percent of total production in the country during the year 2008-2009.

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63 http://in.reuters.com/article/2013/08/19/india-agriculture-imports-idINDEE97I08S20130819
Table 8.1: Moong production in India during 2008-09

<table>
<thead>
<tr>
<th>State</th>
<th>Moong production in tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rajasthan</td>
<td>36.07</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>13.15</td>
</tr>
<tr>
<td>Bihar</td>
<td>11.07</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>10.54</td>
</tr>
<tr>
<td>Gujarat</td>
<td>6.77</td>
</tr>
<tr>
<td>Punjab</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Source: Data from IndiaStat

Punjab has highly suitable soil and climate for moong gram cultivation but it has been less popular among the farmers in Punjab hence the trivial contribution in total national production. Data suggests that in the last few years the total production of moong in Punjab has successively declined because of the rice-wheat cropping system besides the general preference towards cereals rather than pulses prevalent in the state (Figure 8.2). Consumption of pulses has also been decreased due to inflation in prices of pulses. Analysis showed a tendency of the population to substitute more expensive pulse varieties for less expensive ones.

Figure 8.2: Production of moong in Punjab

Source: Data from PunjabStat

Area under pulses cultivation has also declined significantly in Punjab (Figure 8.3). It clearly depicts that with irrigation facilities and good resources farmers have been preferring cash crops like rice or sugarcane rather than food crops. In areas like Punjab and Haryana, for instance where we get high yields, even higher than global averages – as much as 900 kg of pulses per
hectare --farmers have shifted to cash crops. But in Central and Southern India, where pulses are grown on marginal lands, the area under cultivation has increased considerably.65

**Figure 8.3: Area under moong cultivation in Punjab**

Source: Data from PunjabStat

At present the water table is roughly going down by 33 cm every year in Punjab due to continuous cultivation of paddy since the green revolution period.66 In such a scenario, moong cultivation is likely to be beneficial since it consumes very less water in comparison to the water-guzzling paddy. Moong crop requires 8 times less water than paddy crop for irrigation (Table 8.1).

**Table 8.1: Water requirements of paddy and moong**

<table>
<thead>
<tr>
<th></th>
<th>Moong</th>
<th>Paddy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Irrigation required</strong></td>
<td><strong>Sandy and loomy soil</strong></td>
<td><strong>Once in 3 weeks</strong></td>
</tr>
<tr>
<td><strong>Irrigation required</strong></td>
<td><strong>Heavy and clay soil</strong></td>
<td><strong>Once in 4 weeks</strong></td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>2 acres</td>
<td>2 acres</td>
</tr>
<tr>
<td><strong>Supply of water</strong></td>
<td>6 hours</td>
<td>6 hours</td>
</tr>
</tbody>
</table>

Source: InsedA

Therefore, pulses cultivation offers tremendous benefits to the farmers ranging from soil health and nutrient replenishment with least requirement of inputs and management which will help in restoring the damages caused by the prevailing rice-wheat monopoly.67

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65 http://www.growmorepulses.com/article.aspx?cont_id=1JjGM1BSf/c=
### 8.2 MOONG SUPPLY CHAIN IN PUNJAB

The flow of moong from the farmer (producer) to the final consumer takes place through the following steps (Figure 8.4) where in each stage different stakeholders are involved, facing constraints as well as opportunities for value addition.

**Figure 8.4: Steps between producer and consumer**

The steps involved from production to consumption include processing in the form of polishing, milling, packaging, sorting and storing with the storage requirement ranging from normal to cold. The final product can take the form of green gram whole, milled and split. The sales take place through *mandi’s* which cater only Punjabi consumers since negligible production is taking place within Punjab at present vis-à-vis the consumption (Figure 8.5) and the same is being imported from other states.

**Figure 8.5: Production and consumption of moong in Punjab**

(Data: *IndiaStat and NSSO-66th Round*)

Based upon primary research, the following supply chain(s) varying in terms of customer location have been identified (Figure 8.6).
We have identified four channels of moong supply from producers to consumers wherein arhitya’s, aggregators, millers, wholesalers, traders and retailers are the major intermediaries between the producer and consumers with the farmer as the supplier on the one end. An additional channel explains the supply chain emanating from outside Punjab with the traders outside Punjab at the starting point from where the supply takes place, via the wholesalers and retailers to the consumers within Punjab.

Despite of the significant benefits it offers in form of improved farm productivity in terms of soil health and nutrients replenishment besides the minimal irrigation requirements as compared to paddy, moong does not feature amongst the major crops of Punjab. Its cultivation requires 6-7 times less water than paddy cultivation, yet it is not as profitable as paddy owing to certain constraints that it faces presently. Therefore in light of the present scenario for the cultivation of moong let us have a look at the constraints existing both on the demand and the supply/production side.

8.3 DEMAND-SIDE CONSTRAINTS

On the demand side: the major constraint is the absence of established marketing channels for buyers.
**Exploitative hoarding practices and no opportunities for direct sourcing:**

At present there are no direct channels for buyers to purchase moong as it is mainly hoarded by the traders, who are the biggest, perhaps the only participants in the exchange process.\(^6^8\) Hoarding practices increase the price significantly but it doesn’t help the farmers in increasing his revenue since all profits are held by traders. On the other hand, customers are equally disturbed for instance, moong dal that is popular and a widely consumed pulse but in the absence of any established buying channel they cannot purchase it in bulk.

In case of paddy, Food Corporation of India (FCI) and other state-run organizations are responsible for buying paddy at a pre-determined rate from *arhitya’s*. But the trader lobby is strong in case of moong that the farmers find it difficult to get a fair price from traders even though government has set MSP on moong. Therefore the absence of alternate viable marketing channels for direct sourcing of moong where in big players such as Wal-Mart, Reliance besides Others who can directly procure from farmers, has resulted in massive exploitation by the traders.

**8.4 SUPPLY-SIDE CONSTRAINTS**

In understanding the constraints on increased production from economic viability perspective we have identified the following issues on the supply side: *dearth of research and development, and inadequate post-harvest management infrastructure*.

**I. Absence of advancements in developing new and suitable seed/hybrid varieties:**

There are two types of moong crops available in Punjab, summer moong which takes 60 days for harvest and traditional moong that takes 3-4 months. According to the farmers average yield of kharif moong is 6-7 quintals per acre and summer moong is 5 quintals per acre which is quite low as compared to the paddy yield which is 33 quintals per acre on average.

“This with the help of government schemes and the green revolution effect the yield of paddy and wheat has improved two-fold and three-fold respectively whereas pulse yield has

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\(^{68}\) Interviews
remained stagnant at 5-6 quintals per acre. Hence farmers focus on growing crops where returns are higher.”

Hence the biggest challenge for farmers growing moong is availability of quality seed. There is need to develop improved seed varieties with higher germ-plasm for higher yields to attract more farmers for diverting their area to moong cultivation.

“Provision of seeds, essential nutrients, pesticides etc to farmers at the right time will go a long way in increasing pulse production in the country.”

The real pulse problem is the availability of adequate quality seed for its production.

“In reality is that the biggest challenge for farmers who grow pulses is availability of quality seed. Also there is complete absence of infrastructure and support system to distribute among farmers and make them aware of these. What India needs is better systems at the grassroots level, not statements at the policy level.”

II. Lack of aggregation facilities at an appropriate level:
Aggregation at pre-mandi level is hampered by the absence of facilities at the direct disposal of the farmer or at least at a pre-mandi level. Whatever minimal aggregation that is taking place is done by the middlemen who have high bargaining power, which does not benefit the primary producer at all.

III. Inadequate and unscientific post-harvest management facilities:
Before reaching the final consumer, moong has to undergo various processes vis-a-vis grading, polishing, milling, sorting and packaging after being harvested. Sellers are offered a price after considering the size, colour and moisture content of the grains but in the absence of the required post harvest processing, the produce is being sold at a lower price.

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70 http://www.growmorepulses.com/article.aspx?cont_id=JfjGM1BSf/c=
71 http://www.growmorepulses.com/contribution_details.aspx?lid=fbIwNPJhC0c=
Also the dearth of the processing and storage facilities in Punjab has lead to a slower degeneration causing voluminous wastages whereas the existing plants/ facilities are highly concentrated (only available in Moga and Jagraon district).

**IV. Risky crop:**
Moong is a risky crop due to lower returns and high susceptibility to fungal and insect infection. The lower returns make it unviable for a farmer to produce moong. Besides being unattractive it is also highly susceptible to yellow mosaic disease which damages the crop and leaves the farmer to the woes of the moneylender. This feature of moong has also been highlighted by Dr. Gurdial Singh, Joint Director, Agriculture Department, Punjab:

“Low return is one of the main reasons for its unattractiveness among farmers. Yellow mosaic virus which is a fatal disease for this crop makes it high risk crop. It is very difficult to purify such virus with help of available insecticides in the market. And emergence of early rainfall damages summer moong to a great extent in its sowing-harvesting cycle. 72”

Also the varieties of moong developed at present in Punjab are prone to fungal and insect infection caused by rodents and microorganisms. 73 This deterioration of the crop further restricts the farmer in diverting his area to moong cultivation due to uncertainty and the fear of low returns.

72 Interview
73 http://agmarknet.nic.in/Greengram_profile.pdf
9. RECOMMENDATIONS

There are loopholes across the value chain for the five commodities studied. There is a dearth of state-specific research and development advancements, inadequate post-harvest management infrastructure and an underdeveloped distribution and marketing mechanism. In view of these bottlenecks, there is a need for augmentation as well as creation of new channels across the supply chain must be prioritized by the policymakers.

9.1 RECOMMENDATIONS FOR KINNOW

For profitable absorption of increasing production, addressing the constraints present on both demand- and supply-side is important. This would require creation of effective post-harvest infrastructure in the entire supply chain thereby making kinnow cultivation economically viable. In the process concerted efforts towards generating demand are also required. As stated by a PAU expert, the solution lies in

“Virus-free nurseries, waxing and scientific storage facilities, market infrastructure for quick disposal in the domestic and world markets thereby helping in shifting at least 0.5 lakh hectares from paddy to fruit cultivation.”

These efforts are likely to create a win-win situation for the farmer through increased profits. The prospects of profitable absorption or more specifically value addition for the smallholder involves higher share of the producer in consumer rupee. In the following section, we discuss the recommendations as regards specific problem areas which require support in terms of time, money and commitment.

74 http://www.tribuneindia.com/2013/20130625/edit.htm#6
I. Creating consumer awareness about kinnow

There is a need for concerted efforts to tap the national and international markets where increased kinnow produce can be absorbed at remunerative prices. To guard the farmers against too much of price fall due to increase in production, role of advertising will be crucial as it would help in raising the demand. Similar opinion has been voiced by Citrus Nodal Officer of Punjab, Dr. Gurkanwal Singh that there is a need for advertising kinnow throughout India for its versatile properties and better quality as compared to other citrus crops. Once the internal demand rises, the prices will automatically increase thus encouraging farmers to increase his area under its cultivation.

Promotional advertising campaigns must be initiated by the government like those for milk and egg in the past. Advertising the properties of fruit can play an instrumental role in increasing its demand, as rightly said by an adman that “sometimes an unexpected shower can trigger events”. Hence kinnow must also be promoted by the government agencies with appropriate taglines on the same lines as for milk and egg which were “Piyo glass full doodh” by Dairy Health Benefits Campaign and “Sunday ho ya monday roz khao andey” campaign by the National Egg Coordination Committee (Figure 9.1).

II. Grading and waxing facilities:

Grading and waxing significantly increases the marketability of the produce. If production increases grading facilities become all the more important as it will help in restricting any drop in price because then only A and B grades will come to the market/mandi and C and D grades.


Grades fixed by APEDA, Grade A : 48 kinnows/10Kg, E: 120 kinnows/10Kg

Ibid.
will be kept for processing. Waxing facilities enhance the shelf life of the fruit so that the farmer or buyer could sell it at a better price even in distant markets without incurring any huge losses. Presently there are 41 grading and waxing plants\(^7\) in Punjab that are sufficient for current level of production but with the increase in production capacity will have to be increased. Such facilities must be made available at a low cost/subsidized rate so that the farmer can secure a better price.

Viable solutions for a smallholder can be achieved by creating grading and waxing machines in a cost-efficient manner. However the location of these facilities will be a crucial factor determining their usefulness (Table 9.1).

- Grading and waxing facilities on farm,
- Grading and waxing facilities at nearby mandis,
- Grading and waxing facilities on citrus estates and,
- Mobile grading and waxing facilities.

Amongst these citrus estates and mobile machines on farm or mandi level are desirable options for grading and waxing of the produce because these are economically more viable offering wider access, cost and time efficiency. Aggregation facilities at the mandis could result in farmers facing a price lock. At the farm level, grading and waxing facilities are not efficient as self certification by the farmer would lead to lack of credibility. Also the fragmentation of land is in such that aggregation at farm level is not possible.

**Table 9.1: Location of grading and waxing facilities-optimal and sub-optimal options**

<table>
<thead>
<tr>
<th>Grading &amp; Waxing Facilities</th>
<th>Preference</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td>×</td>
<td>price lock &amp; self-certification leading to lack of credibility</td>
</tr>
<tr>
<td>Mandi</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Mobile</td>
<td>✓</td>
<td>economically viable, cost-effective, wider access, R&amp;D support</td>
</tr>
<tr>
<td>Citrus Estates</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

\(^7\) Director, Department of Horticulture Mission, Punjab
**Citrus estates** are optimal for the farmer as they provide technical know-how, expert advice and motivation besides machinery on lease. Also farmers can obtain their own equipment varying from tractors, rotavators and automatic power sprayers to tillers, ridges and hydraulic pruners at affordable prices. These estates provide pre-harvest infrastructure besides supporting the post-harvest management through mechanical grading and waxing facilities to enhance the quality of the produce. Also considering marketing directly by farmers as a pre-requisite of economic empowerment of the smallholders, the citrus estates are a step in the right direction by facilitating sale directly to large retail chains and food processing companies at better prices. Initiatives like bulk sellers meet can be organized by these estates. At present there are five such estates in Bhunga (Hoshiarpur), Hoshiarpur in Village Chunni Kalan 79, Abohar (Ferozepur), Tahliwala Jattan (Ferozepur) and Badal (Muktsar) with one of the estates in having hi-tech soil and leaf testing lab that is one of its type in northern region. This lab has been providing pesticides and insecticides on a no-profit basis to kinnow farmers for better yield and quality of the fruit. Besides this, these estates have a provision for imparting training and knowledge on inter-cropping techniques at various stages through its welfare initiatives under its mandate. If production increases, more of such estates are needed in other villages to gain wider access. In favour of these estates a farmers stated:

“I was finding it hard to survive on the earnings from my seven-acre kinnow farm because of the high production cost. I could not afford to raise loans to purchase the machinery. But now I save a good amount as I get each and every help required for the production from Citrus Estate, Bhunga on a very nominal rent. 80”

**Mobile grading and waxing facilities** helps in bringing down the farmer’s cost of production. Such mobile machines can be transported to kinnow growers instead of them transporting truckloads to the grading and waxing centers, without any spoilage or delay. To avoid the problem of self-certification the agencies responsible for providing mobile facilities can be made responsible for the same. The produce can then be transported to distant markets by reducing the spoilage loss to a great extent. The feedback to this innovation has been very encouraging especially for the small and marginal holders, as quoted by a farmer in Fazilka:

79 Report of the Joint Inspection Team on its visit to Punjab during 14-19 October, 2012 to review the progress under the National Horticulture Mission, Ministry of Agriculture, Department of Agriculture & Cooperation, New Delhi

“It is not viable for small farmers to take their produce to the grading centers. It takes both time and money and the fruit gets spoilt during loading and unloading. Since waxing and grading are very important for higher marketability, a mobile grading machine is the right answer.”

III. Processing as an opportunity for value addition:

Processing is another area where value addition has huge potential to protect farmers from price variability. It has huge potential in the value addition process especially during peak season thereby acting as a tool for price stabilization due to glut. Processing facilities offer enormous opportunity to expand in the juice market given the fact that it is presently growing at the rate of 26 percent annually.

From farmers perspective juice processing will be an economically viable option resulting in increased revenue. If kinnows of grade C and D are used for processing, the revenue is doubled (Rs 10800 per acre) as when the same varieties are not processed (Rs 5400-6750 per acre). Therefore there is a strong case in favour of processing the non-table varieties/grades owing to increased revenue (Table 9.2).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Price (Rs. per kg)</th>
<th>Yield (kg per acre)</th>
<th>Revenue (Rs. per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14</td>
<td>2700</td>
<td>37800</td>
</tr>
<tr>
<td>B</td>
<td>9</td>
<td>3600</td>
<td>32400</td>
</tr>
<tr>
<td>C&amp;D</td>
<td>Without Processing: 2-2.5</td>
<td>2700</td>
<td>5400-6750</td>
</tr>
<tr>
<td></td>
<td>With Processing: 4</td>
<td>2700</td>
<td>10800</td>
</tr>
</tbody>
</table>

Source: Primary inputs (Note: 1 acre yields 9000 kg of kinnow)

Farmers have not yet realized benefits from processing mainly due to uncertainty in plant operations and business model (Box 4.1) so confidence building is important. This will require utilizing the capacity of multi-product processing plants of Punjab to its fullest potential which will provide a shield from seasonal price fluctuations of fruits (and vegetables) which otherwise affects the farmer’s income.

Punjab Agro-Juices Limited in this regard has proposed a business model which requires constitution of an autonomous body of prime stakeholders such as progressive farmers, representatives of citrus estates and department of food processing, department of horticulture and subject experts, to procure raw materials as per market demand leading to increase in producers share in consumer’s rupee. To ensure adequate supply material at the right time and at a competitive price, contract farming needs to be encouraged. This will ensure that produce of a given specification will be promoted by the cooperative society for assured supply to the processing facilities.\(^8^2\) The autonomous body can further plan, manage, supervise and control besides packaging and marketing the finished product.

**IV. Sustainable processing operations:**
To ensure aggregation at a pre-\textit{mandi} level (or at the farmer’s level) opportunities for value-addition must be provided thus ensuring sustainable processing operations. Here collective representatives in the form of cooperatives operating at multiple village levels can play a crucial role in bringing together individual farmers and organizing them into groups. This would ensure substantial bargaining power, addressing the farmers across the value chain i.e. from planting to marketing. A cooperative set up on lines of agri-mart can be promoted wherein a virtual market place model can be introduced to support the cooperatives in facilitating information exchange between buyers and sellers.

**V. Making the kinnow farmer financially better-off:**
Adequate steps in the form of programmes and schemes need to be taken by the Government to ensure a continuous flow of income to the smallholder. Since farmers would have to wait for three to four years to bring the crop to fruition, the Government should try and persuade financial institutions to provide easy finance to growers. Special agriculture loans such as the one being given by NABARD for instance can be promoted. Besides easy availability of credit, proactive citrus policy initiatives can help in creating greater profitability and soil sustainability.

**VI. Capacity building initiatives:**
Intercropping (for instance ginger and turmeric alongside kinnow) can increase the profitability of the farmer and make it more favourable compared to wheat-paddy rotation system. Kinnow

\(^8^2\) Punjab Agro Juices Limited : Primary interview
cultivation is likely to get a boost if capacity building efforts are promoted. Therefore knowledge on intercropping needs to be imparted in terms of what crops to sow and in what periods. Such awareness programmes can be arranged by agriculture universities and government agencies at villages (individual or aggregated as 10-20 villages taken together).

9.2 RECOMMENDATIONS FOR MAIZE

For maize developments along the value chain are needed in view of the existing constraints, from research and development advancements to a better post harvest management infrastructure. Besides this special emphasis needs to be laid upon developing local use based varieties and promoting them as a brand. Direct and easier access to retailers for marketing the use based varieties is also important.

I. Need for research and development initiatives:

In view of agriculture intensification happening in Punjab in the recent years, it is important that the pace of research and development activities in terms of better/hybrid seed varieties, quality fertilizers (providing maximum resistance from diseases), improved cropping techniques (alternate water-saving practices) and latest machinery and farm equipment must be attuned. The need for better seed/hybrid seed variety is realized not only for greater yield but to enhance the quality of grain and make it more processable.

For assuring better yields there is a need for import of germplasm and seed material best suited to the soil type and the temperate climate of Punjab. Here educational institutions, public and private organizations can assume joint responsibility.

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83 Interview
Fertilizers are an important agriculture input and its quality can be upgraded. Also rice and wheat cropping system has a well placed weed management system so farmers feel reluctant in moving from rice and wheat cultivation to maize.

Another crucial aspect of research and development is on the technology side i.e. mechanization which has supposedly reached at its saturation point. Onus should be laid upon residual treatment equipments & multi-purpose equipments for maize for instance.

Lastly, experimentation and knowledge dissemination must be encouraged in order to replace water guzzling practices with water saving ones. In this regard an important research experiment was done by Rice Research Institute; in northern Gangetic plains over a time span of two years long extensive field study that found the prevailing system of puddled transplantation of rice (CT-TPR) is surpassed by an alternate and more environment friendly cropping system of maize-moong-wheat (again with zero-tillage). This cropping system can be a solution in areas with extreme water scarcity. The above conservation and diversification based alternate cropping system is feasible from the point of view of efficient resource use (water, labour and energy) also resulting in larger economic benefits. Our analysis also supports the adoption of this system on account on higher profits than the rice-wheat rotation i.e. Rs. 65530 per acre annually for the former while Rs. 53660 per acre annually for the latter.

To give a push to more research and development in the maize value chain, patent regime can be an incentive for innovators. Also public-private partnership research and development model in terms of joint research and development efforts must be encouraged further alongside the government’s continual efforts for instance Krishi Vigyan Kendras.

**II. Post- harvest management infrastructure:**

Processing facilities both at the end of the primary producer and distributors need to be upgraded and provided (where missing) for value addition as it enhances the quality, safety and competitiveness of the produce. Processing and drying facilities which at present are inadequate in Punjab need to be established considering the highly perishable nature of maize. To meet the current deficiency in drying, grading and packaging facilities integrated plants that combine the

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84 “Optimizing intensive cereal-based cropping systems addressing current and future drivers of agricultural change in the northwestern Indo-Gangetic Plains of India”; Gathala Mahesh et.al

85 Interview
benefits of dryers and separators are required. Dryers are essential for post-harvest management of maize because dry maize sells better in the market and is beneficial to the farmer in terms of increased shelf life of their produce. These integrated plants ensure that all steps which are necessary for value addition are done at one place and the graded product is picked up by the starch manufactures even with high moisture content.

An important step in this direction has been taken by the setting up of a state of the art drying plant in Garhshankar (first of its kind in the country) while the financial viability study of setting up the second one is under consideration. However there are serious issues because the present capacity of the dryer is in excess of the produce in the adjoining areas. In view of this, it is recommended that more of such facilities must be set up across Punjab but the capacities should be small to medium i.e. the capacity of individual dryers should be around 50 quintals instead of 160 quintals. Therefore instead of making massive investments in setting up huge capacity dryers that are likely to remain unutilized for a major part of the year and under-utilized while operating, a smaller portion should be invested for the same; say 5 crores out of 9 crores while the rest of the investment can be made for making maize platform. This is likely to benefit the farmers and to motivate them to grow maize by assuring value addition.

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**Establishing sound post-harvest management infrastructure across the maize value chain**

- Integrated Grading & Drying plants
- Locating aggregation facilities at pre-mandi level
- Restrict exploitative practices against bulk handling
- Developing quality supply chain infrastructure specially for exports to distant markets
- Encourage Contract Farming for providing quality inputs (seeds & fertilizers) and latest technology

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86. Interview
88. Present capacity of the maize dryer
89. Interview
III. **Tapping export potential of baby corn:**

In the recent years, baby corn has emerged as a profitable option for the farmers.

“A farmer on average can earn Rs 25,000 to 35,000 per acre every quarter against Rs 40,000 to 50,000 that they can make from wheat and paddy in the entire year.”

Baby corn has huge export potential if it is processed into pickles and canned products thereby improving its shelf life. In this regard the government needs to ensure that a sound infrastructure for its export is established right at the producers end in terms of processing facilities to transportation and marketing facilities at the distributors and retailers end.

IV. **Maize estates:**

Owing to the highly perishable nature of maize, there is a need to have aggregation facilities at pre-**mandi** level that would ensure better returns to the farmer by reducing the role of middlemen besides assuring minimal spoilage. Also the post-harvest management facilities in the form of integrated plants (as discussed above) are highly recommended by experts and leaders of cooperative organizations. But in this regard it would be important to state that farmers are skeptical about using the grading and sorting facilities, therefore adequate training and awareness creation amongst the farmers in this regard would be highly useful.

Citrus estates in the state are a best model for development of maize estates along similar lines. Such estates can be set up in different areas whereby each can focus on different use based varieties besides providing technical know-how and post harvest implements at marginal rates.

V. **Contract farming:**

Contract farming, which is still at a nascent stage in the agriculture set up of Punjab needs to be established with adequate regulatory support and a conducive environment. Especially for maize there is a need for an assured supply of quality inputs (seeds & fertilizers) and latest technology under the purview of contract farming.

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91 Interview
VI. Exploring the processing potential of use-based varieties:

Maize is being used as poultry feed, cattle feed, flour, green fodder and baby corn. There is a need to come up with innovative, cost-efficient yet agriculturally sustainable practices for producing and marketing them given the fact that there is huge demand for them both nationally and internationally.

Poultry feed has 60% of usage\textsuperscript{92} of the total maize, has huge demand from South East Asian countries like Vietnam, Malaysia, Taiwan and Bangladesh. Here corn gluten can be used as poultry feed and plants of baby corn can be used after harvesting as a fodder. This would help reduce the expenses of the farmer who will not have to reserve his land for growing green fodder.

Maize based alternate products for consumption such as popcorn and sweetcorn need to be promoted. There is a need to come up with better corn seed varieties for popcorn which is suitable to consumer’s preferences. This is likely to play an important role in shifting the demand of American corn to Indian corn for popcorn. As stated by Raj Kumar Gupta, Team Leader at the Borlaug Institute:

“There is a need to develop more usable (processable) and commercially viable varieties of maize. Why can’t we have our own variety of Indian corn rather than consuming American corn? There is a need to introduce new grading methods and initiatives like prototype testing.”

Ethanol which is processed/ fermented from the corn starch can be a useful environment friendly fuel blended with petrol by contributing immensely towards sustainability in terms of energy saved by switching to this crop. One quintal of maize yields upto 41 litres of ethanol in India besides yielding useful by-products in the form of distilled dried grains that can be used as cattle, fish and poultry feed because of its high protein content. The Cabinet Committee on Economic Affairs (CCEA) has also made it mandatory for Oil Marketing Companies (OMCs) to blend 5 percent ethanol in petrol from 2013 onwards. Since ethanol can be produced by fermentation, this acts as a useful way for economies without an oil industry to reduce its petrol imports. Therefore Punjab must grab this opportunity through ethanol production.

\textsuperscript{92} Interview with starch manufacturer
9.3 RECOMMENDATIONS FOR WOOD

Within the supply chains identified, there are bottlenecks that must be addressed so as to ensure financial stability and security for the farmer. Therefore in view of the strengths and the weaknesses in large scale adoption of agro-forestry in Punjab; we give the following recommendations from the view point of the smallholder (Figure 9.2).

Figures 9.2: Key recommendations for profitability from agro-forestry practices: small farmer’s perspective

I. Research and development:
R&D is perhaps the strongest push-factor; an impetus to increased productivity that is extremely crucial, hence there is a need for introducing high yield varieties of saplings for successful absorption of increased produce.93

There is a need to create awareness on agro-forestry especially at small farmer’s level, since a vast majority of farmers said that they are not very well aware of the techniques both basic and advanced technologies, planting materials, planting methods (inter-cropping) and the marketing aspects of agro-forestry. Awareness on high input intensive agro-forestry practices must be imparted amongst the farmers in Punjab (Figure 9.3). As a best practice by a progressive farmer

93 http://www.fao.org/docrep/007/ae535e/ae535e06.htm
in Haryana, this includes the application of fishpond sludge and urea to promote fast growth and high-value productivity\textsuperscript{94}.

\textbf{Figure 9.3: High Input Intensive Agro-forestry as a Best Practice}

Besides there is a need to set up a formalized procedure for quality certified planting materials at reasonable rates. This envisages the need for joint efforts between public and private sector to speed up the efforts further. We suggest that efforts should be made to impart training to the farmers to ensure they adopt modern agro-forestry practices. Initiatives such as Greening Punjab Mission by Punjab Government (launched in 2013) is a positive step in the areas of seed collection, storage, nursery and planting techniques of poplar, usage of quality clones of poplar for agro-forestry, silviculture and after care of agro-forestry plantation, insect pests of agro-forestry species and their management, economics and marketing. We have identified three alternate methods of inter-cropping namely block plantations, line/boundary plantations (Figure 9.4) and plantations on unproductive areas. Farmers must be informed and made aware about them since awareness is significantly affecting adoption levels in Punjab. Such awareness programmes can be arranged by agriculture universities and government agencies at villages (individual or aggregated as 10-20 villages taken together).

\textsuperscript{94} http://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/PUB122/RR122.pdf
II. **Marketing infrastructure:**
Aggregation at a pre-**mandi** level can attract buyers such as retailers, brokers and manufacturers. At these aggregation points, farmers can directly market their produce which assures greater profitability by establishing a common platform for the buyers and sellers. Real-time information sharing between these buyers and the farmers post the aggregation can be supported by a virtual information sharing system. This would ensure informational efficiency since price and demand are determined in advance and ensure benefit to the farmer in particular who could now make an informed decision prior to deciding what amount to sell and at what price.

III. **Funding for the farmer:**
To take care of the funding constraint, the government can consider a Perennial Cash-Flow Model which would assure a continuous flow of income to the farmer. In the proposed model; government (through its financial subsidiary like NABARD) could take on multiple years contract (spanning from 4-6 years) upon assessment of the proposed land. This loan would be renewable on annual basis through a contract signed between the bank and the farmer. The government would provide yearly payments to the farmer to cover the cost of cultivation previously done by the farmer. Once the harvest is ready, the loan can be repayed by the farmer.

### 9.4 RECOMMENDATIONS FOR TURMERIC

There is a need to develop a mechanism to cope with the rising uncertainty in price movements hitting the small and marginal farmers the most thereby discouraging the new ones too to adopt turmeric under the diversification programme. Therefore concerted efforts need to be adopted in order to make turmeric cultivation a popular practice in Punjab. In this regard we propose the following recommendations:
I. Promotion of cooperative models such as FAPRO:

Encouraging the role of cooperatives with self help groups (SHGs) at the bottom of the pyramid for procuring and processing (that will greatly enhance the shelf life of the produce) will help in stabilizing the prices. Such cooperatives can be set up at an intra state level. For instance, the cooperative farmers produce promotional society, FAPRO (Box 9.1), acts as a processing unit besides imparting training and technical know-how to the farmers. Such cooperatives act as a boon specifically for the small and marginal holders.

Box 9.1: FAPRO case study

Farmers of district Hoshiarpur found their way to make turmeric production commercially profitable through the initiation of FAPRO cooperative, a farmers produce promotional society founded in 2001 by a group of 178 members/farmers. The society has set up its processing unit, granted by the government under Rashtriya Sam Vikas Yojana to process their farm produce such as turmeric, pulses and honey in Village Kang Mai, district Hoshiarpur.

Today, 'FAPRO' is well-known for its quality and low-priced products. Eighty five of its members are small and marginal farmers that reap rich dividends growing turmeric on 600 acres. As there are no middleman involved in the entire value chain of turmeric, FAPRO is able to buy turmeric produce at fair price which is also one of the mandates of FAPRO i.e. maintaining fair trade for farmers. As a result of which the farmer members are not growing wheat and paddy anymore. For marketing, he mentioned that the society has opened its own retail outlet with six more in the offing, admitting however that the retail network was capable of selling only a fraction of the total produce.

II. Availability of post-harvest management technologies:

Post-harvest technologies are vital for turmeric production. Fresh turmeric can’t be stored for more than 3 days therefore post-harvest management for turmeric is essential for quality produce. Post–harvest management of turmeric can be improved by considering the following solutions:

a. Turmeric estate model: In order to make turmeric a commercially viable crop for farmers and traders, post-harvest management facilities are highly recommended by market experts and leaders of cooperative organizations. Turmeric requires far less water for cultivation as compared to paddy therefore rain-fed regions and water scarce areas can be utilized for turmeric
cultivation. Kinnow estates in the state are the best models to replicate for the development of turmeric estate. Turmeric might not be profitable for farmers of all regions in the state thereby turmeric estates can be organized according to the soil and water suitability.

b. **Mobile boiling machines:** Traditional method of boiling turmeric is highly time consuming and labour intensive. And in absence of mechanized processing facilities in the state small and marginal farmers are incurring heavy losses due to huge transportation cost for ferrying their produce to processing units in far off places. As a replacement, mobile boiling machines can be provided to farmers on rental basis. National horticulture mission (NHM) even provides 40 percent subsidy on the machine. Mobile boiling machines are highly cost effective for boiling of turmeric and can be jointly held by several districts. As quoted by Chaman Lal Vashisht, Chief Agriculture Officer\(^95\):

> “Mobile boiling machine costs around Rs 6-7 lakhs. Farmer can hire a machine by paying Rs 4500 for a day. Its capacity is 16 tonnes per day therefore it can boil turmeric produce of 2 acres in one day. FAPRO have already rented it to the farmers in Haryana and Uttar Pradesh (Figure 9.5).”

\(^95\) Interview

**Figure 9.5: Mobile boiling machine at FAPRO**
It is evident from the above discussion that processing facilities are a prerequisite for profitable absorption of turmeric, if increased as a consequence of the draft policy. Therefore from viability point of view (both time and cost), processing units should be established near turmeric estate(s) to minimize the expenses on transporting the produce along the value chain.

9.5 RECOMMENDATIONS FOR MOONG

Despite being a sustainable cropping practice, the farmers have not adopted its cultivation actively in view of constraints being faced by the farmer. This calls for concerted efforts to be made in order to make moong cultivation a popular practice in Punjab. In view of this we have put forward the recommendations that the stakeholders must ponder upon in order to realize benefits from increasing the area under moong cultivation as regards the diversification plan.

I. Creating alternate channels for marketing and distribution:

Alternate marketing channels need to be established where in the well established big players like MARKFED can directly procure from farmers thus reducing middleman exploitation. To cater to the rural segments, agencies like ATMA can assume this role. A similar step in this direction has been taken in the form of ‘Kisan- Huts’ under the Agriculture Technology Management Agency (ATMA) scheme for moong specific areas in Punjab, where training and marketing assistance is given for moong cultivation. At present the farm hut model is functioning in Roopnagar and Patiala with the latter having 3 retail outlets already. An official opined, as regards the growing popularity of this model:

Amritsar has also opened Kisan Hut retail outlet in the city. Kisan hut retail in Amritsar will also sell homemade pickles, organic jaggery, kheer of sugarcane juice and saag packed in earthen pots with makdi roti.

Therefore the Government actively needs to promote this Kisan-Hut model where the farmers can market and sell their produce themselves.

II. Scope for research and development advancements:

- **Increasing the yield of Moong**
  - Supply of Good Quality Hybrid Varieties

- **Promoting the cultivation of Summer-Moong**
  - Awareness and Trainings

**a. Supply of good quality seeds:** Considering differences in the yield of paddy and wheat to all the other crops, as the major factor responsible for dominance of wheat-paddy cultivation unless research and development advancements are not generalized across all the crops, diversification will not be successful. As regards the prospects of moong cultivation, it has been found that good and hybrid quality seeds of moong gram are not being made easily available to farmers which are a prerequisite for better yields. Also in view of moong being highly susceptible to failure on account of being prone to yellow mosaic disease, the hybrid varieties must be resistant to it. As seeds are the foremost requirement for any crop cultivation, sufficient supply of seeds to farmers should be the foremost concern, to increase cultivation of moong in the Punjab. Besides making the availability of better quality seeds easier, the government agencies must also assure that these seeds should be provided at subsidized rates. This would be important so as to ensure that the poor farmer’s cost of cultivation of the crop does not increase if he shifts from his present cultivation practices.

**b. Promotion of summer moong cultivation:** Moong cultivation can be made a viable option both economically and ecologically if partnered with crops like maize. As a complementary crop; the short duration summer moong emerges as a successful option. The cost benefit analysis shown in table 7.2 below supports the cultivation of both summer and spring moong alongside maize and wheat, thus an economical and environmentally sustainable replacement to the predominant wheat-paddy system by giving comparable revenues with no significantly large costs compared to wheat-paddy cultivation.
Table 9.3: Cost-benefit analysis from moong cultivation

<table>
<thead>
<tr>
<th>Crop Cycle</th>
<th>Revenues (Rs per acre per year)</th>
<th>Cost (Rs per acre per year)</th>
<th>Profit (Rs per acre per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat + Paddy</td>
<td>68050</td>
<td>14390</td>
<td>53660</td>
</tr>
<tr>
<td>Maize + Wheat + Summer Moong</td>
<td>71900</td>
<td>14370</td>
<td>57530</td>
</tr>
</tbody>
</table>

Source: Research Team

Summer moong crop is economically more viable for the farmers than kharif moong as it is only a 60 days crop and can be grown in between period from 10 April -10 June as an additional crop in between the wheat harvest and sowing of paddy. In order to promote summer moong there is a need to bring awareness about the value addition of moong to the crop cycles.

*Therefore awareness about summer moong amongst the farmers* is required which can be brought about through print as well as mass media in terms of advertisements and articles in the newspapers stressing upon the value addition of summer-moong to annual crop rotation. Also the benefits of moong gram residual in the form of green foliages in increasing the fertility of soil must be conveyed to farmers. In this regard, academia can play a very important role of information dissemination with government’s support.

**III. Establishing post-harvest management infrastructure:**

Once moong is harvested it needs to be polished, milled, packaged and sorted before it can be made available to the consumer. In view of this there is a need to establish a comprehensive post-harvest supply chain infrastructure both at the *mandi* as well at a pre-*mandi* level (village or multiple villages) level. Proper processing ensures better price, lesser spoilage while its availability at a pre-*mandi* level would ensure reduced involvement of middlemen and lesser price manipulation. Schemes like ATMA can work with the government in this regard in setting up of such facilities at low costs and minimal complexities to assure maximum adoption.

9.6 OVERALL RECOMMENDATIONS

In view of bottlenecks across the value chain of the five commodities in terms of dearth of state-specific research and development advancements, inadequate post-harvest management infrastructure and an underdeveloped distribution and marketing mechanism; the following recommendations are given targeting the constraints at present. Firstly, state-specific research and development must be encouraged through provision of better/suitable seed varieties,
mechanization and trainings & awareness (for instance, on intercropping practices in case of agro-forestry). In this regard, special commodity specific estates such as kinnow estates need to be replicated for other commodities like maize and turmeric across Punjab.

Sound infrastructure for post-harvest management of the produce needs to be established. For kinnow this would require augmentation of grading & waxing facilities and setting up processing facilities, for maize medium-sized drying and grading facilities, for moong all the facilities from sorting to packaging and mobile boiling facilities along with drying and grading for turmeric. To ensure efficient marketing, channels must be developed focusing upon a direct exchange between the farmer and the buyer with minimal role of middlemen (traders). Initiatives like FAPRO, Kisan-Hat and Agri-Mat need to be expanded and replicated, wherein besides direct marketing the post-harvest aggregation facilities can also be provided at a pre-mandi level. Consumer awareness for locally produced use-based varieties of corn (such as baby corn) and kinnow must also be prioritized in view of expanding the demand through brand building and marketing. Besides these, to ensure continuity in flow of income for commodities like kinnow and poplar that have a long gestation period, perennial loan options must be made available and accessible.

At each stage across the value chain for each of the five commodities there are bottlenecks and unless these are addressed, farmers will not be encouraged to step up of the wheat-paddy cultivation practice. This would make the proposed diversification plan unsuccessful. Therefore a comprehensive approach addressing constraints at each stage is recommended. In view of this, multi-commodity estate i.e. SAADA Kendar facilitating pre-mandi aggregation can offer common solutions.
This pre-mandi aggregation center (SAADA Kendar) can offer the following facilities:

- There is a need for Punjab and even region specific research on seed varieties, fertilizers and pesticides as also district level research on account of varying topography, climatic and geographical conditions. This can be done at the aggregation point itself.

- Training and extension programmes to ensure effective information dissemination on best practices, methods and techniques can be arranged within the premises. Role Model Schemes for farmers will be very effective.

- Common facilities for post-harvest processing can be setup i.e. PHM infrastructure for multiple commodities such as kinnow, maize, moong etc. can be set up together. Processing capacities for value addition can also provided for a suitable commodity portfolio at the aggregation point. Besides this, the aggregation point can have some facilities that are common for all the commodities such as soil testing facilities.

- Buyers such as retailers, brokers and manufactures can also be attracted to these aggregation points and ensure that farmer’s margin remains intact. The aggregation
point can ensure clustering of the produce from the villages which attracts buyers and retailers on account of economic viability. This can be extremely beneficial in case of maize, moong and turmeric. In case of wood, farmers can have a direct dealing with the buyer with real time information sharing between them post the aggregation supported by a virtual information sharing system.

- Funding for the farmer could be facilitated by allying up with cooperative financial institutions supported by NABARD. Self help groups can also use these facilities for value addition and sale of products.
10. CONCLUSION

The deteriorating agricultural health of India’s granary on account of depleting water table and loss of soil fertility owing to the dominance of rice-wheat cropping system has stressed upon the need for immediate policy intervention. The diversification drive initiated by the Punjab government in terms of the Agriculture Policy for Punjab (Draft) is envisaged as a necessary step in order to shift the land presently under rice and wheat to environment friendly kharif and rabi crops. However the success of the proposed diversification policy initiative will not only be realized by achieving environmental sustainability alone but also by increase and greater stability in farm incomes.

To analyze the feasibility of expanding area under cultivation for crops other than paddy and wheat, in this report a dedicated market research of five commodities namely kinnow, maize, wood, turmeric and moong was done. The idea was to understand their current baselines as to the existing market opportunities in terms of their demand, markets and products for selected crops in Punjab and then analyzing the opportunity to increase the demand with existing channels, and the constraints therein. The constraints identified below have posed a major roadblock in making the cultivation of alternate crops profitable in Punjab which needs to be addressed on a priority basis.

An indifference towards making research advancements and providing extension services has emerged as a prominent but missing link. In the absence of which improvement in yields and awareness on innovative plantation methods can never be realized. The remarkable research and development progress that has been taking place for rice and wheat has lead to the dominance of this cropping system in the state. For instance, in case of maize because of inadequate research and development, its cultivation is impaired with technology, mechanical and quality fatigue. Also the seeds that are available are not best suited for the climatic conditions of Punjab and as a result provide lesser yield. Similar is the case for wood cultivation, whereby shortage of quality planting material, inadequate training/awareness on progressive agro-forestry practices need immediate policy attention. In case of kinnow, moong and turmeric too, there is inadequacy of research and development on new and use based varieties.
The state needs a strong push on post-harvest management. For instance, in case of kinnow there is a dearth of processing facilities for the lower grade varieties besides inadequate storage, transportation, grading and waxing facilities. For maize, which is a highly moisture contented crop; there is an absence of drying facilities which has made the crop susceptible to huge spoilage and reduced its intake by the processing industries. Again for moong and turmeric, the post harvest infrastructure for boiling (in case of turmeric only), grading, polishing, milling, sorting and packaging is highly inadequate and underdeveloped. Therefore the dearth of post harvest management facilities has lead to low profitability, thereby affecting the large scale adoption of these commodities as a cultivation practice in the state.

The distribution channel from the farmer/producer on the one end to the consumer on the other is distorted by the presence of middlemen such as arhitya’s (mandi traders). These traders are charging exorbitant fees from the farmer as a result of which farmer’s share in consumer’s rupee is negligible. For instance in case of kinnow it was reported that arhitya’s buy only selected quality produce and delay payments besides charging exorbitant fees. Also there is an absence of mandikaran for commodities such as moong and turmeric as also dearth of commodity-specific mandis like in case of wood. In case of maize, small farmers face problems due to lack of direct access to the retailers for selling use-based varieties such as babycorn.

Demand is also constrained on account of fixed demand for commodities such as kinnow and turmeric. Besides, there is low demand for use-based maize varieties produced locally such as popcorn and babycorn. On the whole, awareness or brand building for local varieties of kinnow, maize and turmeric has been missing. The potential for value addition for kinnow, maize and turmeric has been unmet as a result of which demand increase is unlikely. Funding is also an issue for commodities such as kinnow and wood which have a long gestation period due to absence of a continuous income flow over several years.

For all the five commodities there are common bottlenecks across the value chain so a consistent approach is required instead of commodity-specific solutions. In view of this, multi-commodity aggregation of the produce at a pre-mandi level similar to citrus estates can offer common solutions. This can serve as an intermediation point between a village and a mandi for say 10-20 villages. This pre-mandi aggregation setting can be an extension of citrus estates and AgriMart.