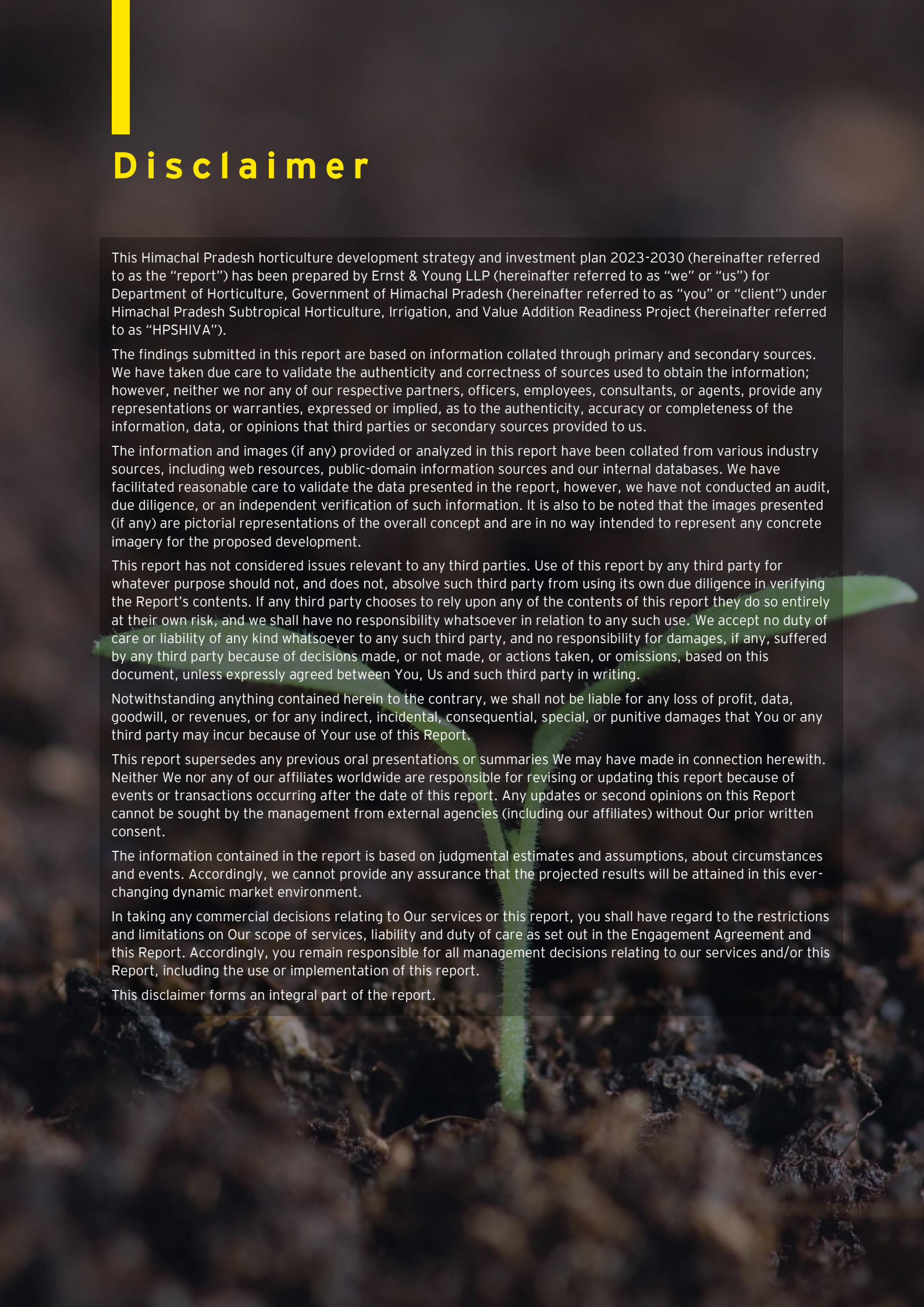


Himachal Pradesh Subtropical Horticulture, Irrigation & Value Addition Project Readiness Financing (HPSHIVA PRF)

CS03: Value Chain Report





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List of abbreviations

ADB	Asian Development Bank
AMS	Audit Management System
APEDA	Agricultural and Processed Food Products Export Development Authority
APMC	Agricultural Produce Market Committee
CA	Commission Agent
CA Store	Controlled Atmosphere Store
CAC	Codex Alimentarius Commission
CAN	Calcium Ammonium Nitrate
CFB	Corrugated Fibreboard
CHF	College of Horticulture and Forestry
CHMPA	Community Horticulture Production and Marketing Association
CII	Confederation of Indian Industry
CODEX	Codex Alimentarius collection of food standards
CoE	Centre for Excellence
DIPH	Department of Irrigation and Public Health
EA	Executing Agency
EMS	Environment Management System
e-NAM	Electronic National Agriculture Market
EU	European Union
EUREPGAP	Euro-Retailer Produce Working Group Good Agricultural Practice
EY	Ernst & Young
FAO	Food and Agriculture Organization (of UN)
FBO	Food Business Operators
FICCI	Federation of Indian Chambers of Commerce and Industry
FICS	Food Import Clearing System
FLD	Front Line Demonstration
FLRS	Food Licensing and Registration System
FoSCo	Food Safety Compliance System
FoSCRIS	Food Safety Compliance through Regular Inspection and Sampling
FPO	Farmer Producer Organizations
FRE	First Round Estimate
FSM	Food Safety Mitra
FSSAI	Food Safety and Standards Authority of India
GAP	Good Agricultural Practice
GLOBALGAP	Global Good Agricultural Practice
GoHP	Government of Himachal Pradesh
GoI	Government of India
GSP	Generalised System of Preference
GST	Goods and Services Tax
GVA	Gross Value Added
Ha	Hectare
HACCP	Hazard Analysis and Critical Control Points
HIMCU	HP Fruit Canning Unit
HIMFED	HP State Cooperative Marketing Federation
HP	Himachal Pradesh

HPMC	Horticulture Produce Marketing and Processing Corporation
HPSAMB	Himachal Pradesh State Agriculture Marketing Board
HPSHIVA	Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition
HSDF	Himalayan Sustainable Development Forum
HSDSIP	Horticulture Sector Development Strategy and Investment Plan
HYV	High Yielding Varieties
IA	Implementing Agencies
ICC	Indian Chamber of Commerce
IHR	Indian Himalayan Region
ILO	International Labour Organization
InFLoNET	Indian Food Laboratory Network
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IPR	Information and Public Relations (of GoHP)
ISO	International Organization for Standardization
J & K	Jammu & Kashmir
JICA	Japan International Cooperation Agency
KCC	Kisan Credit Card
KII	Key Informant Interview
KVK	Krishi Vigyan Kendra
LLP	Limited Liability Partnerships
MC	Market Cost
ME	Marketing Efficiency
MIDH	Mission for Integrated Development of Horticulture
MI	Millilitre
MM	Marketing Margin
MMGRS	Mukhyamantri Green House Renovation Scheme
MP	Madhya Pradesh
MRL	Minimum Residue Limited
MSME	Micro, Small and Medium Enterprise
NABARD	National Bank for Agriculture and Rural Development
NAFED	National Agricultural Cooperative Marketing Federation of India Ltd.
NBFC	Non-Banking Financial Company
NHB	National Horticulture Board
PAM	Project Administrative Manual
PAN	Permanent Account Number
PCDO	Progeny cum Demonstration Orchard
PMU	Project Management Unit
PoP	Package of Practices
Ppm	Parts per Million
PPP	Public Private Partnership
PRF	Project Readiness Financing
PS	Price Spread
RKVY	Rashtriya Krishi Vikas Yojna
R-WBCIS	Restructured Weather Based Crop Insurance Scheme
SAARC	South Asian Association for Regional Cooperation
SDG	Sustainable Development Goal
SME	Small and Medium Enterprise

SOP	Standard Operating Procedures
SPS	Sanitary and Phytosanitary Measures
SQ	Service Quality
SRE	Second Round Estimate
SWOT	Strength, Weakness, Opportunity, and Threat
TBT	Technical Barriers to Trade
ToR	Terms of Reference
TSS	Total Soluble Solid
UHF	University of Horticulture & Forestry
UIDAI	Unique Identification Authority of India
UP	Uttar Pradesh
USA	United State of America
UV Rays	Ultra-violet Rays
VCA	Value Chain Analysis
WBCIS	Weather Based Crop Insurance Scheme
WHO	World Health Organization
WUA	Water User Association

Executive Summary

The Government of Himachal Pradesh (GOHP) has commenced the prestigious project “Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition (HPSHIVA)” from Project Readiness Financing (PRF) loan approved by Asian Development Bank (ADB) in December 2020. The PRF project (or HPSHIVA-R) is being implemented for two years over 2021-2022, and thereafter an ensuing project or HPSHIVA is planned to be implemented after the PRF project completion.

The HPSHIVA project is targeting a minimum of 25,000 farm households (10,000 hectares) in 1000 clusters/ villages in 28 blocks across 7 districts namely Bilaspur, Hamirpur, Kangra, Mandi, Solan, Sirmour and Una in the subtropical low hills zone and some in the mid hills subhumid zone of the state. The project aims to

- ▶ expand irrigation provision to farmers
- ▶ increase subtropical horticulture production and its climate resilience, and
- ▶ raise the profitability and farm gate price of sub-tropical horticulture production through value chain development of targeted commodities.

The Executing Agency (EA) and Implementing Agencies (IAs) are same for both PRF and HPSHIVA projects. The EA is the Department of Horticulture (DOH), and two IAs are DOH and Jal Shakti Vibhag.

The Project Management Unit (PMU) of HPSHIVA invited proposals from qualified agencies to develop Himachal Pradesh Horticulture Development Strategy and Investment Plan 2023-2030 (CS03), which will guide the overall future development of the HP horticulture sector and the HPSHIVA project design. One of the deliverables under this assignment is to develop horticulture Value Chain report for selected sub-tropical fruit crops. Ernst & Young LLP (EY) has been appointed, and accordingly deputed a qualified team for the assignment. The EY team interacted with PMU, concerned line departments, and key stakeholders as well as conducted field assessment to prepare this report. Eight sub-tropical fruit crops namely, Sweet orange (*Citrus sinensis* osbeck), Guava (*Psidium guajava*), Litchi (*Litchi chinensis*), Pomegranate (*Punica granatum*), Mango (*Mangifera indica*), Plum (*Prunus domestica*), Persimmon (*Diospyros kaki*), and Pecan (*Carya illinoensis*) as per crop prioritization analysis.

Key Assessment and Findings

i. Comparative advantage of Himachal Pradesh

EY team found that the Himachal Pradesh has a comparative advantage over other states of India for sub-tropical fruit production owing to climate and soils. The morphological and climatic conditions of HP have natural advantages. A wide degree of variation in the climatic conditions, especially night and day temperature allow diversification of the horticulture-based livelihood options. Sub-tropical fruits in HP are naturally adapted to warmer climates and many varieties of the fruit tree species are resilient to various indicators of climate-related stresses. The fruits like mango, litchi, citrus, pomegranate, etc. ripens late as compared to the adjoining plain areas, resulting into competitive advantage in the market, favouring better price realisation. A greater variation in day and night temperature also results in excellent appearance related to colour and build-up of requisite sugar acid ratio, in addition to appreciable exquisite flavour.

This above characteristic has resulted in shifting of land use pattern in HP from agriculture to fruit crops in the past few decades. There has been 300 times increase in area (from 792 hectares to 2.33 lakh hectare) and 700 times increase in production (from 1200 MT to 8.45 lakh MT) in last 70 years, from the year of 1950-51 to 2019-20. The area under citrus, predominantly, sweet range and other sub-tropical fruits have increased from 1,225 hectares and 623 hectares in 1960-61 to 25,051 hectares and 56,079 hectares in 2019-20, respectively.

The highest positive trend in production of sub-tropical fruits is noted in Mandi district, followed by Kangra and Sirmour. The overall production trend is growing, and the trend line shows that it will continue in the future, All the districts of sub-tropical zone have showed a positive average annual growth in the area for the cultivation of sub-tropical fruits for the period from 2014-15 to 2020-21 except Una district. Bilaspur district has the highest growth in the expansion of production area followed by Sirmour, whilst the rest of the districts have average annual growth rate of cultivation area expansion of 1%.

ii. Marketing analysis

Generally, fruits are sold by the farmers in HP without any value addition or primary processing (grading, or packing) activities. Majority of fresh fruits are sold in Azadpur Mandi, New Delhi, or in Pathankot and Chandigarh in Punjab/Haryana, Yamuna Nagar in Haryana, Paonta Sahib and Jessore in Himachal Pradesh and Narwal mandi in Jammu. In recent years, processing and canning of fruits have started taking place, and the Himachal fruits are sold not only as fresh but also as processed fruits. The processed products from fruits are beverages, jams, jellies, candies, preserves, canned fruits, dehydrated fruits, pickles, soup mixes, sauces, and ketchups. Fruit products that have growing demand, especially in the Middle East countries include pickles, chutneys, fruit pulps, canned fruits, concentrated pulps and juices, and frozen fruits.

All fruits arriving at the APMC yards have shown an increasing growth trajectory during 2020-21. However, Sweet oranges have shown significant growth rates. Conversely, plum is the only produce, which has shown a sharp decline during the period, which could be due to direct sale to whole sale market outside the state or decline in production.

In relation to export market, it was observed that China, Ireland, Thailand, and Spain distinctly show rising trend in the import of fruits and vegetables from the base year 2016. Whilst more advanced economies like Japan and Germany show a decline in the rate of import of fruits and vegetables. The analysis by EY team forecasted that the total volume of fruits and vegetables imported by the **best twenty countries in the world (Referred as “B20”)** would be around 236,436 MT by 2030 having an annual average growth rate of 10%. Whilst B20 countries form 84% of the world import, this share will grow to 88% by 2030. In the Emerging Markets (EM, as defined in **Annexure IV- Table 99**), total volume imported will expected to be 58,545 MT by 2030 and has the highest annual average growth rate of 21% as compared to World (7%) and they form the 10.5% of the B20 and 15.3% of the import volume for fruits and vegetable of the World. Thus, it clearly shows Emerging Markets (EM) to be the future markets for fruits and vegetable.

Among the biggest ten importers (B10) with positive growth in import value, China, Ireland, Thailand, and Spain has a higher rate of growth and the trend seems to show a faster growth rate than the rest of the countries with positive growth, and this will continue into the future. These markets also provide the highest price per MT.

Interestingly, there is a growing market of fruits in domestic market due to growing number of health conscious population and having more disposable income. Therefore, there is a need to explore domestic high end market with branding indicating superior quality of HP fruits.

iii. SWOT Analysis:

The EY team conducted Strength, Weaknesses, Opportunities and Threats (SWOT) analysis of the Value Chain of sub-tropical fruits in Himachal Pradesh which identifies the unique features of the State.

The HP government has demonstrated strong political will to support small & marginal farmers by promoting horticulture for better livelihood options. The region is blessed with rich biodiversity and abundant untapped water resources of perennial rivers and its tributaries, and suitable Agro-climatic condition. The soil is rich in organic matter which helps in nutrient inputs. There is institutional support for research and development coupled with dissemination of technology by KVKs.

The team identified main opportunities for creation of infrastructural facilities with the active participation of private sector; convergence with government schemes (RKVY, MIDH, micro-irrigation, road access, etc.). Opportunity also exists for value addition at commercial level having to produce certified food products. Geographical location and climate provide opportunities to target high value domestic and export market. The opportunity for exploring more market for high competitiveness of HP fruit due to late arrival and excellent quality also exist in HP.

The main weaknesses identified in value chain development are high dependency on government for capital, inadequacy of initiative at farmers' level, lack of functional value-added infrastructural facilities, poor market access due to hilly terrain, and poor business acumen among the farmers. Inadequacy of knowledge of the technology, and market intelligence are also other weaknesses.

The main threats identified are unexpected climate changes, uncertainty in trade scenario, inadequacy of social agreement among the members of producer associations which may lead to domination & disruption by certain agents. There is also a threat to socio-economics condition of the region if potential is not harnessed, which exist in the region, owing to climate and soil added with competitiveness in marketing and better price realisation of fruits and chance of youth migration in search of employment.

iv. Value Chain analysis:

a. Market analysis:

The value chain for sub-tropical fruits in HP starts with farmers, who are responsible for production, harvesting, and many times cleaning, grading, and packing of the produce. The produce then flows to the local and distant traders, who directly procure, and transport fresh fruit produce from farmers. A very small quantity of fruit produce also goes into the processing. The fruit produce from traders

reach to wholesalers/retailers, which subsequently reach to the final consumers, mostly in fresh form. The field visits to the farmers' fields in Mandi, Bilaspur, Hamirpur, Una, Sirmaur, Kangra and Solan districts revealed that the supply chain of sub-tropical fruits involves multiple intermediaries depending on the point of sale and the destination market.

The most prevalent supply channel observed in the clusters was sale via aggregates traders. It was learned, during interactions with the farmers, that in most cases the traders approach them and buy the fruits directly at the farm gate. The transportation from the farm-gate is arranged by the traders. Another prevalent marketing chain involves farmers selling the produce directly to local retailers in the markets. This mainly happens when there is an immediate cash requirement by the farmers. In such cases, the transport is arranged by the farmers themselves.

In certain cases, the farmers directly sell to distant wholesalers/ traders in Delhi, Mumbai and faraway places. This channel is normally opted by bigger farmers who have larger volume of fruit produce and who have ability to organize and market the fruit produce of fellow farmers. In such cases, the price negotiation is done beforehand, normally over phone. Based on that the harvested fruits produce is brought to the market. The traders sometimes sell the produce to local retailers through which it finally reaches to the consumers.

Another channel noted was through pre-harvest contractors, who contact the farmers and fix a price during the time of flowering/fruitletting. They inspect the field, forecast the estimated production, and then negotiate price with the farmers. Thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce.

The least preferred marketing channels observed during the field assessment is through the processors. This is mainly due to inadequacy of required number of processing units, inadequacy of transport facilities from farmers' fields to the processing units, poor bargaining power, and absence of procurement facilities by the processing units. Most of the processors are family-owned businesses, having low capacity and capital.

b. Analysis of Production:

The major gaps observed at production level are small and fragmented land holdings, rendering it difficult to reach economic threshold and inadequate soil testing. The most important constraint in area expansion is non-availability of disease-free quality planting materials of required varieties. Inadequate availability of organic manures and non-adoption of scientific package of practices, including cultivation, training, pruning, irrigation and plant protection are also key concerns. The poor fruit set due to poor availabilities of pollinizer has been observed. Considering the high degree of perishability of the fruits, inadequacy of temperature-controlled vehicles is a constraint in transportation. Insufficient numbers of pack-houses and Cold Storages are also a major constraint in sub-tropical fruit supply chain in HP.

c. Post-harvest management analysis:

Inadequacy of optimally distributed post-harvest infrastructure (grading, sorting, cold stores, etc) poses huge challenges in maintaining an even supply of raw materials for the fruit processing

industry. In addition, lack of on-farm primary processing facilities, such as grading, and sorting hamper the quality of raw material and limit the growth of processing industry.

Packaging and other downstream subsidiary industries are inadequate in the state. For example, majority of the packaging material is currently being brought into HP from neighbouring places like Delhi and Chandigarh. This increases the cost of packing material and subsequently builds up the cost of product. Transportation within the state suffers from monopoly by unions. Given the hilly terrain and limited competition, there is hardly a level playing field in the transportation segment, which makes the freight charges uncompetitive. Currently, most of the processing of sub-tropical fruits are done at household level with some small-scale organized facilities.

Though Himachal Pradesh has opened the marketing sector for private investment, development of alternative marketing arrangements outside the regulated wholesale markets have been limited. There are a few private players like Adani Agrifresh Limited, Devbhumi Cold Chain Limited, and others which have established controlled atmosphere storage facilities at different locations in Himachal Pradesh, specifically for apples. At present these operators are buying directly from farmers and the fruits are sold through a nationwide network of dealers. By taking control of the produce early in the chain and then storing the same till the off-season, the CA store operator can make the highest margin in the chain.

v. Climate change impacts and mitigation measures

The EY team also conducted assessment on effect of climate change on sub-tropical fruit production. It was found that the climate change has emerged as a major concern for the horticulture sector in HP, with visible changes in productivity and quality of fruits. The two major parameters of climate change that has far reaching implications on horticulture are (i) erratic rainfall patterns, and (ii) unpredictable high and cold temperature spells. It is predicted that due to rise in temperature, heat accumulation will be faster, resulting in speedy development and early fruit maturity. For example, citrus, mango, guava etc. will mature earlier. Delay in monsoon, dry spells, , and untimely rains during water stress period, erratic temperatures during flowering and fruit growth, and hailstorms are some of the most encountered climatic conditions being experienced by the fruit growers.

Due to high temperature, physiological disorder of horticultural crops is more pronounced. Climate change is predicted to have a direct impact on the occurrence and severity of diseases in horticultural crops. As per the estimates from Himachal Pradesh State Action Plan on Climate Change, annual temperatures are expected to rise for all seasons with significant decline in snowfall in mid-hills temperate wet agro-ecological zones. The frequency of rains is expected to increase but with diminished average intensity creating drought condition. Since temperature will rise in sub-tropical region the frequency of frost will decline which will reduce the risk of frost injury in Mango, Guava and Litchi.

The most effective way to manage climate change variations is to adopt conservation horticulture, using renewable energy, water conservation, reforestation etc. to sustain the productivity. Modification in present horticultural practices to the use of mulching, dripper /pulse irrigation, training and pruning and integrated management of insect pests is recommended. Development of new cultivars of horticultural crops tolerant to high temperature, resistant to pests and diseases and

producing good yield under stress conditions need to be promoted. Adoption of hi-tech horticulture and judicious management of land and water use should be the main strategies to meet the challenges due to climate change.

Recommendations

The major recommendations for value chain development of the sub-tropical fruits in the state are:

- ▶ As under HPSHIVA project, non-availability of disease-free quality planting material is one of the major constraints in Value Chain, it can be recommended that Hi-tech nurseries, having facilities to produce quality planting material, ensured by indexing for all the targeted fruits should be established. Till nurseries established in HP start producing required planting material, the required planting materials should be obtained from outside the states only from accredited nurseries. Quality of planting material be assured before delivery to the farmers.
- ▶ Since small land holding and scatteredness are major constraint, land consolidation of interested group to develop cluster is needed so that cluster development approach for each fruit can be established having backward and forward linkages, as is done in FLD and PRF clusters.
- ▶ Implementation of technological package of practice for pre-production, production, harvest, post-harvest, transportation, and marketing level at different nodes of value chain is required to be taken up in regionally differentiated manner to reap maximum benefits.
- ▶ Poor fruit set in sweet orange, litchi, persimmon, pecan nut etc. reported is attributed to inadequacy of pollinizer. Since these fruits are largely dependent on honeybees for effective pollination, it is essential that Bee Keeping is promoted, which shall provide pollination service and add to income of farmers by sale of honey, bee wax and other product of bee keeping.
- ▶ Climate change which will lead to rise in temperature and uncertainty of rain fall coupled with higher concentration of CO₂. High temperature may reduce the risk of frost and high CO₂ will enhance photosynthesis. However, due to high temperature fruit set may be affected, yield may reduce, and maturity period may increase. Thus, it is recommended to adopt to change by modification in cultivar and practices. Mulching, fertigation, Integrated pest management should be encouraged. New crops like dragon fruit, Jamun, Bael etc. should be introduced which are less vulnerable to the climate change.
- ▶ Since most of fruits have gestation period of 3-5 years and space is available in between the rows, it is recommended that intercrops should be adopted. In intercrops, largely leguminous crop should be preferred which enrich the soil and provide additional income to farmers in initial years.
- ▶ At group of clusters, there is a need to establish collection centres. These proposed centres are 70 in number and to be constructed in phased manner depending on the production capacity. The business plan has to be supported by subsidiary activities like bee keeping, mushroom cultivation etc.
- ▶ There is a need for establishment of 13 packhouses at district level, 3 processing units (new/upgradation), one cold room in pack house with mango ripening facilities and one pecan processing unit. Integrated facility center, deciding upon the components based on location may be explored.
- ▶ A state level body can be located at PMU office. The primary responsibility of this unit will be quality control, certification, branding and market promotion.
- ▶ To reach the difficult areas seven (7) gravity ropeways installation are proposed.
- ▶ For the capacity building and quality production, at state level 3 trainings are proposed, one training for every 2 years for state manager, experts and DoH officials.
- ▶ Training and capacity building support shall be provided to 17 Managers, 34 technicians and 170 skilled workers.

- ▶ It is suggested to appoint one (1) Horticulture Extension Functionary for every 25 hectares (i.e., 400 Horticulture Extension Functionaries for 10,000 hectares) in proportion with plantation schedule and training shall be conducted accordingly.
- ▶ These Horticulture Extension Functionaries will, in turn train all the 25,000 farmers which may coincide with the plantation schedule. As 25 farmers are estimated in each cluster, 1000 training events will be needed to be organized in proportion with plantation schedule. Each training shall be of 1-day duration.
- ▶ Out of the clusters, motivated and diligent individuals will be selected and trained to serve as micro entrepreneurs in the state. The capacity of the microentrepreneurs will be enhanced by conducting four (4) trainings every year from 2023 to 2025, eight (8) in 2026 and 10 each in 2027 and 2028 with participation of 50 in each training.
- ▶ DDH, SMS, HDO and HEO from each district should be given one day orientation on Value Chain Management, Promotion of linkage with financial and non-financial institutions, one (1) day exposure visit within the State and one to three - days exposure visit outside the state and one (1) exposure visit outside India.
- ▶ Pack house and processing unit models have been suggested to implement with 70% grant from Government and 30% equity contribution which may be a SME loan taken from a bank by the promoters, or in this case the Cluster Association, or any entrepreneur.

1. Introduction and Context

The Indian Government has recognized the potential of horticulture sector in the country's economic growth and job creation. It also recognizes the need for certain strategic shifts to enable and facilitate the structural transformation, such as:

- ▶ transition from traditional food-grain production towards diversification of higher value nutritious crops such as fruits, vegetables, and dairy products.
- ▶ transition from emphasis on-farm production and towards value addition in the post-harvest segments; and
- ▶ emphasis on creation of adequate market infrastructure and alternate marketing channels.

The state of Himachal Pradesh (HP) is well endowed with natural resources. It also has diversity in agro-climatic conditions with possibilities to produce 'off-season' fruits and vegetables. The area under fruits, which was 792 hectares in 1950-51 with total production of 1,200 tonnes increased to 2,33,300 hectares during 2019-20 with total fruit production of 8.45 lakh tonnes¹.

The HP has two distinct horticulture production systems, viz. (i) temperate and sub-temperate horticulture; and (ii) sub-tropical horticulture. The temperate horticulture, which occurs in the high hills and valleys and cold/dry zones, is dominated by apple cultivation. The sub temperate horticulture, which is predominantly in the mid-hills zone, includes stone fruits (peach, pear, plum and apricot). The sub-tropical horticulture primarily occurs in the Low Hill and Valley zone, which includes mango, litchi, guava, citrus, pomegranate, fig, papaya, and banana production.

Horticulture in HP has been responsible for many of the positive outcomes in employment, wages, and in turn, poverty reduction. The women in horticulture continue to provide significant labour and supervisory support to pre-harvest and post-harvest activities. Notwithstanding the significant potential of horticulture production in HP, the state faces several sectoral, institutional and policy challenges which need to be addressed more systematically if the full potential is to be realized and sustainable development goals (SDGs) has to be achieved. These challenges include:

- ▶ limited access to appropriate production technologies, including availability and accessibility of elite planting materials, leading to low productivity
- ▶ insufficiently developed water management systems, leaving the state's horticulture almost entirely dependent on rainfall despite available water resources
- ▶ challenging research system and extension services, leading to inappropriate horticulture practices
- ▶ high post-harvest losses, paired with low value addition, exacerbated by inadequate storage, processing, and marketing capabilities; and
- ▶ limited institutional capacity for the development of micro, small and medium enterprise (MSME) in agro processing.

The strategy of Government of India (GoI) and Government of Himachal Pradesh (GoHP) to address the constraints to the rapid and sustainable development of the horticulture sector includes a variety of initiatives. These focus on growth through diversification into high value horticulture production by creating an environment that enables the farming community to acquire the necessary technical knowledge and capacity to capitalize on emerging market opportunities. The government is also focusing on infrastructure development, including fencing, an expanded irrigation area and improved road infrastructure. The central and state governments also emphasize on improved horticulture market linkage, particularly through e-commerce.

The Government of Himachal Pradesh (GOHP) has commenced the prestigious project "**Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition (HPSHIVA)**" from project readiness

¹Economic Survey 2020-21, Govt of Himachal Pradesh, pp.106

financing (PRF) loan approved by Asian Development Bank (ADB). The HPSHIVA project comprising, a Project Readiness Financing (PRF) USD 10 million (over two years), and the ensuing loan of USD 90 million, aims to increase the income of at least 25,000 farm households in seven districts, namely Hamirpur, Bilaspur, Solan, Sirmour, Una, Kangra and Mandi in the subtropical low hills zone and some in the mid hills subhumid zone of the state. The project aims to

- ▶ Increase income to rural households
- ▶ expand irrigation provision to farmers
- ▶ increase subtropical horticulture production and its climate resilience, and
- ▶ raise the profitability and farm gate price of subtropical horticulture production through value chain development of targeted commodities.

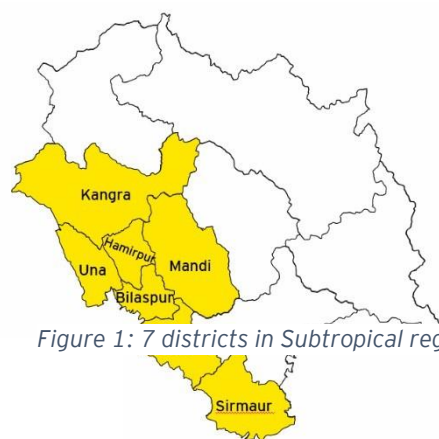


Figure 1: 7 districts in Subtropical region

The PRF project (or HPSHIVA-R) is being implemented for two years over 2021-2022, and thereafter an ensuing project (or HPSHIVA) is planned to be implemented after the PRF project completion. The Executing Agency (EA) and Implementing Agencies (IAs) are same for both PRF and HPSHIVA main projects. The EA is the Department of Horticulture (DOH), and two IAs are DOH and the Department of Irrigation and Public Health (DIPH).

The Project Management Unit (PMU) of HPSHIVA invited proposals to develop Himachal Pradesh Horticulture Development Strategy and Investment Plan 2023- 2030 (CS03), which will guide the overall future development of the HP horticulture sector and the HPSHIVA project design in particular. One of the deliverables under this assignment is to develop horticulture Value Chain report for selected sub-tropical fruit crops. Ernst & Young LLP (EY) has been awarded with this contract, and accordingly deputed a qualified team for the assignment. The EY team interacted with PMU, concerned line departments, and key stakeholders as well as conducted field assessment to prepare this report. Eight sub-tropical fruit crops namely, Sweet Orange, Guava, Litchi, Pomegranate, Mango, Plum, Persimmon, and Pecan nut were finalised for the Value Chain study based on crop prioritization.



Figure 2: Interaction with Woman Farmer on Guava Production

2. Overview of HP Horticulture Sector and Crop Selection

Indian horticulture sector contributes about 33% to the agriculture Gross Value Added (GVA) making very significant contribution to the Indian economy. India is producing about 331.05 million tons (2020-21) of horticulture produce which has surpassed the food grain production, that too from much less area (i.e., 27.05 million Ha. for horticulture against 127.6 M. ha. for food grains). Productivity of horticulture crops is much higher compared to productivity of food grains (12.49 tones/ha against 2.23 tones/ha.)².

Himachal Pradesh has made significant progress in horticulture development. The Himalayan ecosystem offers an enabling environment characterised with favourable microclimatic conditions for cultivation of a wide range of temperate to sub-tropical fruits. This characteristic has resulted in shifting of land use pattern from agriculture to fruit crops in the past few decades. There has been 300 times increase in area (from 792 hectares to 2.33 lakh hectare); and 700 times increase in production (from 1200 MT to 8.45 lakh MT) in last 70 years from 1950-51 to 2019-20.

2.1. Topography, Demography and Land Holding Pattern

The State has been divided into five major physiographic regions³, namely: (i) wet sub-temperate zone; (ii) humid sub-temperate zone; (iii) dry temperate - alpine high lands; (iv) humid sub-tropical zone; and (v) sub-humid sub-tropical zone. Himachal is a hilly and mountainous tract with altitude varying from about 350 meters to 6,975 meters above mean sea level. The region presents an intricate mosaic of mountain ranges, hills, and valleys.

According to Unique Identification Authority of India (UIDAI), the estimated population of Himachal Pradesh is 7.45 million by mid-2020⁴. About 90 percent of the state's population lives in rural areas, most of which is dependent on agriculture in some way, for their livelihoods. The Agriculture & Allied Sectors as a key sector, has been supporting about 60 per cent of the population. It registered a growth of 18.3 per cent in 2019-20 (First Revised Estimate or FRE) with a Gross Value Added (GVA) of INR 10,583 crore as compared to INR 8,949 crore during 2018-19 (Second Revised Estimate or SRE)⁵. In Himachal Pradesh, horticulture is no longer a sub sector of agriculture sector but is recognised as a sector. It has crossed agriculture in terms of value addition.

The distribution of land holdings in Himachal Pradesh has been given in Table below.

Table 1: Landholding Pattern in Himachal Pradesh

Landholding Size (Ha)	Farmer's category	No. of Holdings (lakh)	Area (lakh ha)	Av. size of Holding (ha)
Below 1.0	Marginal	7.12 (71.41%)	2.86 (30.30%)	0.40
1.0 - 2.0	Small	1.74 (17.45%)	2.42 (25.63%)	1.39
2.0 - 4.0	Semi-medium	0.82 (8.23%)	2.23 (23.62%)	2.72
4.0 - 10.0	Medium	0.26 (2.61%)	1.46 (15.47%)	5.62
10.0 and above	Large	0.03 (0.30%)	0.47 (4.98%)	15.67
Total		9.97	9.44	0.95

Source: Economic Survey, 2020-2021, pp.74

² Department of Agriculture and Farmers Welfare 2nd Advance estimates 2019-20.

³ HP at a Glance, by Information & Public Relations Bureau, Govt of HP, at <http://himachalpr.gov.in/Index.aspx?Data=31&AspxAutoDetectCookieSupport=1>

⁴ <https://uidai.gov.in/images/state-wise-aadhaar-saturation.pdf>

⁵ Economic Survey, 2020-21, pp.10

Out of the total geographical area of State (55.67 lakh hectare) the area of operational holdings is about 9.44 lakh hectares and is operated by 9.97 lakh farmers with an average holding size of about 0.95 hectare⁶. The distribution of land holdings, according to 2015-16 Agricultural Census highlights that **88.86 per cent of the total holdings belongs to small and marginal farmers**. About 10.84 per cent of holdings are owned by semi medium and medium farmers and only 0.30 per cent by large farmers.

2.2. Overview of Horticulture Production and Post- harvest

Horticulture in HP has been responsible for many of the positive outcomes in employment, wages, and poverty reduction. The area under temperate fruits, other than apple has increased from 900 hectares in 1960-61 to 27,956 hectares in 2019-20. Nuts and dry fruits exhibit area increase from 231 hectares in 1960-61 to 10,070 hectares in 2019-20, citrus and other sub-tropical fruits have increased from 1,225 hectares and 623 hectares in 1960-61 to 25,051 hectares and 56,079 hectares in 2019-20 respectively⁷.

The total area under fruit production and volume of production are presented below. It is observed that the area is increasing over the years. However, the volume of fruit production had declined from 2015-16 till 2018-19 and increased in 2019-20.

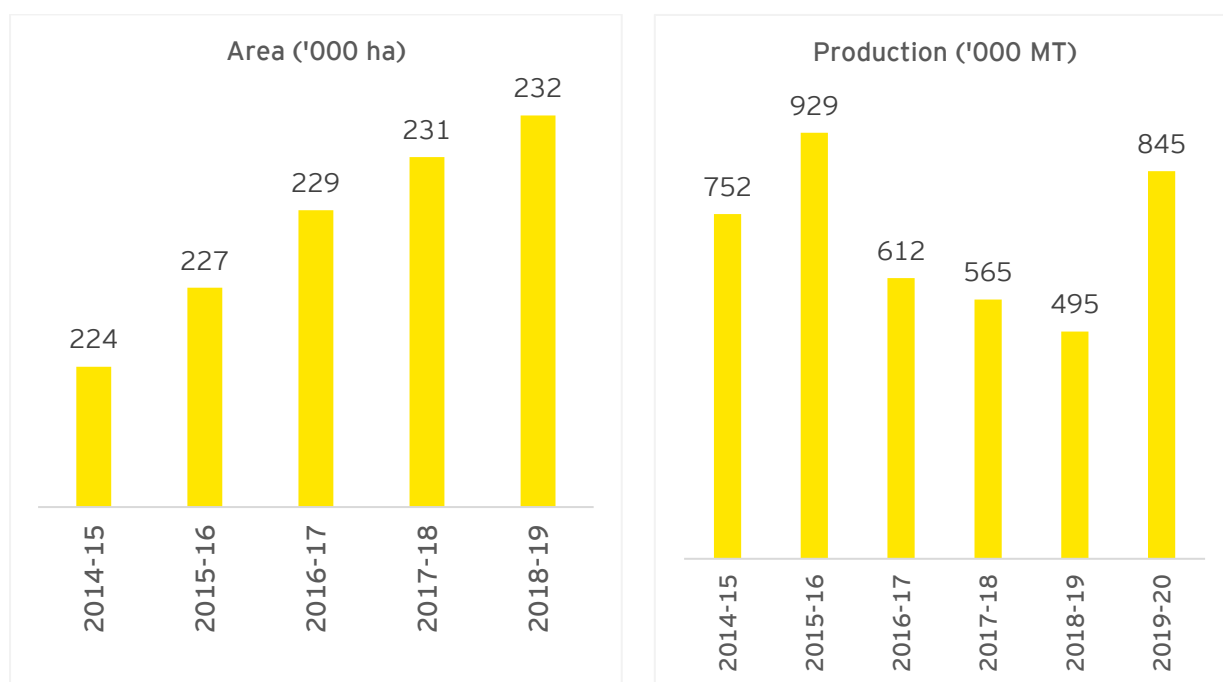


Figure 4: Total area under fruit production in HP ('000 ha) Figure 3: Total fruit production in HP ('000 MT)

Source: Department of Horticulture, Government of Himachal Pradesh

⁶ Economic Survey, 2020-21, pp.74

⁷ Economic Survey, 2020-21, pp.84

2.2.1. Sub- tropical district wise analysis

i. Production Volume:

Most of the production and arrivals in the state of Himachal Pradesh are consumed fresh, or as processed products. The production hubs that have positive average annual growth rate are Bilaspur with the highest growth rate of 40% followed by Mandi (14%), Sirmour (11%) and Una (7%). From Figure below, we can observe a positive production trend with Mandi District in the lead in producing sub-tropical fruits, followed by Kangra and Sirmour. The overall production is growing, and the trend line shows that it will continue in the future.

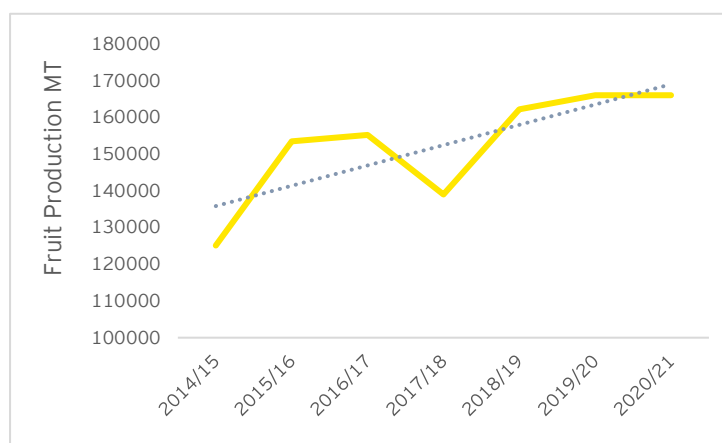


Figure 6: Total fruit production volume in sub- tropical districts

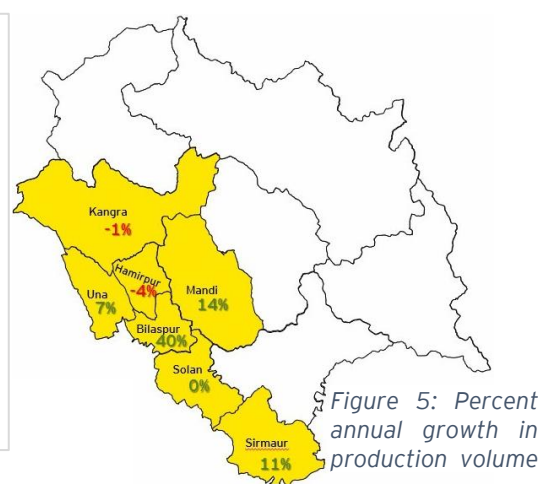


Figure 5: Percent annual growth in production volume

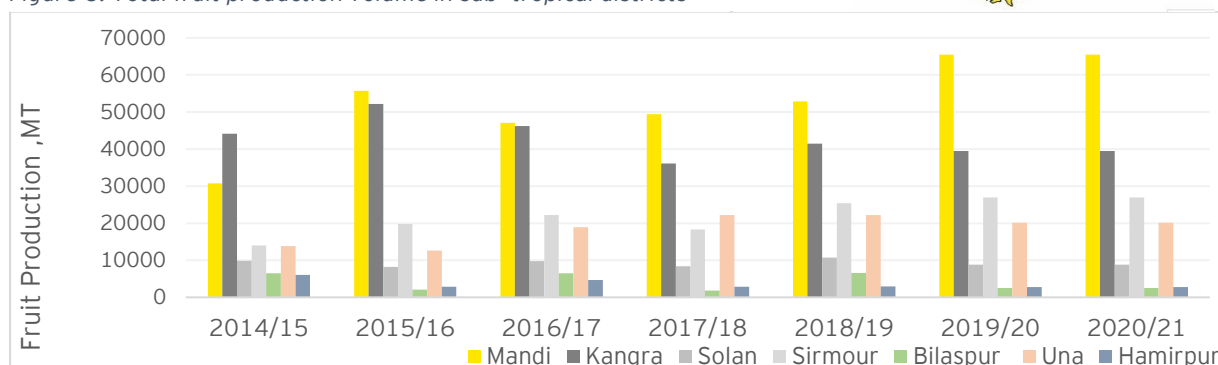


Figure 7: Trend in the production of different types of fruits in the sub-tropical zone districts of HP (2014- 21)

Source: Department of Horticulture, Government of Himachal Pradesh

ii. Area of Production

Except Una all the sub-tropical zone districts have a positive average annual growth in the area expansion for the cultivation of sub-tropical fruits during 2014/15 to 2020/21. Bilaspur has the highest growth in the expansion of production/plantation area followed by Sirmour, whilst the rest of the district have average annual growth rate of cultivation area expansion of 1%.

The figure below shows that there is an overall growing trend in the expansion of total area under various types fruits in the sub-tropical zone districts of Himachal Pradesh. Additionally, it shows that Kangra and Mandi are on the lead in the expansion of cultivated area followed by Hamirpur. This trend will continue in the future especially with the further coverage of areas under the project.

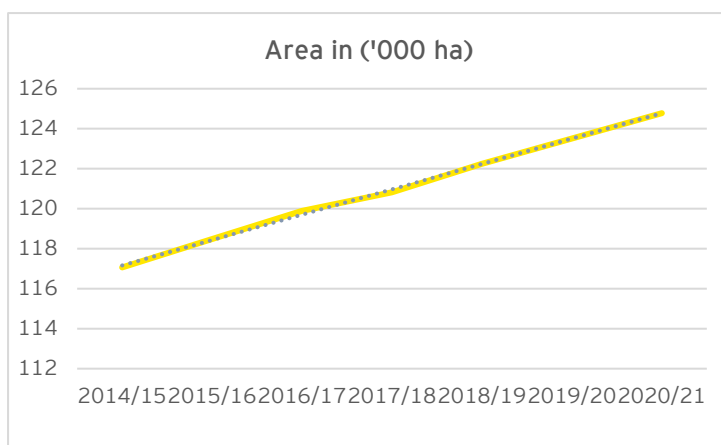


Figure 10: Total fruit area in sub-tropical districts

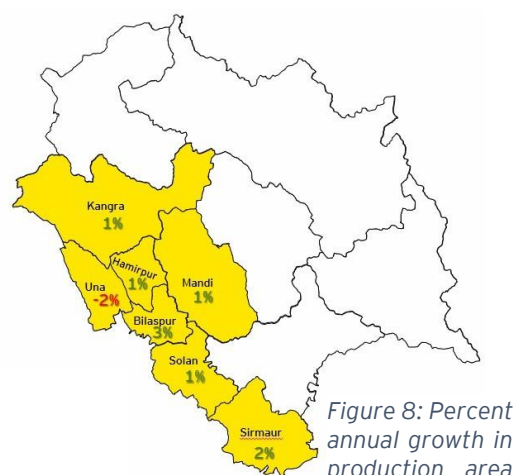


Figure 8: Percent annual growth in production area

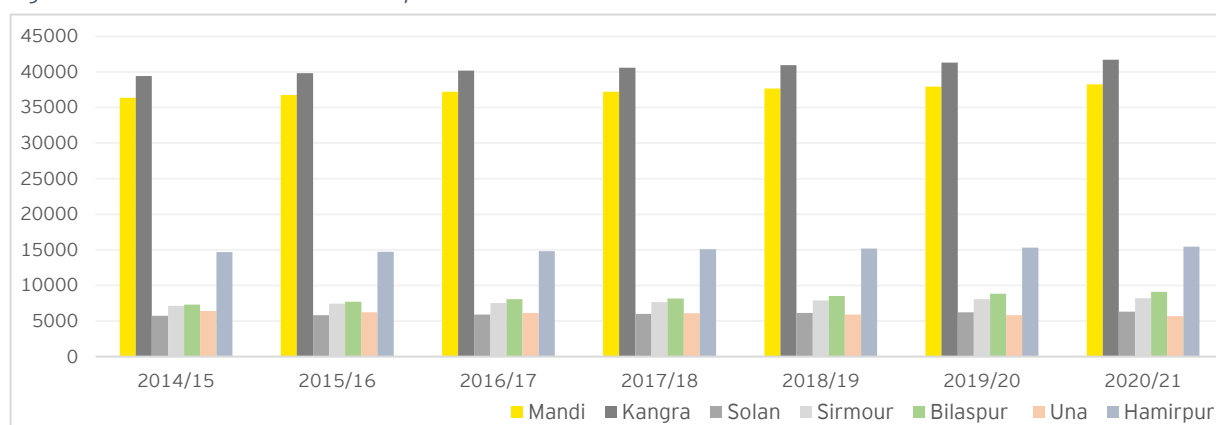


Figure 9: Trend in the expansion of cultivated area in the sub-topical zone districts (2014-21)

Source: Department of Horticulture, Government of Himachal Pradesh

iii. Post- Harvest Scenario in Himachal Pradesh

Generally, fruits are sold by the farmers in HP without any value addition or primary processing, grading, or packing activities. The grading and packing are conducted by commission agents and/or traders in market yards, although parts of farmers are aware of its importance and advantages. Majority of fresh fruits are sold in Azadpur Mandi in New Delhi, or in Pathankot and Chandigarh in Punjab/Haryana, Yamuna Nagar in Haryana, Paonta Sahib and Jessore in Himachal Pradesh. Central government has provided internal standard for grading and provisions concerning size for selected fruits such as apple, grape, mango, strawberry, pears, etc.

In recent years, processing and canning of fruits have started taking place, and the Himachal fruits are sold not only as fresh but processed fruits also. The processed products from fruits and vegetables are beverages, jams, jellies, candies, preserves, canned fruits and vegetables, dehydrated fruits and vegetables, pickles, soup mixes, sauces, and ketchups. Fruit products that have growing demand, especially in the Middle East countries include pickles, chutneys, fruit pulps, canned fruits, concentrated pulps and juices, and frozen fruits.

The food processing industry in HP is at a nascent stage⁸. A study conducted by the Industries Department, GoHP indicates that the total investment in assets, across food processing, for Small and Medium Enterprise (SME) is INR 83.75 million, with an abysmally low total processing capacity of about 1,113 tonnes⁹. The major challenges include procurement of raw materials for processors especially if it has to be done in large volumes; and lack of i) on farm primary processing facilities such as grading and sorting, ii) cold chain infrastructure and iii) forward linkages through refrigerated transportation.

Background of Post-Harvest Industry in Himachal Pradesh

In Himachal Pradesh, post-harvest processing activities of agricultural and horticultural products started towards the end of 1950s under the ICAR (Indian Council of Agricultural Research, organization under Ministry of Agriculture, Government of India) scheme for Setting up "*Himachal Pradesh Fruit Canning Unit (himcu)*".

During 1970s to 1980s, seven semi-commercial based fruits and vegetables processing industry also started at different places, to diffuse the new technology of post-harvest processing. The above Fruit Canning Units were later got affiliated to the Department of Horticulture. The Agro Industries Corporation was established in the year 1971 for providing agro-industrial support to the horticulture. Himachal Pradesh Horticulture Produce Marketing & Processing Corporation, popularly known as HPMC was incorporated on 10th June 1974 with the financial assistance of World Bank. The mandate of this organization was to provide post-harvest facilities to the fruit growers of the state and to help them to get best returns for their produce from the market.

A separate University of Horticulture and Forestry (UHF) was established in the year 1985 for providing research and development support to horticulture. Besides this several other organizations namely Himachal Pradesh Cooperative Marketing Federation (HIMFED), Himachal Pradesh State Cooperative Bank, State Cooperative Agriculture and Rural Development Bank, Himachal Pradesh State Agriculture Marketing Board etc. have also been established in Himachal Pradesh to provide the necessary support to the horticulture industry.

Source: JICA, 2009 "*Study on Diversified Agriculture for Enhanced Farm Income in the State of Himachal Pradesh*". Annex G, and HPMC website <https://hpmc.in/>

8 Himachal Pradesh Horticulture Development Society,
<https://hds.hp.gov.in/GeneralpageWithTemplate.aspx?key=PROJKEY0001>

9 MSME Development Institute, Solan, Himachal Pradesh
<https://msmedihimachal.nic.in/pages/view/146/201-small-scale-enterprises>

2.3. Crop Prioritization for the Value Chain Analysis under HPSHIVA

Himachal Pradesh lies between 31° 22'40" and 33° 12'40" N latitude and 75° 45'55" and 78° 12'20" E longitudes, bounded by Jammu and Kashmir (J & K) in North, Punjab and Haryana in the South and Uttar Pradesh (UP) in Southeast. It has an area of 55,673 sq. kilometres with a population density of 123 person/sq km, Kangra being the most populous and Lahaul-Spiti being the least populous district¹⁰.

2.3.1. Crop Prioritization

The **crop prioritization** for the value chain study was done on the basis of suitability of fruits crops in agro-climatic zones of Himachal Pradesh; importance in terms of area and production; potential for marketing and livelihoods generation, etc.

The overview of crop prioritization process has been presented below:

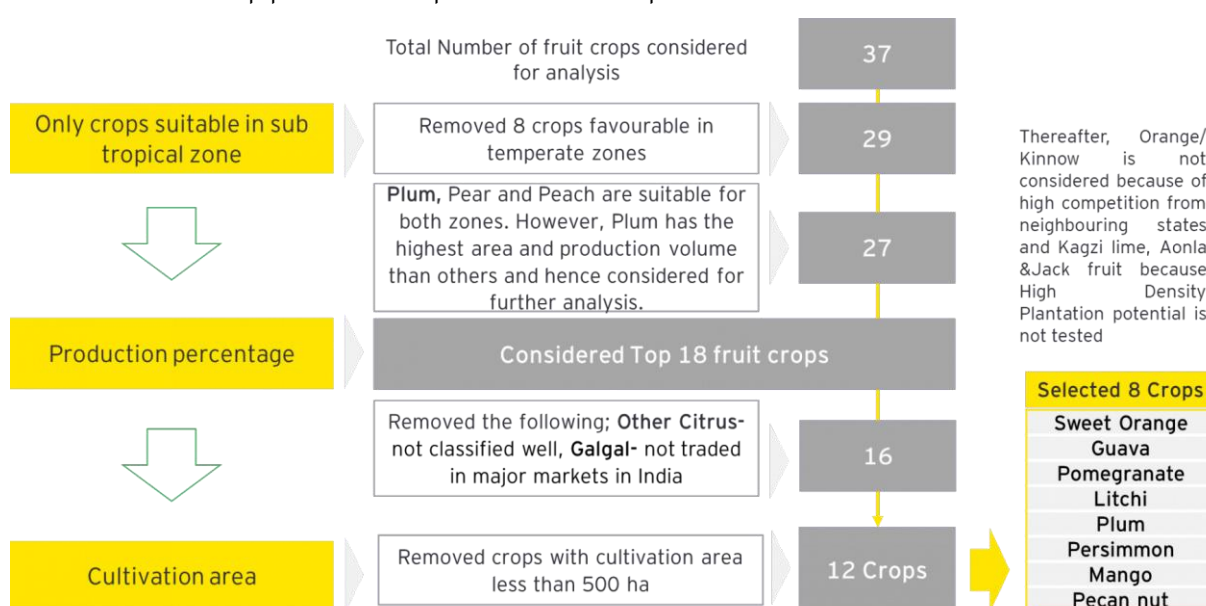


Figure 11: Summary of Crop prioritization process

Depending upon the agro-climatic conditions and the suitability for the growing of specific horticultural crops, HP can broadly be divided into four agro-climatic zones namely Sub- tropical, Submountain, Low Hill; Sub- tropical, Sub-humid, Mid Hills; Wet Temperate High Hills; and Dry Temperate High Hills & Cold Desert. The brief details of the zone wise Horticulture crops and districts covered are provided in Annexure VIII.

The total area under fruits in Himachal Pradesh is 2.32 lakh ha and production are 4.95 lakh MT. The temperate fruit production in the state occupies around 86% share in the fruits whereas sub-tropical and some crops in both temperate/sub -tropical region occupy a share of only 14% in state horticulture production. The crops that are being removed in each step are highlighted in grey.

¹⁰ India Census Net at <https://www.indiacensus.net/states/himachal-pradesh>

Table 2: Area and Production of fruits in Himachal Pradesh

Sr.No.	Fruit	Area (Hec)	% of area	Prod (MT)	% of prod	Climatic conditions
1	Apple	1,13,154	48.75%	368603	74.41	Temperate
2	Plum	8,816	3.80%	11389	2.30	Temperate/Sub-tropical
3	Peach	5,042	2.17%	7292	1.47	Temperate/Sub-tropical
4	Apricot	3,642	1.57%	4,635	0.94	Temperate
5	Pear	6,803	2.93%	9,099	1.84	Temperate/Sub-tropical
6	Cherry	453	0.20%	225	0.05	Temperate
7	Kiwi	182	0.08%	254	0.05	Temperate
8	Pomegranate	2,847	1.23%	3,215	0.65	Sub- tropical
9	Olive	29	0.01%	34	0.01	Sub- tropical
10	Persimmon	523	0.23%	877	0.18	Sub- tropical
11	Strawberry	49	0.02%	30	0.01	Sub- tropical
12	Almond	4,850	2.09%	641	0.13	Temperate
13	Walnut	4,406	1.90%	2,872	0.58	Temperate
14	Pecan nut	926	0.40%	136	0.03	Sub- tropical
15	Hazel Nut	12	0.01%	0	0.00	Temperate
16	Chestnut	0	0.00%	0	0.00	Temperate
17	Orange/Kinnow	8,816	3.80%	14,978	3.02	Sub- tropical
18	Sweet Orange	1,813	0.78%	3,227	0.65	Sub- tropical
19	Kagzi Lime	11,660	5.02%	7,490	1.51	Sub- tropical
20	Galgol	2,542	1.10%	3,291	0.66	Sub- tropical
21	Other Citrus Fruits	NA	0.00%	358	0.07	Sub- tropical
22	Mango	42,248	18.20%	43,540	8.79	Sub- tropical
23	Litchi	6,028	2.60%	5,467	1.10	Sub- tropical
24	Guava	2,344	1.01%	3,012	0.61	Sub- tropical
25	Aonla	2,587	1.11%	2,107	0.43	Sub- tropical
26	Jack Fruit	1,474	0.64%	439	0.09	Sub- tropical
27	Papaya	213	0.09%	1,254	0.25	Sub- tropical
28	Grapes	77	0.03%	131	0.03	Sub- tropical
29	Loquat	56	0.02%	47	0.01	Sub- tropical
30	Karonda	14	0.01%	7	0.00	Sub- tropical
31	Ber	30	0.01%	47	0.01	Sub- tropical
32	Sapota	45	0.02%	44	0.01	Sub- tropical
33	Fig	10	0.00%	11	0.00	Sub- tropical
34	Banana	79	0.03%	249	0.05	Sub- tropical
35	Jamun	247	0.11%	251	0.05	Sub- tropical
36	Bael	13	0.01%	26	0.01	Sub- tropical
37	Deun	59	0.03%	71	0.01	Sub- tropical
	Grand Total	2,32,099	100	4,95,349	100	-

Source: Department of Horticulture, Government of Himachal Pradesh

As a **first step towards crop prioritization**, out of the total 37 fruits, the fruits which are grown in temperate zone are removed. The 8 fruit crops that are removed are as follows (as highlighted in Grey in the above table):

- Apple, Apricot, Cherry, Kiwi, Almond, Walnut, Hazel nut and Chestnut.

Plum, Pear, and Peach have cultivars suitable for both temperate zone and sub-tropical zone. Among the three fruits which are suitable for both sub-tropical and temperate zone i.e., Peach, Pear and Plum. **Plum was selected** as it has highest area among these fruits. Moreover, the colour and overall quality of sub-tropical plum cultivars like Angeleno, Friar are comparable to temperate varieties. Thus, we considered plum for further analysis along with the remaining 26 fruit crops. Hence, out of 37, 27 crops are selected for further analysis.

After considering the climatic zones, as a **next step**, we selected top 18 sub-tropical crops as per decreasing order of their production percentage in the state are selected:

Table 3: Production of Sub tropical fruits

Fruits	Production (MT)	% of total production
Mango	43,540	8.79
Orange/Kinnow	14,978	3.02
Plum	11,389	2.30
Kagzi Lime	7,490	1.51
Litchi	5,467	1.10
Galgol	3,291	0.66
Sweet Orange	3,227	0.65
Pomegranate	3,215	0.65
Guava	3,012	0.61
Aonla	2,107	0.43
Papaya	1,254	0.25
Persimmon	877	0.18
Jack Fruit	439	0.09
Other Citrus Fruits	358	0.07
Jamun	251	0.05
Banana	249	0.05
Pecan nut	136	0.03
Grapes	131	0.03

Source: Department of Horticulture, Government of Himachal Pradesh

Out of these 18 fruits, other citrus fruits were eliminated as this is not classified well. Galgal has less commercial importance and is not traded in major markets in India.

As a **next step**, fruits having area less than 500 hectares are eliminated which includes 4 fruit crops namely Papaya, Jamun, Grapes and Banana.

Table 4: Crops having area (>500 ha)

Fruit	Area (Ha)
Mango	42,248
Plum	8,816
Orange/Kinnow	8,816
Kagzi Lime	11,660
Litchi	6,028
Sweet Orange	1,813
Pomegranate	2,847
Guava	2,344
Aonla	2,587
Papaya	213

Fruit	Area (Ha)
Persimmon	523
Jack Fruit	1,474
Jamun	247
Banana	79
Pecan nut	926
Grapes	77

Source: Department of Horticulture, Government of Himachal Pradesh

After eliminating fruits with less than 500 ha area the remaining crops are:

Table 5: Final 12 crops

Fruit	Area (Ha)	Prod (MT)	USP of the state	Market value	Remarks
Mango	42,248	43,540	Late varieties	High	Late varieties when varieties from other states are over
Plum	8,816	11,389	Better quality	High	Better quality and colour
Orange/ Kinnow	8,816	14,978		Mid	Heavy competition from Punjab Haryana and Rajasthan
Kagzi Lime	11,660	7,490	Quality production	Mid	
Litchi	6,028	5,467	Late varieties	High	Extended harvesting season till July gives comparative advantage
Sweet Orange	1,813	3,227	Special colour development on fruits	Mid	Special colour development on fruits due to cool night and warm days
Pomegranate	2,847	3,215	Very nice quality and separate marketing time	Very high	Very nice quality. Available in Sep-Oct, very less fruits in market
Guava	2,344	3,012	Variation in day and night temperature resulting in development of attractive colour	Mid	Attractive colour, better quality
Aonla	2,587	2,107			HDP potential not tested
Persimmon	523	877	Novel fruit/ Non-astringent cultivars	Very high	Quickly attracting consumers
Jack Fruit	1,474	439			HDP potential not tested
Pecan nut	926	136	Highly imported fruit	Very high	Can serve as potential revenue earner

Source: Department of Horticulture, Government of Himachal Pradesh

Further considerations for crop prioritization:

- ▶ Potential of 4 crops i.e., Guava, Litchi, Pomegranate and Sweet Orange have been already tested in High density planting in FLD clusters of the state and found successful.
- ▶ As per production cost, marketable price, and marketing avenues among citrus crops, Kagzi Lime and Sweet Orange have almost equal potential. However, high density plantation for Kagzi lime is not tried and tested.

- ▶ Kinnow also has similar potential but all the three neighbouring states i.e., Punjab, Haryana and Rajasthan are excessively focused on Kinnow. Hence, it will not have competitive advantages in price realisation.
- ▶ Persimmon, pecan nut and plum have been successful in the region. On middle hills these fruits come early in market giving them market combativeness.
- ▶ Aonla and Jackfruit potential in High Density Planting have not been well established in the studies so far. Hence, they are not considered now. However, they may be considered as future potential crops after establishing their potential in HDP

Finally, 8 crops are selected for further strategy development and nursery plant preparation. The selected crops are:

Final List

- ▶ Sweet Orange
- ▶ Guava
- ▶ Pomegranate
- ▶ Litchi
- ▶ Persimmon
- ▶ Plum
- ▶ Mango
- ▶ Pecan Nut

3. Detailed Comparative Advantage of Himachal Pradesh in Selected Fruit Crops

Himachal Pradesh has a comparative advantage over other states of India for fruit crops production. The morphological and climatic conditions of HP have natural advantage, and a wide degree of variation in the climatic conditions which allows diversifying the horticulture-based livelihoods. Due to typical and variable geological formations, faults and fractures in the rocks, there are numerous springs which are potential water resources in hill areas of the state, which can be diverted for farming fields. In this chapter, the comparative advantage of Himachal Pradesh has been discussed in detail in terms of Climatic conditions, production, and marketing in detail.

3.1. Advantage in terms of Climatic Conditions

The sub-tropical zone is characterized by high density of glacier deposits, which provides year-round supply of natural water. One of the studies documented that there are 2,554 glaciers in HP, covering an area of 4,160 Sq. Kms¹¹. These perennial glaciers plus the seasonal snow cover serve as the perennial water sources of rivers which are used as renewable sources of irrigation, drinking water, energy, and industry for lower reaches in HP. The suitable agro-climatic conditions, topography and soil types are conducive for production of selected horticultural crops. Delay in warming up coupled with cooler climate the maturity of many fruits is extended by about a month compared to similar fruits produced on the plain.



Figure 12: Meeting with CHMPA Members, Sehla Cluster

Sub-tropical fruits in HP are naturally adapted to warmer climates and many varieties of fruit tree species are resilient to various forms of climate-related stresses. The fruits like mango, litchi, sweet orange, pomegranate, etc. ripens late as compared to the adjoining plain areas, hence face low competition in the market and therefore, can get remunerative prices for their produce. For example, while in other states Litchi is harvested in May and early June, in Himachal Pradesh it is harvested in late June and early July.

The sub-tropical zone of HP receives wide variation in day and night temperature. Nights are cooler and days are warmer. This type of temperature variation favours for better accumulation of TSS resulting in excellent sugar acid ratio.

As per study finding by Dr. Maria¹², the application of UV light treatment on fresh fruits contributes to decontamination, prevent diseased and enhance shelf life and quality. The UV radiation is divided into three segments: UV-A, UV-B and UV-C. The effect of UV is directly lethal



Figure 13: Meeting with Dean and Experts at CHF, Neri, Hamirpur

¹¹Centre for Geo Informatics Research and Training, Kangra, Himachal Pradesh at http://hillagric.ac.in/edu/cobs/gis/index_files/Page2127.htm

¹² Turtoi Maria (2013), "Ultraviolet Light Treatment of Fresh Fruits and Vegetables Surface: A Review", published in Journal of Agroalimentary Processes and Technology, Volume 19, series 3, pp.325-337, at https://www.journal-of-agroalimentary.ro/admin/articole/22340L53_Vol_19_3_2013_325-337.pdf

to microorganisms, hence the term “germicidal”. The UV light (180-280 nm with maximum at $\lambda = 254$ nm) has been considered as an alternative to chemical fungicide to control postharvest diseases.

The UV also induces resistance to postharvest storage rots and to delay the ripening process extending the shelf life of fruits and vegetables. Moreover, when used at optimum level, UV light induces an accumulation of phytoalexins that play an important role in the resistance to disease of many plant systems and activates genes encoding pathogenesis-related proteins.

To summarize, the key advantages for selected fruits cultivation in HP are:

- ▶ Suitable Agro climatic condition with the advantage of growing fruit crops in late season to avoid the glut in the market. Due to cooler climate the maturity of many fruits is delayed by about a month as compared to similar fruits produced in the plains.
- ▶ Natural perennial streams with traditional irrigation system like Kuhl
- ▶ Variation in night and day temperature gives better colour and quality.
- ▶ Soil is rich in organic matter with potential for natural farming
- ▶ Government willingness and support to farmers with potential for convergence with government existing schemes
- ▶ Traditional knowledge and wisdom of growing specific fruit crops like Plum, Persimmon and Pecan nuts which can be further enhanced with technical know-how from horticulture universities and research stations
- ▶ Proximity to export destinations such as emerging markets
- ▶ Potential to commercialise fruit products

3.2. Potential for growth

The total production (MT) of the selected target 8 crops namely Sweet Orange, Guava, Litchi, Pomegranate, Mango, Persimmon, Pecan nut and Plum is presented below.

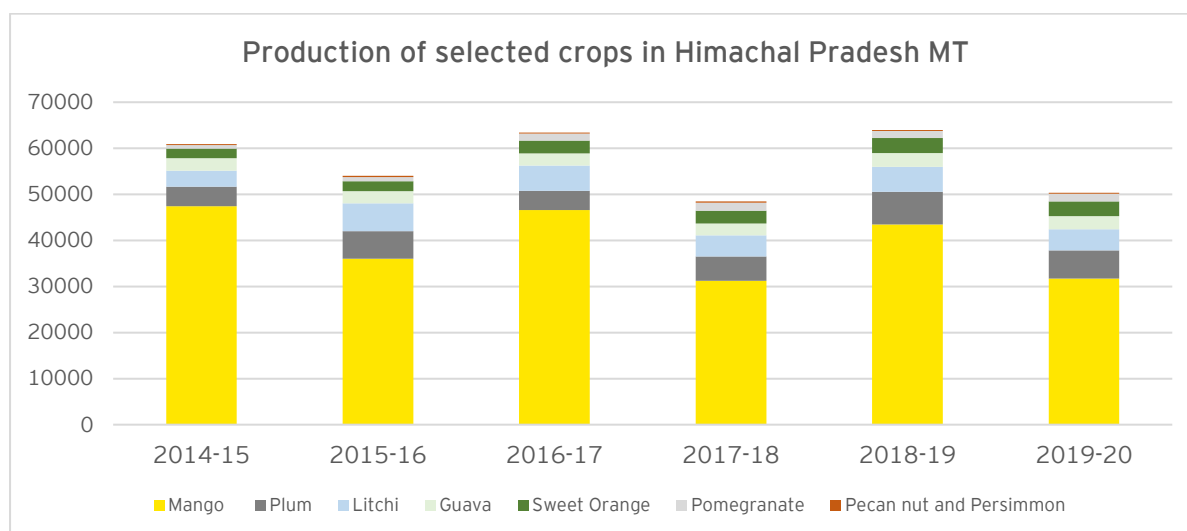


Figure 14: Production of selected 8 crops in 7 sub- tropical districts in Himachal Pradesh

Source: Department of Horticulture, Government of Himachal Pradesh

The mango production is the highest among crops varying between 30,000 MT and 47,500 MT across 7 subtropical districts in Himachal Pradesh and constitutes about 70% of total production of fruits considered over period between 2014- 15 and 2019-20. The lowest volume of production is observed in Persimmon and Pecan nut combined. The CAGR of production volume of each of the crops is positive varying between 1% to 15% and thus showing an increasing trend indicating Potential growth, except for mango (-4%). The highest CAGR is observed in Pomegranate (15%), Sweet Orange (9%), Plum (8%), Persimmon (7%), Litchi (6%), Pecan nut (2%) and Guava (1%).

The marketing of fruit is a complex process and includes all the functions and processes involved in the movement of the produce from the growers to final consumers. The number and type of the functions, the cost of performing these functions, the margins, or profits of those who perform these functions and the competition in the trade all these vary from commodity to commodity, time to time and from place to place.

According to the JICA study in HP, about 70 to 80% of the fruits produced in the State are marketable surplus¹³, and there is huge export potential of agriculture and horticulture products to other States not only in fresh conditions but as processed foods.

The market analysis of the fruit crops highlights the potential for increased cultivation in Himachal Pradesh. The characteristics of the principal market Yard/ Submarket Yards of APMC, for the year 2020-21 is presented below. The market arrival indicator shows the level of domestic trade that Himachal Pradesh is having with fruits with respect to Total arrivals (fruits and vegetables). In Sirmaur APMC, 5668 Quintals of fruit arrivals in 2019-20 and 16,785 quintals of vegetables arrivals in 2018-19 are recorded. Sirmaur is not included in analysis because of lack of data. It is observed that total fruit arrivals in Sirmaur APMC is 27% of total arrivals¹⁴.

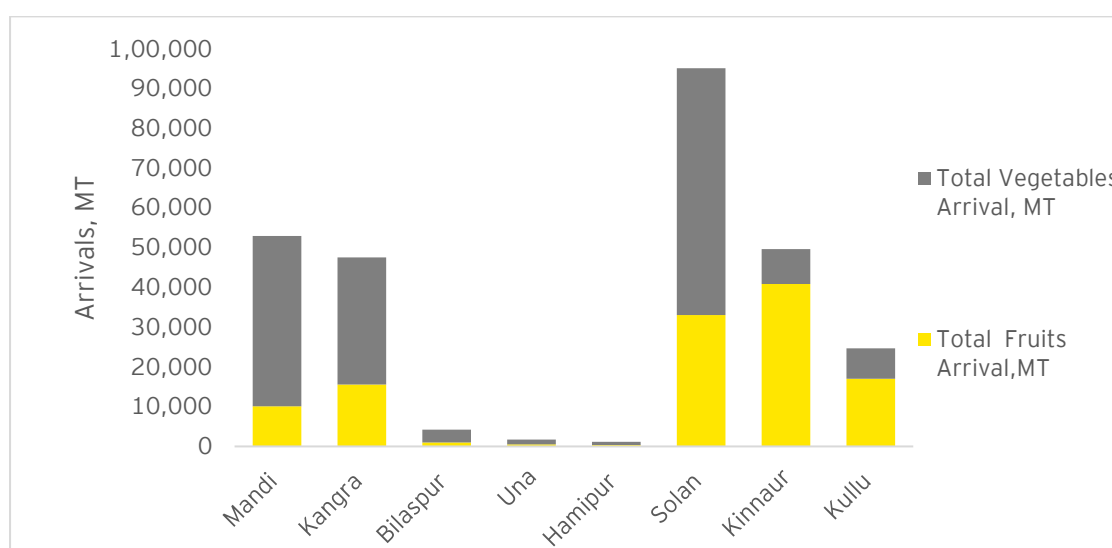


Figure 15: Trend of fruits and vegetable arrivals

Source: APMCs in Himachal Pradesh

Table 6: Percentage of fruit arrivals wrt total arrivals (fruits and vegetables)

Market Arrival Indicator	Mandi	Kangra	Bilaspur	Una	Hamipur	Solan	Kinnaur	Kullu
Total Fruits as % of Total Arrival	19%	33%	24%	30%	28%	35%	82%	69%

Source: APMC in Himachal Pradesh

As can be seen from above, Kinnaur APMC had the highest arrival of Fruits followed by Solan. In Kinnaur and Kullu fruits comprise 82% and 69% of the total arrival of the markets (fruits and Vegetables). The graph below presents the trend of target arrivals based on production based forecast arrivals till 2030.

¹³JICA“Study on Diversified Agriculture for Enhanced Farm Income in the State of Himachal Pradesh”. Annexure G (2009)

¹⁴20220208_ Value Chain Analysis

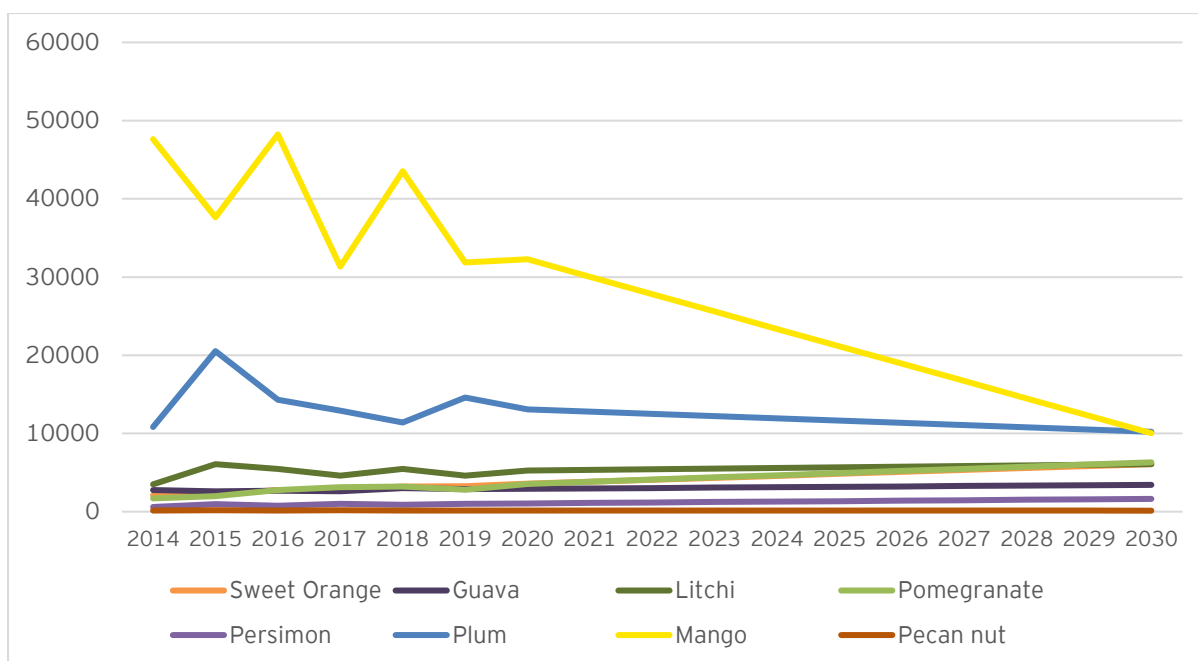


Figure 16: Trend in the arrival of different subtropical fruits

Source: Department of Horticulture, Government of Himachal Pradesh

The crop wise detailed domestic market analysis is presented in individual value chain analysis in the subsequent sections. The state wise export data in India is not available. The detailed crops wise international market analysis is presented in individual Value chain analysis and Annexure IV.

The below table highlights the potential opportunities of selected fruit crops in HP, as well as current position of Himachal Pradesh across other states in India.

Table 7: Potential Opportunities of Sub-tropical fruit crops

Fruit	Production	Potential Opportunities
Sweet Orange	Top producing states are (i) Andhra Pradesh (61%); (ii) Maharashtra (21%); (iii) Telangana (11%). Himachal Pradesh is 11 th with 0.08% share.	Off season supply potential; processing, packaging, and marketing of organic products
Guava	Top producing states are (i) UP (23%); (ii) MP (17%); (iii) Bihar (11%). Himachal Pradesh is 23 rd with 0.06% share.	Domestic market demand as fresh or dried fruit, pulp, juices, jams, jellies, ice creams etc. The market is estimated to rise at a CAGR of 5.6 per cent over the forecast period 2017 to 2025 ¹⁵
Litchi	Top producing states are (i) Bihar (35%); (ii) WB (13.5%); (iii) Assam (9%). Himachal Pradesh is 11 th with 1.09% share.	Litchi matures during late June and early July when fruits from major litchi growing area exhausts. This provides competitive advantages in marketing owing to better price realisation by the growers.
Pomegranate	Top producing states are (i) Maharashtra (63%); (ii) Gujarat (16%); (iii) Karnataka (9.5%) Himachal Pradesh is 11 th with 0.11% share.	Off season supply potential. Climate is conducive for growing late varieties of pomegranate. Variations in day and night temperatures help in development of major quality characteristics such as anthocyanins, polymeric colour, antioxidant activity and total phenol

¹⁵<http://www.fnbnews.com/Top-News/demand-for-food--beverage-industry-driving-guava-puree-market-report-51931>

Fruit	Production	Potential Opportunities
		content ¹⁶ which improves its quality and appearance.
Mango ¹⁷	Top producing states are (i) Uttar Pradesh (20.89%); (ii) Andhra Pradesh (20.07%); (iii) Bihar (11.22%). Himachal Pradesh is 21 st with 0.14% share.	This characteristic is a high potential for marketability of Himachal Mango over other states for late maturity and better quality.
Persimmon	Himachal Pradesh is the major growing state for Persimmon. J & K and Uttarakhand are other states where Persimmon is grown.	The cool climate in mid and high hills of Himachal Pradesh is ideal for persimmon cultivation. It starts arriving in the market early, at the beginning of October and is available till mid-November. It helps in getting high price.
Plum	Top producing states are Uttarakhand (36%), Himachal Pradesh (21%)- 2 nd Position, Jammu & Kashmir (10%).	Ideal climate at the mid-hills of the Himachal Pradesh. This fruit comes early in the market, therefore gets better price
Pecan nut	Top producing states are (i) J & K (72.42%); (ii) Himachal Pradesh (27.73%). Himachal Pradesh is 2 nd with 27.73% share	Previously, Pecans were primarily consumed during certain Indian festivals. The domestic consumers now prefer it throughout the year due to its nutrition and health benefits ¹⁸ .

Source: National Horticulture Board, extracted from APEDA agrixchange (2017-18) except Plum (2015- 16). EY analysis

https://agriexchange.apeda.gov.in/India%20Production/Result_SearchProduct_ViewMore.aspx?cat=fruit

¹⁶<https://www.sciencedirect.com/science/article/abs/pii/S0889157511000329>

¹⁷<http://apeda.in/agriexchange/Market%20Profile/one/MANGO.aspx>

¹⁸https://aces.nmsu.edu/ces/pecans/documents/2020_10new.pdf

4. Value Chain Analysis of Selected Crops

This chapter presents Approach and methodology adopted for conducting value chain analysis followed by detailed crop wise value chain analysis.

4.0. Approach and Methodology

EY Team used a quantitative and qualitative data based analysis to develop the strategy. Predominantly, the approach took a market system perspective focusing on end markets where the selected fruits will be sold fresh or in value-added form either locally, regionally, or internationally - providing the opportunities for creating economic growth. The EY team used the value chain mapping and development approach wherein data will be collected and analysed for value chain development and investment plan.

The collection of data and information included the following steps:

- ▶ First, collect qualitative and quantitative data on the macroeconomic aspects of the sector as well as quantitative data from reports and documents for desk review and analysis.
- ▶ Second, collect quantitative data in term of the demand of the selected horticulture crops based on volume and value of imports to different regions of SAARC and South-East Asia, and price development in the last five years. State export and import data for the selected crops. Seedling demand and supply data for nursery production plan and seedling procurement plan.
- ▶ Third, collection of data to map each of the selected crop value chains. This will include identification and exploration of value chain enterprise development, value creation, analysis of margins, and technical, institutional and infrastructure constraints of respective value chains.
- ▶ Finally, collection of data on yield of selected crops in the sub-tropical agro climatic zones including data on demand and supply of planting materials for nursery production and management and procurement from outside the state.



Figure 17: Interaction with KVK In-charge, Kangra

The value chain analysis involved mapping the value chain and collection of data from all the stakeholders mapped across the value chain. The value chains were mapped as per agronomic production profile, traders, marketers and understanding the climate change implications on the particular crop.

i. Methodology

EY has conducted field visits to collect and understand the ground level information. The visits in each district cover Focussed Group Discussions and interviews with stakeholders from PRF clusters, FLD clusters, District Department officials, Agricultural Produce Market Committees, Krishi Vigyan Kendra, Public and private Processing units, Public and Private nurseries, Universities, Research institutions.

Number of PRF and FLD clusters covered in each district are as follows:

District	PRF	FLD	Total
Bilaspur	2	2	4
Una	-	3	3
Hamirpur	2	1	3

Kangra	5	-	5
Mandi	6	-	6
Sirmaur	-	1	1
Solan	-	4	4

The details of the field visit and list of the stakeholders are present in Annexure I.

ii. Data collection tools

A field visit plan has been prepared to meet a list of relevant stakeholders. The EY team visited all the stakeholders and hold discussions on respective value chains. The following tools were used:

Questionnaire survey:

A questionnaire is designed to collect information of selected fruits growing households. The questions are designed as such that it is clear and minimizes ambiguity and provides the valid data and information.

It comprises three sections, namely

- ▶ Questions related to socio-economic status of the farm households in a cluster
- ▶ Fruit production data including, input use, cost of farm inputs, pest and disease management, irrigation, labour use -both hired and family labour, yield and marketing
- ▶ Questions on value chain development of selected crops.

Key Informant Interview (KII):

Semi structured questions are designed for KII with lead farmers already cultivating the selected crops to collect data on production constraints, input supply issues, integrated nutrient management (INM), integrated pest management (IPM), sufficiency of PoP, GAP, initial investment costs, operational cost, quality management issues, sorting and grading, post-harvest management, and marketing. Likewise, KIIs were conducted with line departments, Horticulture Produce Marketing and Processing Corporation (HPMC), Himachal Pradesh State Agriculture Marketing Board (HPSAMB), input suppliers, commission agents, wholesalers, and retailers to understand their costs, margins, and constraints as well as to get their inputs/insights.



Figure 18: Discussion with Owner of Hamirpur Supplement Food Processor

Focus Group Discussion (FGD):

Open ended topic specific questions were designed for FGD with homogenous groups of stakeholders, such as input suppliers, cluster farmers, wholesalers, commission agents, retailers, and financiers. FGD with cluster farmer groups to begin with related to the following: production constraints, marketing constraints, harvesting and assembling constraints and post-harvest management and post-harvest loss, infrastructure up grading, policy, capacity building and regulatory issues, institutional issues such as federation of clusters to enhance for example bulk procurement of inputs and seedlings from suppliers and collective post-harvest management and marketing, etc.

Stakeholder workshops:

EY team conducted technical stakeholder workshop as follows:

Technical workshop: Inputs from technical workshop conducted by AFC under CS08 package at Bilaspur on 27th November 2021 with DoH officials from the districts and blocks, lead farmers, input suppliers, representatives from the university and EY team. The purpose of the technical workshop was to assess production systems of selected crops, market linkages, organization for marketing, preparation of value chain maps and analysis of selected crops.

iii. Stakeholders' Analysis

A stakeholder can be defined as an agency, institution, group or individual with direct or indirect interest in the fruit value chain. Identifying relevant stakeholders for collaborative initiative is challenging. Stakeholders are often selected by their roles and functions. Stakeholder analysis can be used to understand the value chain by defining the aspects of the value chain, identifying the key actors in the chain and assessing their respective interest and influence in that value chain.

Generally, stakeholder analysis refers to a range of approaches for the identification and description of stakeholders on the basis of their attributes, interrelationships and interests. There are two important tools identified to undertake stakeholder analysis namely, the Participation Analysis Matrix (PAM) and Process Net-Map (PNM). Both approaches measure different aspects of stakeholders' interaction in the value chain.

For this study, we used PNM approach by identifying different stakeholders in each process of the value chain, and then discussing with them in details to understand their roles, level of influence and interest and issues faced by them.

The tentative list of stakeholders across the 3 phases of value chain is as follows:

- ▶ **Upstream:** Cultivators (Farmers); nurseries (private and government); Input providers (seed, agro chemicals); Credit providers (Banks, NBFCs); Irrigation technology / services providers
- ▶ **Midstream:** Processors; Warehouse; Cold storage owners; Grading, Sorting and packaging unit owners
- ▶ **Downstream:** Traders; Wholesalers; Commission Agents; Retailers; Exporters; APMCs / Mandi

Besides individual stakeholders, institutions that have a direct role in the value chains were shortlisted for further analysis. Based on the skills and FGDs with key stakeholders, their roles, level of importance and influence; and the issues are highlighted in table below.

Table 8: Stakeholders Analysis in Existing Value Chain of Himachal Pradesh

Actors	Level of Importance	Level of Influence	Roles	Issues/Challenges
Farmers	High	Low	▶ Land Preparation ▶ Purchase of Inputs ▶ Planting ▶ After-care ▶ Harvesting ▶ Post-harvesting ▶ Marketing/Sale	▶ Lack of Finance ▶ Price & quality of agriculture inputs ▶ Low access to knowledge and technologies ▶ Uncertainties of labour ▶ Lack of facilities for processing and value addition ▶ Lack of facilities to transportation ▶ Market information & intelligence

Actors	Level of Importance	Level of Influence	Roles	Issues/Challenges
				▶ Climate vagaries, leading to low productivity and sometimes, crop failure
Traders	Medium	High	▶ Purchase from Farmers ▶ Aggregating ▶ Transporting ▶ Grading & sorting	▶ Size of farms and produce leading to low quantity of produce from individual farmer ▶ Product quality ▶ Lack of finance ▶ Poor road connectivity and accessibility
Commission Agents	Medium	High	▶ Channelizing the produce between farmers/traders & wholesalers/retailers	▶ High fluctuations in volume and price ▶ Poor market facilities ▶ Market spoilage
Wholesalers	Medium	High	▶ Grading & sorting ▶ Distributing	▶ Product quality & Shelf life ▶ Price fluctuations ▶ Lack of grading & sorting facilities ▶ Lack of Cold chain facilities
Processors	Medium	Low	▶ Processing ▶ Packaging & labelling ▶ Distribution and Marketing	▶ Low volume of produce ▶ High rate of transportation ▶ Lack of finance ▶ Poor market accessibility ▶ Low demand of processed fruit products
Retailers	Medium	High	▶ Aggregating ▶ Sorting & Grading ▶ Packaging & labelling ▶ Distributing & Marketing	▶ Lack of finance ▶ Lack of sorting & grading facilities ▶ High cost of transport ▶ Market spoilage
Consumers	High	Low	▶ Consumption ▶ Processing	▶ Price fluctuations ▶ Product quality
Input Providers	High	Low	▶ Provision of quality inputs	▶ Lack of finance ▶ High transportation cost ▶ Storage ▶ Quality
Nurseries (Govt)	High	Low	▶ Provision of quality planting materials	▶ Inadequate infrastructure ▶ Lack of skilled human resources ▶ Difficulty in getting mother progeny for multiplication
Nurseries (Pvt)	High	Low	▶ Provision of quality planting materials	▶ Inadequate infrastructure ▶ Lack of finance ▶ Lack of skilled human resources

Actors	Level of Importance	Level of Influence	Roles	Issues/Challenges
				▶ Difficulty in getting mother progeny for multiplication
NABARD	High	Medium	▶ Provision of necessary finance	▶ Difficulty in getting necessary documentation/proposals for re-financing
Other financial institutions	High	Medium	▶ Provision of credit	▶ Defaulters ▶ Remoteness of clients ▶ Small loan amount and high cost of operation
University	High	Low	▶ Research and development ▶ Training to farmers ▶ Preparation of Package of Practices (PoPs) for different fruit crops	▶ Lack of finance for necessary R & D ▶ Infrastructure maintenance and improvement
HPMC	High	Low	▶ Pack house and CA stores ▶ Fruit processing	▶ Lack of finance ▶ Infrastructure upgradation and renovation
HPSAMB	High	Low	▶ Marketing of fruit produce	▶ Lack of finance ▶ Infrastructure upgradation and renovation
DoH	High	High	▶ Policy support ▶ Project Implementation support ▶ Quality control ▶ Farmers' training & capacity building ▶ Infrastructure development	▶ Shortage of finance ▶ Staff turn-over and transfers
ADB	High	High	▶ Provision of necessary finance ▶ Policy support ▶ Guidance and support	▶ Quality control ▶ Fund utilization
NHB	Medium	Medium	▶ Accreditation of nurseries ▶ Development of infrastructure ▶ R & D in technology upgradation	▶ Maintaining quality control of the accredited nurseries ▶ Lack of finance ▶ Infrastructure upgradation and renovation
APEDA	High	Low	▶ Export promotion ▶ Research and studies	▶ Maintaining quality standards
IPH	High	High	▶ Development of irrigation infrastructure ▶ Training and capacity building	▶ Lack of finance ▶ Infrastructure upgradation and renovation

Actors	Level of Importance	Level of Influence	Roles	Issues/Challenges
Other Line Dept	Low	Low	▶ Providing necessary support in horticulture promotion ▶ Collaboration and convergence	▶ Lack of finance ▶ Infrastructure upgradation and renovation

iv. Value chain actors

The details of role played by various members of the fruit crops value chain as understood from the field visits are as under:

Farmers: Most of the farmers are from small/marginal category with lack of necessary finance for fruit cultivation. As fruit production is normally not bankable, getting institutional credit facility is very difficult for them. Finally, even after all these hurdles if they cultivate the fruits, then they have to come across the final hurdles of taking their produce to the market and selling them at fair price. Many farmers do not have sufficient knowledge regarding the cultivation practices. The other key issue is getting disease free planting materials. These leads to production of lower quality of fruits. Normally, the farmers do not opt for soil testing, and themselves buy/ prepare Farmyard Manure (FYM) and compost by using cow dung, poultry, and plant wastes, etc without any technical support. The hilly terrain and lack of good road infrastructure is a serious limitation for the marketing of the fruits.

Aggregators: The aggregators procure the fruits mostly at the farm-gate from the farmers. They play an important role in distribution of produce to other value chain actors at various locations within and outside HP. Generally, the aggregators deal with large volumes of produce. Considering the high perishability of fruit crops and lack of market infrastructure in the region, the aggregators bear greater marketing risk. Most of the farmers/fruit growers are small landholders who stay at remote places, approaching and procuring produce from them is a real challenge. The poor infrastructure facilities make transportation of fruit produce challenging, and lead to high fruit spoilage.

Traders: The traders take the produce directly from the farmers or from the aggregators. As they have to procure the produce directly, they face a greater spoilage risk. The main difference observed in field areas between the traders and aggregators was that while traders were mostly outsiders, the aggregators were mostly one of the big farmers, who besides selling his/her produce, also used to collect other farmers' produce from the locality and transport to the markets.

Pre-harvest Contractor: Farmers sell their produce through pre-harvest contractors also. The pre-harvest contractors mostly visit the farmers during flowering or fruit setting stage. They inspect the field, forecast the estimated fruit production, and then negotiate price with the growers/farmer based on distance of farm from road and destination markets, expected price during the season etc. Accordingly, a price is mutually agreed and thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations, such as plant protection, harvesting, sorting, grading, packing, transportation and marketing of fruit produce.

Commission Agents: They provide cleaning, sorting, and weighing facilities as well as short time storage (normally less than 24 hours). During field assessment by the EY team, a strong linkage was found between Commission Agents and those farmers who come directly to the Mandi to sell their produce. Many times, the Commission Agents arrange their lodging and boarding when the farmers reach late evening or at night. As per HP APMC rules, the Commission Agents get 5% commission for their services which they charge to wholesalers/retailers who buy harvested produce. The farmers do not have to pay any market charges in HP.

Wholesalers: The wholesalers in the marketing of fruits are a crucial link between the farmers and consumers. Normally, the wholesalers either buy directly from the traders, aggregators or through pre-harvest contractors. Recently, e-NAM system has also started functioning. Some of the harvested fruits have shorter shelf life. Due to absence of cold chain in fruit marketing, there is big price fluctuations, and the wholesalers either face glut in market or scarcity of fruits in demand. The backward-forward linkage is also not well developed. The Wholesalers also face shortage of grading and packing infrastructure which affect long distance transportation and marketing. Maintenance of

quality standards by growers is also very poor, due to which marketing of good quality produce is an issue with the Wholesalers.

Processor: Majority of the fruits reach the market as fresh fruits. Few fruits' juices in cans are getting the popularity though these are still in nascent stage in Himachal Pradesh. They are also processed into squash and other processed items. The processors procure the lower quality fruit produce, either directly from the farmers or through traders/wholesalers or pre-harvest contractors. At the processing unit, the fruit is sorted and graded.

The processing units are seldom affected by price variation, and their production is depended largely on the cost of raw materials. The small processors normally lack finance, and therefore, quality equipment which might enable quality production of processed fruits at larger scale is out of reach for these processors. The processors also lack transport facility, and therefore normally sell locally. Some processors share equipment and hire transport.

Retailers: They normally either sale to the consumers directly or sometimes to shopkeepers/processors. In case of processors, they again work as their salespersons by collecting the processed fruit products and then selling to consumers or shopkeepers. The retailers normally lack institutional credit facilities. They normally raise finance either from private moneylenders or from micro-finance institutions. The fruit spoilage at retailers' level is also very high due to lack of proper grading, packing and storage facilities.

In addition to above functional analysis, the specific points related to each fruit crop value chain are presented in the below value chain sub sections.

v. SWOT Analysis

The common features identified as part of SWOT analysis of all crops are as follows:

Strengths ▶ Suitable Argo- climatic condition ▶ Government willingness and support to farmers ▶ Proximity to emerging markets - Export orientation ▶ Soil is rich in organic matter which helps in nutrient inputs ▶ Institutional support for research and development coupled with dissemination of technology by KVKs	Weaknesses ▶ High dependency on government for Capital cost ▶ Lack of initiative at farmers' level ▶ Lack of functional value- added infrastructural facilities ▶ Lack of market intelligence and access ▶ Hilly terrain - difficulty in access and do not favour mechanization leading to higher cost of production- labour cost ▶ Lack of business acumen
Opportunities ▶ Infrastructural facilities can be created with the participation of private sector ▶ Convergence with government schemes (RKVY, MIDH, micro-irrigation, road access, etc.) ▶ Scope for value addition at commercial level ▶ Opportunity to produce certified organic products	Threats ▶ Non cohesiveness in development of infrastructure ▶ Unexpected climate changes ▶ Uncertainty in external trade scenario ▶ Lack of social agreement may lead to domination & disruption by certain agents ▶ Youth migration in search of employment.

In addition to above the specific SWOT analysis of each of the crops is provided in individual sections below.

4.1 Value Chain Analysis of Sweet Orange

4.1.1. Overview

i. Global Scenario:

The world production of Oranges (FAO- Orange category includes Sweet Orange) is recorded at 75 million MT in 2020. Brazil is the largest producer in world accounting for 22% of overall world production. India ranks 2nd in the world production constituting 13% of total production in 2020¹⁹. Volume of import of Citrus has increased from 14.8 million MT in 2016 to 17.8 million MT in 2020. The top four important destination markets for citrus are Germany, USA, France, and the Russian Federation²⁰.

ii. Indian Scenario:

Citrus fruits rank third in area and production after banana and mango in India. Sweet orange (*Citrus sinensis*) is the second largest citrus fruit cultivated in the country. It's grown commercially in tropical, subtropical, arid-irrigated and mountains regions in varying soil and weather conditions. Among Citrus Sweet orange is one of the most important subtropical fruits of India and belongs to the family Rutaceae.

State-wise area production and productivity

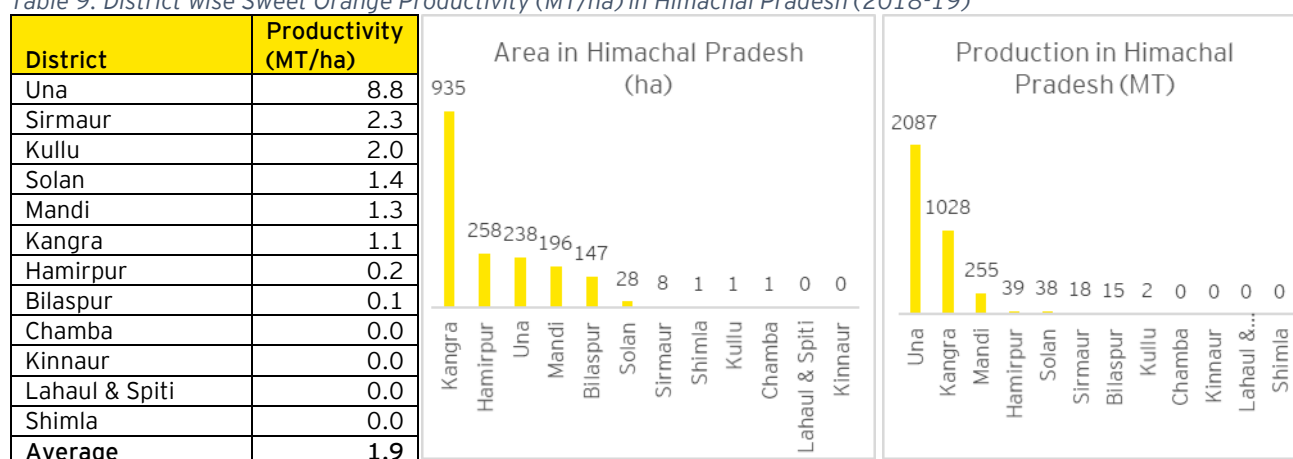
India recorded 3 million MT production of Sweet Orange (*Malta, Mosambi*) in 2017-18. Andhra Pradesh, Maharashtra and Telangana are the top producing states in India and they together have a share of more than 90% of overall production in India²¹. Currently, Himachal Pradesh stands at 11th position with production of 2770 MT in 2017-18 and it has increased to 3234 MT in 2019-20²². Sweet orange also has significant export demand. Netherland, France, Germany, Russia, China, and Saudi Arabia are the top destinations for exports from India in 2020²³.

4.1.2. Sweet Orange Production in Himachal Pradesh

i. Area and Production:

In Himachal Pradesh, the area cultivated under Sweet Orange is 1813 ha and Production volume is 3482 MT with a productivity of 1.9 MT/ha.

Table 9: District wise Sweet Orange Productivity (MT/ha) in Himachal Pradesh (2018-19)



Source: Department of Horticulture, HP

Figure 19: Sweet Orange Production Area and Production Volume in HP (2018-19)

¹⁹Food & Agricultural Organisation (FAO) 2020. <https://www.fao.org/es/faodef/fdef08e.htm#8.03>

²⁰ITC Trade Map- Trade Statistics for International Business Development

²¹National Horticulture Board (NHB) 2017-18

²²Department of Horticulture, Himachal Pradesh

²³DGCIS Annual Export report

4.1.3. SWOT Analysis of Sweet Orange Value Chain

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Sweet Orange Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 10: SWOT Analysis of the Sweet Orange Value Chain in Himachal Pradesh

Strengths ▶ Agro- climatic conditions in sub- tropical zone is highly suitable for growing sweet oranges. ▶ Orange colour on fruits and good TSS and acid ratio of sweet orange grown in subtropical zone gives competitive advantages. ▶ Sub-tropical climate with cool nights and warm days is best for the colour development and sugar build up.	Weaknesses ▶ Poor knowledge of farmers regarding growing and postharvest management of sweet oranges. ▶ Sweet orange is highly susceptible to weather changes and may attracts insect, pests and diseases.
Opportunities ▶ Orange color of the skin results in better price in market	Threats ▶ Citrus tristeza, citrus ring spot, Psylla pose major threat for orchards and fruits.

4.1.4. Value Chain Analysis:

i. Commodity Flow Analysis

The key players involved in the Sweet Orange value chain are:

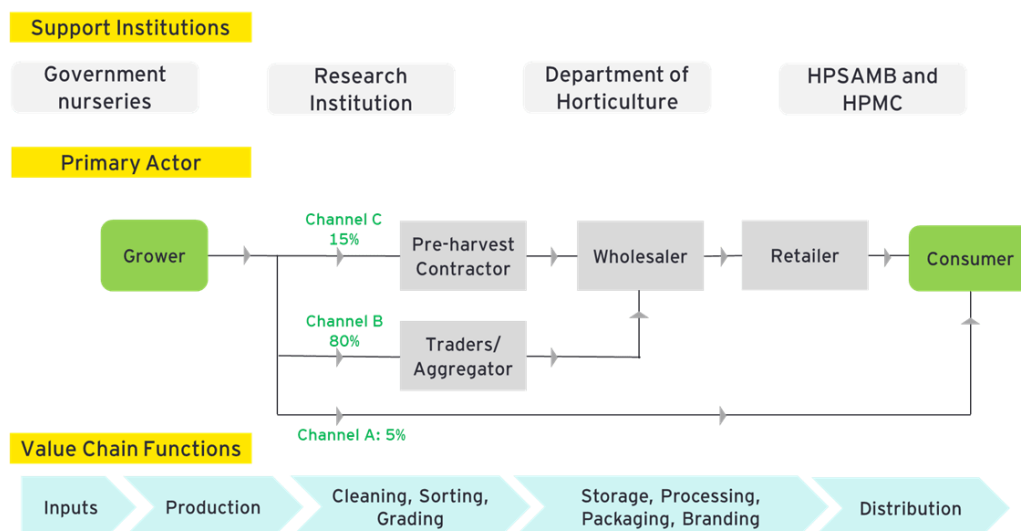
- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Traders/ Aggregators
- ▶ Wholesalers
- ▶ Retailers

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified three main channels in the study area:

- ▶ Channel - A: Producer → Consumer
- ▶ Channel - B: Producer → Traders/Aggregators → Wholesaler → Retailer → Consumer
- ▶ Channel - C: Farmer → Pre- harvest Contractor → Wholesaler → Retailer → Consumer

Majority of growers sell the produce to traders or aggregators who organize harvesting and transportation. Some of the farmers are also selling through pre-harvest contractors who visit the farm either during flowering or fruiting stage, estimate the yield and negotiate a price. Subsequently, they take care of the trees and ensure harvesting and transportation. A very few farmers are also selling directly to the consumers, mostly to get immediate cash to meet family expenses. The various marketing channels and the flow of harvested produce are depicted in below diagram.



Most of the farmers sell their produce through traders/ Aggregators i.e., Channel-B, followed by pre-harvest contractors, i.e., Channel C.

Channel A: This is the least preferred marketing channels observed during the field visits. Sometimes, the farmers sell to the consumers directly. This is normally used when the farmers need immediate cash or little bit enterprising.

Channel B: The most prevalent supply channel observed in the cluster was sale via traders or aggregators. It was learnt during interactions with the farmers/ clusters' members that in most of the cases, the traders approach the farmers and buy the fruits directly at the farm gate. The transportation from the farm-gate is arranged by the traders.

Channel C: Another prevalent marketing chain involves farmers selling the produce through pre-harvest contractors. The pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. Thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce. In most of the cases, the pre-harvest contractors pay 10-15% less than the negotiated prices during peak harvesting season, by making excuses on various issues.

The detailed price- build up analysis for these marketing channels is present in 4.1.5(ii).

ii. Value Chain Activities

Preharvest Activities

Land preparation: Sweet orange grows well in subtropical climates and can withstand drought conditions. The average temperature for good growth is about 13 °C to 37 °C.

Planting: Farmers train the trees to single stem with 4-6 well-spaced branches for making the basic framework keeping the lower most branches not below the height of 50 cm from the soil surface. Generally planting is done during rainy season with a spacing of 6X6 m. Pruning is done during the initial years of planting. Farmers remove water sprouts and rootstocks. Pruning of non-bearing trees can be done at any time of the year, but for bearing trees the best time is after harvesting, during late winter or early spring when these are in somewhat dormant stage.

Irrigation: Irrigation is provided at an interval of 10-15 days during winter months whereas during summer months it is provided at an interval of 5-7 days.

Disease management: Application of dry leaf mulch or paddy husk to a thickness of about 8 cm. in the basin keeps down the weed growth and decreases the number of irrigations. It also improves fruit quality. Devitalization of plants on account of the attack of the different insect pests viz. citrus black fly, citrus psylla, citrus leaf miner, bark eating caterpillar, mealy bugs, citrus aphids, citrus thrips, fruit fly, mites etc. results in poor performance in terms of quality fruit production.

Harvesting and Postharvest Activities

Harvesting: Manual harvesting of Sweet Orange is done by the hired labours or members of the family. The fruits are collected in buckets and any diseased or defective piece is removed.

Grading and Packaging: The harvested fruits are graded on the basis of their size and colour.

Value Addition: Value addition in sweet orange is done at home-scale level

4.1.5. Cost Economics and Price build-up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and the field visits. The data collected from field visits are also validated with the data provided by Department of Horticulture. All the values are considered at constant prices without inflation. The lump sum cost of 1 lakh is considered for land preparation. The spacing of the plant is considered as per the suggested spacing in nursery report, i.e., 3 * 3 in Sweet Orange High Density Planting. Mulching sheets are assumed to be replaced for every 5 years. The table below present the annual cost and component wise breakup in 1 hectare land and corresponding revenue from the expected yield.

Table 11: Sweet Orange cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	100000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting Materials (@Rs.150/-)	166650	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pitting and Plantation (@Rs.50/- per pit)	55550	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mulching (including labour) (@Rs.32 per running metre for 1111 x2.5 metre	88880	-	-	-	-	88880	-	-	-	-	88880	-	-	-	-
Micro irrigation development (as per PMKSY rate)	120000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting equipment and tools	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm yard manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertiliser	10,250	10,250	12,000	15,000	18,000	20,000	22,500	25,000	27,500	30,000	30,000	30,000	30,000	30,000	30,000
IPDM and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,000	3,000	3,000	3,000	3,000
Citrus packing boxes (INR 10 per 5 Kg)	-	-	33,330	44,440	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour (INR 203/ person day)	74095	74095	76125	78155	80185	81200	82215	83230	85260	86275	86275	86275	86275	86275	86275
Total Cost (in Rs.)	6,36,980	90,900	1,31,371	1,50,428	1,77,928	2,70,073	1,84,958	1,88,723	1,93,503	1,97,268	2,86,148	1,97,268	1,97,268	1,97,268	1,97,268

Table 12: Annual revenue per hectare from Sweet Orange cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yields (Kg/ha)	-	-	16,665	22,220	33,330	33,330	33,330	33,330	33,330	33,330	33330	33,330	33330	33330	33330
Revenue (@Rs.30/- per kg)			4,99,950	6,66,600	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900
Benefit Cost Ratio			3.81	4.43	5.62	3.70	5.41	5.30	5.17	5.07	3.49	5.07	5.07	5.07	5.07

The table below explains different cost of cultivation in percentage of total cost every year.

Table 13: Year wise cost of Sweet Orange cultivation components in percentage of total cost

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land Development	15.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting Material	26.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Piting and Planting	8.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	14.0%	0.0%	0.0%	0.0%	0.0%	32.9%	0.0%	0.0%	0.0%	0.0%	31.1%	0.0%	0.0%	0.0%	0.0%
Micro irrigation development	18.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting equipment and tools	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FYM	0.9%	6.1%	5.1%	5.5%	4.7%	3.1%	4.5%	4.4%	4.3%	4.2%	2.9%	4.2%	4.2%	4.2%	4.2%
Fertiliser	1.6%	11.3%	9.1%	10.0%	10.1%	7.4%	12.2%	13.2%	14.2%	15.2%	10.5%	15.2%	15.2%	15.2%	15.2%
IPDM and growth hormones (PMU data)	0.2%	1.1%	1.0%	1.0%	1.0%	0.7%	1.2%	1.3%	1.4%	1.5%	1.0%	1.5%	1.5%	1.5%	1.5%
Packing boxes	0.0%	0.0%	25.4%	29.5%	37.5%	24.7%	36.0%	35.3%	34.4%	33.8%	23.3%	33.8%	33.8%	33.8%	33.8%
Irrigation system maintenance	0.0%	0.0%	1.5%	2.0%	1.7%	1.1%	1.6%	1.6%	1.6%	1.5%	1.0%	1.5%	1.5%	1.5%	1.5%
Labour	11.6%	81.5%	57.9%	52.0%	45.1%	30.1%	44.5%	44.1%	44.1%	43.7%	30.2%	43.7%	43.7%	43.7%	43.7%

The establishment cost of Sweet Orange cultivation is approximately INR 6.37 lakhs, and annual cost is from INR 90,000 to INR 2.86 lakhs in the later years. It is observed that the labour component is the major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers. There is cost spike in 6, 11 years, which is due to cost for replacement of mulch.

Sweet Orange starts fruiting from 3rd year and achieve optimum yield in 5th year. The annual return for the farmers ranges from Rs.4.99 lakhs to Rs.9.99 lakhs per hectare per annum.

ii. Price Build-up and Market Margins of Sweet Orange

The price build up analysis is presented below for the 3 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders met during field visits and also validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 14: Marketing costs and margins of different functionaries in the various marketing channels of Sweet Orange (Rs/kg)

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
(I)	Marketing cost incurred by the Farmer									
1	Net price received by the farmer	40.00	72.73%	40.00	30.00	42.86%	30.00	28.00	17.14%	28.00
	Picking and sorting	4.00	7.27%	44.00						
2	Transportation cost	5.00	9.09%	49.00						
4	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)	1.00	1.82%	50.00						
5	Loading / unloading	2.00	3.64%	52.00						
6	Spoilage (approx.. 10%)	3.00	5.45%	55.00						
	<i>Total</i>	15.00								
	Farmer's selling price	55.00	100.00%	55.00	30.00	42.86%	30.00	28.00	40.00%	28.00
(II)	Marketing cost incurred by the Traders/ Aggregators									
A	The gross price paid by Traders/ Aggregators				30.00	42.86%	30.00			
B	Cost components of Traders/Aggregators									
1	Labour cost for picking & sorting				0.50	0.71%	30.50			
2	Transportation cost				1.00	1.43%	31.50			
3	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)				0.50	0.71%	32.00			
4	Loading / unloading				0.50	0.71%	32.50			
5	Spoilage (approx. 10%)				3.00	4.29%	35.50			
	<i>Total</i>				5.50					
	Traders'/Aggregators' Margin (7% to 10%)				3.50	5.00%				
	Traders'/Aggregators' selling price				39.00	55.71%				
(III)	Marketing cost incurred by the Pre-harvest Contractor									

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
A	The gross price paid by Pre-harvest Contractor							28.00	40.00%	28.00
B	Cost components of Pre-harvest contractor									
1	Labour cost for picking & sorting							0.50	0.71%	28.50
2	Transportation cost							1.00	1.43%	29.50
3	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)							0.50	0.71%	30.00
4	Loading / unloading							0.40	0.57%	30.40
5	Spoilage (approx 5%-7%)							1.96	2.80%	32.36
	<i>Total</i>							4.36	6.23%	
	Pre-harvest contractor's Margin (15%-20%)							6.64	9.49%	39.00
	Pre-harvest contractor's Selling Price							39.00	55.71%	39.00
(IV)	Marketing cost incurred by the wholesaler									
A	The gross price paid by wholesaler				39.00	55.71%	39.00	39.00	55.71%	39.00
B	Cost components of wholesaler									
1	Loading / unloading				0.30	0.43%	39.30	0.30	0.43%	39.30
4	Transportation cost				0.50	0.71%	39.80	0.50	0.71%	39.80
5	Mandi Tax				0.39	0.56%	40.19	0.39	0.56%	40.19
6	Commission charge				1.95	2.79%	42.14	1.95	2.79%	42.14
7	Spoilage at Wholesaler level (approx 5%)				1.95	2.79%	44.09	1.95	2.79%	44.09
C	<i>Total</i>				5.09			5.09		
D	Wholesalers Margin (7%-8%)				3.91	5.59%	3.91	3.91	5.59%	48.00
E	Wholesaler Selling price				48.00	68.57%	48.00	48.00	68.57%	48.00
(V)	Marketing cost incurred by the retailer									
A	The gross price paid by retailer				48.00	68.57%	48.00	48.00	68.57%	48.00
B	Cost components of retailer									
1	Loading / unloading				0.50	0.71%	48.50	0.50	0.71%	48.50
3	Transportation cost				1.00	1.43%	49.50	1.00	1.43%	49.50
4	Mandi Tax				0.48	0.69%	49.98	0.48	0.69%	49.98
5	Commission charge				2.40	3.43%	52.38	2.40	3.43%	52.38
6	Storage/rent				0.30	0.43%	52.68	0.30	0.43%	52.68
7	Spoilage at Retailer Level (15%)				7.20	10.29%	59.88	7.20	10.29%	59.88
C	<i>Total</i>				11.88			11.88		

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
D	Retailer Margin (15%-20%)				10.12	14.46%	10.12	10.12	14.46%	70.00
E	Retailer Selling price				70.00	100.00%	70.00	70.00	100.00%	70.00
(V)	Consumer' Purchase Price	55.00	100.00%	55.00	70.00	100.00%	70.00	70.00	100.00%	70.00

The price spread among different marketing channel is described below. The price spread found to be maximum in channel C INR 42, followed by channels B and A.

Table 15: Price spread of Sweet Orange among the different marketing channels (Rs/kg)

S. No.	Particular	Channel A	Channel B	Channel C
1	Producer price	40.00	30.00	28.00
2	Consumer's price	55.00	70.00	70.00
3	Price spread	15.00	40.00	42.00
4	Producer's Share in consumer rupee	72.73	42.86	40.00

The producer's share in Channel A is high (72.73%) as compared to that of in Channel B (41.86%) and Channel C (40.00%). The more the intermediaries the more is price spread and the less is producer's share in consumers' price

While the Channel B found to be very common, Channel C is also emerging as prominent channel because of less hassle to the farmers. The pre-harvest contractors perform all the tasks and pay the farmers a pre-determined price. Small quantities of guava were also sold through Channel A (less than 5%). Though the farmers and consumers both have win-win situation in this Channel, it has limited scope of selling large volume of the produce.

Table 16: Marketing efficiency of Sweet Orange among the different marketing channels

S. No.	Particular	Channel A	Channel B	Channel C
1	Farmer's Price	40.00	30.00	28.00
2	Marketing cost	15.00	22.47	21.33
3	Marketing Margin	0.00	14.03	20.67
4	Marketing efficiency	2.67	0.82	0.67

As calculated above, the marketing efficiency in Channel C is the lowest, and Channel A is the highest. The more the intermediaries, the less is the marketing efficiency. This is because of higher marketing costs and margins as the number of intermediaries increase.

4.1.6. Gaps in the Value Chain

The gaps observed at different stages are:

i. Pre- production

- ▶ Availability of quality planting material is of utmost importance in Sweet Orange cultivation. The plants are very sensitive to various biotic and abiotic stresses.
- ▶ Farmers also normally do not conduct soil testing. Lack of soil analysis results in inappropriate application of nutrients.
- ▶ Farmers do not possess adequate information regarding the varietal differences and scientific growing practices. The information they do possess is unofficial insights from their peers and other value chain actors.
- ▶ Potassium deficiency was observed in some fields of Hamirpur
- ▶ Nematode infestation was seen in Nadaun block

ii. Production

- ▶ Non availability of scientific knowledge. While there are certain trainings provided to farmers, it is not conducive to learning.
- ▶ In Kangra district, Bhawarma block water stress and weeds were noticed
- ▶ Citrus butterfly and Citrus psylla observed Water suckers were also noticed. Infestation of citrus leaf minor was observed in newly plantation in Binga cluster

- ▶ The main complaint received from farmers is that trainings are not conducted at the right time, which reduces the efficacy of the trainings.
- ▶ During the field visits, it was commonly observed that the fencing was not completed or in progress.
- ▶ In FLD clusters, though the drip irrigation system was installed, but in most cases, these were not functional.
- ▶ The fields were generally found to be full of weeds, with farmers not taking proper care. Upon discussion, it was learned that labour issue was one of the main causes for not keeping the fields clean.
- ▶ In addition, owing to the migration of labourers, farmers do not have skilled labour for critical activities such as pruning and harvesting of the crop. Few farmers have to travel long distances to procure inputs and receive no financial assistance for it.

iii. Harvesting and post- harvest

- ▶ Currently, the wastage at various levels of sweet orange value chain is very high. Apart from the loss of revenue to the farmers, it leads to additional costs in the supply chain which ultimately enforces the final consumers to pay high charges.
- ▶ Improper harvesting methods affect the fruit quality and shelf life as well as lead to fruit damage while transporting. Though the training on fruit harvesting has been provided, the farmers do not often practice use of clippers. The citrus fruits are harvested with stem which damage other fruits while transportation.
- ▶ Insufficient numbers of pack-houses are also a major constraint in this value chain in HP.

Transportation and Marketing

Market is also found to be one of the major components for any business. In this regard of the respondents stated the problem that transportation cost upto the market minimizes their profit. Fluctuation in the demand of the product was also one of the major market problems.

4.1.7 Market Overview

i. Domestic Market for Sweet Orange

During 2021 the arrival season began in Himachal Pradesh in the month of January with an entry of 23.95 MT of Sweet Orange and gradually declined till the month of July and then again picked up. It reached the highest volume of 31.55 MT in the month of October that year and then declined and closed the year in December with 13.11 MT.

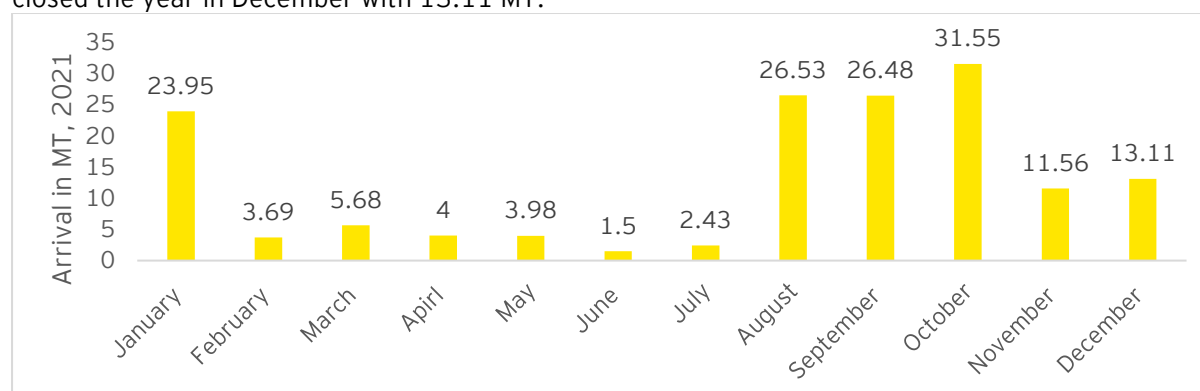


Figure 21: Arrival of Sweet Orange in the markets of Himachal Pradesh in 2021
Source: Agmarknet

Past five years data have shown an increasing trend in the arrival of Sweet Orange in the markets of Himachal Pradesh with a record 230.41 MT in 2019. The trend is increasing and is likely continues to grow in the future.

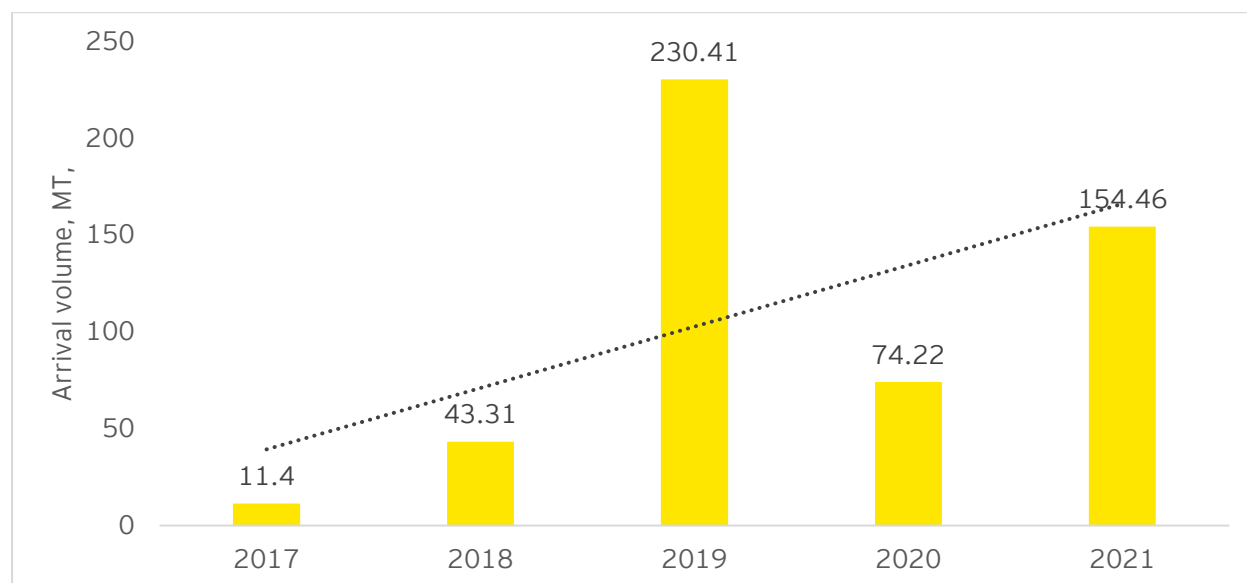


Figure 22: Trend in the arrival of Sweet Orange in the markets of Himachal Pradesh

Source: Agmarknet

Likewise, there is a growing trend in the mean of modal price per kilogram in the last ten years or more. The mean of the modal price was INR 17.62/ KG in 2008 and was INR 52/ KG in 2021, which grew by 195%.

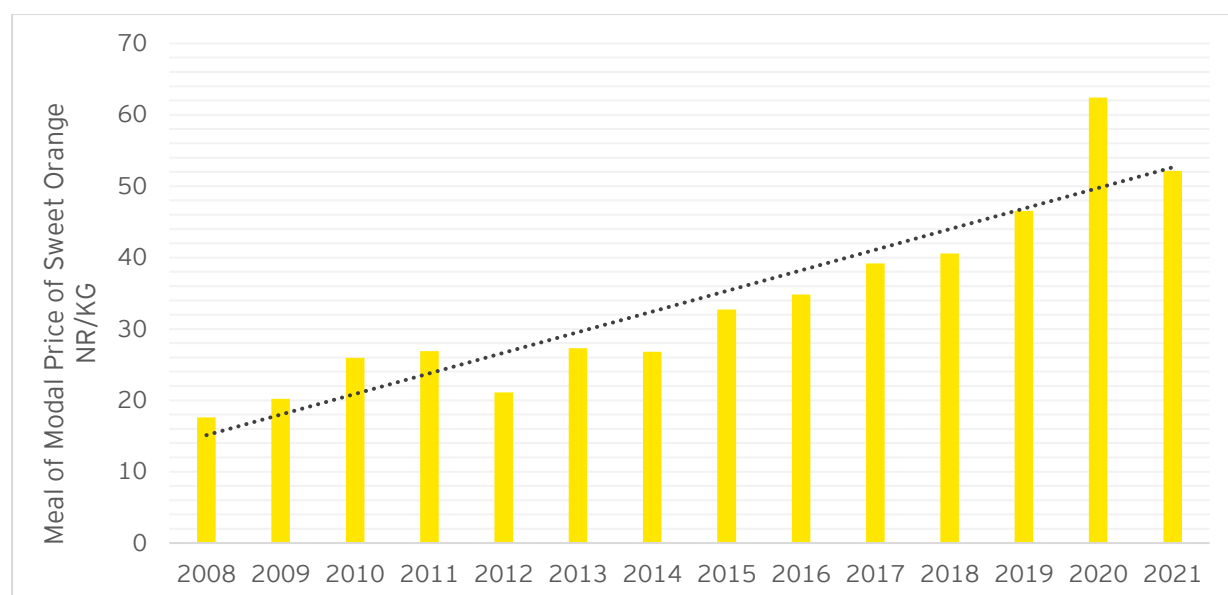


Figure 23: Mean of Modal Price Trend for Sweet Orange INR per KG

Source: Agmarknet

During 2021 the mean of the modal prices of Sweet Orange in the various market show that there is a variation in the market price. Kangra Balaji nath, Jaishinghpur, and Nagrota Bagwan witness the highest price that year INR 70.57/ Kg, INR 69.81/ Kg and INR 65.68/Kg respectively. These prices were followed by a set of prices below INR60 were in Paonta Sahib, Palampur, Shimla and Mandi with INR59.5/Kg, 58.9/Kg and 56.21/Kg respectively.

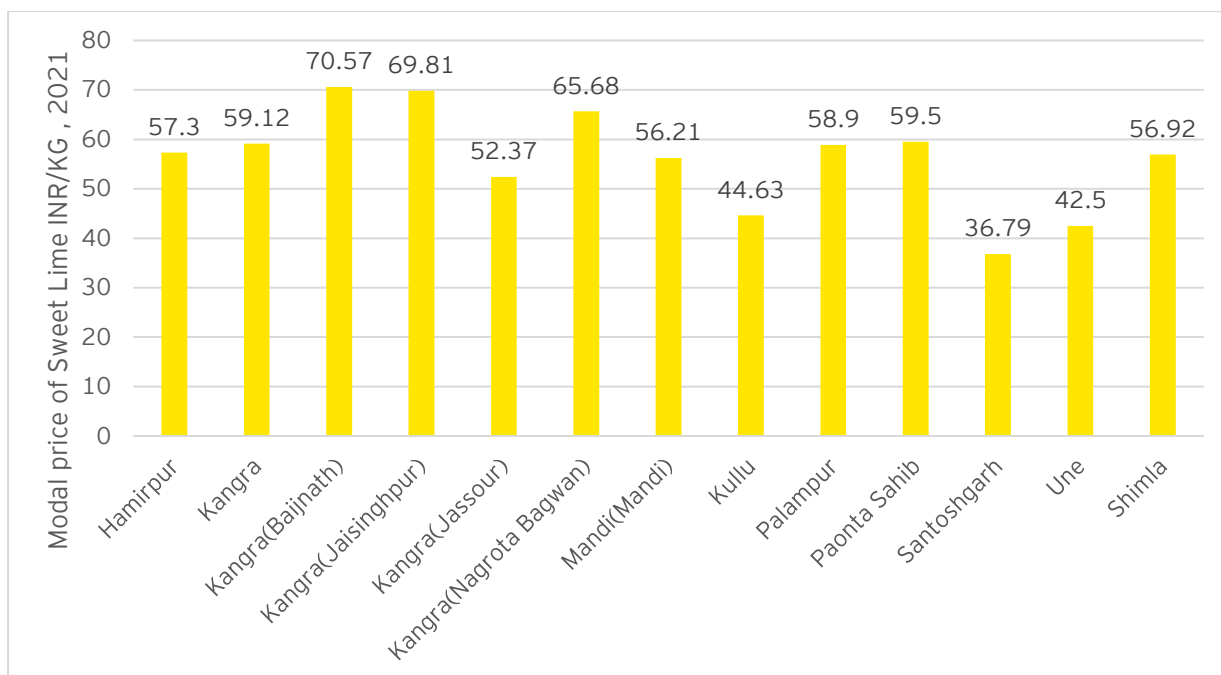


Figure 24: Mean of Modal Price of Sweet Orange (Mousambi) in Himachal Markets in 2021

Source: Agmarknet

The next big market for Sweet Orange is in Jammu & Kashmir. The arrival season began in 2021 in J&K in January with a 40 MT entry and increased to 112 MT in March and further declined, and there was no activity for the next four months (May to August). Its arrivals began again in September and ending the season in December with 103 MT.

As can be seen, Sweet Orange arrived in the three markets of Rajouri, Reasi and Samba where Reasi has the highest share of 567 MT out of the total arrival 627 MT which is around 90% of the total arrival. The other two markets are Rajouri and Samba with a share of 6.4% and 3.1% respectively.

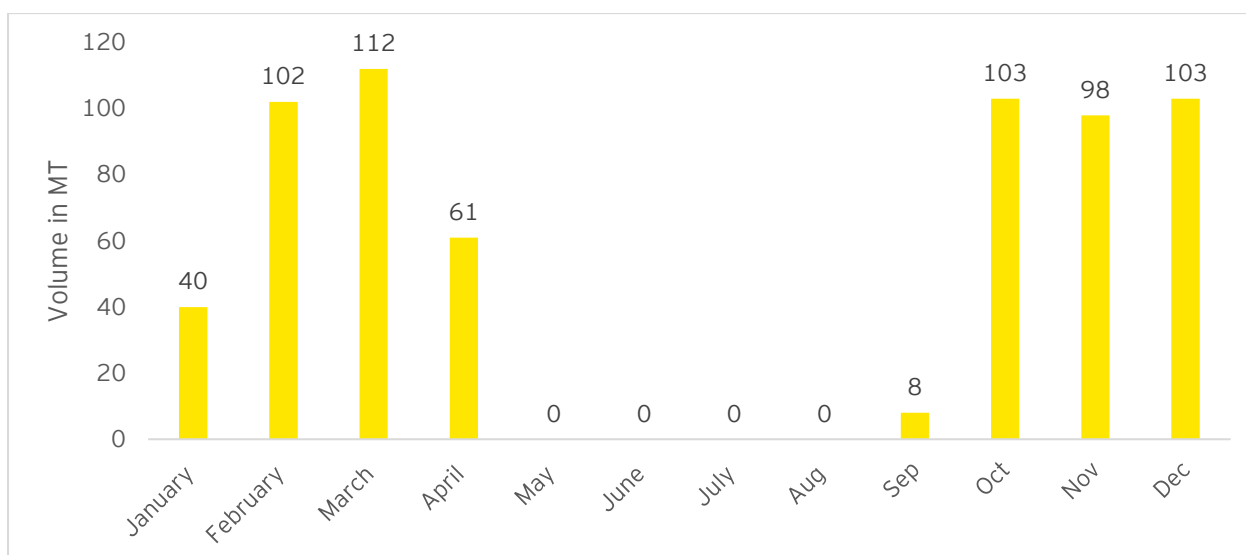


Figure 25: Arrival volume during the season in J&K markets in 2021

Source: Agmarknet

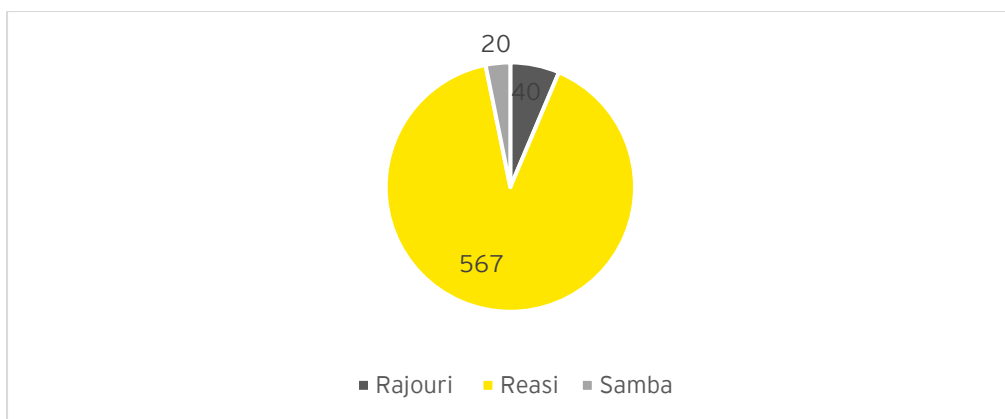


Figure 26: Markets wise distribution

Source: Agmarknet

The J&K markets witnessed the highest prices in the months of March, April, and November in 2021, INR 5,387/ QTL, INR 5,625/ QTL and INR 5,000/ QTL respectively. The lowest price witnessed that year in the markets was INR 4,200 in the month of September.

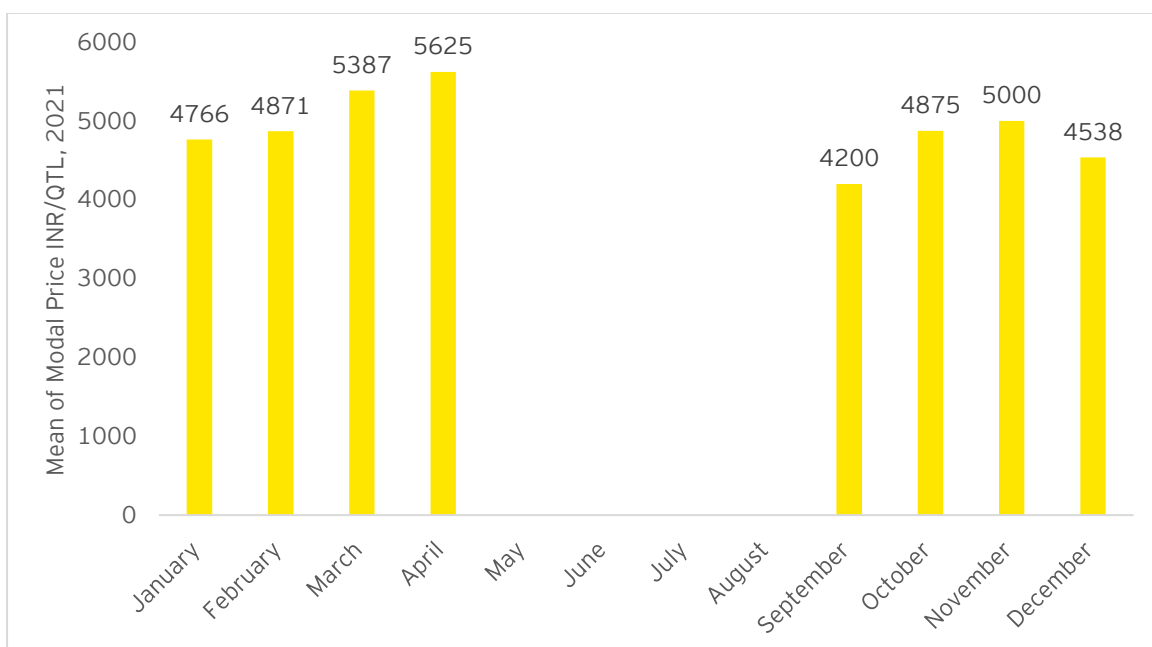


Figure 27: Mean of Modal Price of Sweet Orange in 2021 during the season in J&K markets.

Source: Agmarknet

The arrival in the markets coincides with the harvesting season of the crop i.e., Nov-Feb and most of the markets have shown increased arrival in this period which provides us a clear opportunity for marketing.

ii. Snapshot of International Market Analysis of Sweet Orange

Import markets

- ▶ World import of citrus is increasing and the demand for citrus is growing. Volume of import of Citrus has increased from 1,48,10,104 MT in 2016 to 1,77,85,832 MT in 2020. Emerging market share has increased and is higher than the rest of the countries with an annual average growth rate of 51%.
- ▶ The Best 20 Markets (B20) have annual average growth of 61% in the volume of Import of citrus with an average import volume of 1,46,63,425 MT, which is forecasted to reach 1,86,19,961

MT by 2030. Similarly, the next destination is the Emerging Markets with annual growth of 51% and an average import volume of 41,06,063 MT, which is also forecasted to reach 46,27,603 MT by 2030.

- ▶ Out of these USA, Russia, Netherlands, and Germany show a higher growth trend in import of citrus followed by Saudi Arabia, Canada, Italy, China and Ukraine.
- ▶ All the top importers in terms of value of import will continue to grow. Out of these the top four important destination markets for citrus are Germany, USA, France, and the Russian Federation.
- ▶ The analysis identified the location of export destination for citrus in terms of volume, value, and price, and these are: USA, Germany, Russian Federation France, Republic of Korea, Switzerland, Japan, Belgium, and France are paying higher price

Suggested export destinations

- ▶ Export destination in emerging markets are Saudi Arabia, Poland, and Russian Federation.
- ▶ Netherlands, Russia, Saudi Arabia, Germany, China, and France were the top five importing countries of Citrus Sinensis from India.
- ▶ Whilst Republic of Korea, Hong Kong China and the USA offered higher price of USD1,649/MT, 1,042/MT and USD1,007/MT respectively.

Market criteria	Priority country destination (By Growth rate and Trend)	Growth Rate and Import Price	
Higher volume	▶ USA ▶ Russian Federation ▶ Netherlands ▶ Germany	Volume	▶ 303% ▶ 28% ▶ 18% ▶ 12%
Higher value	▶ USA ▶ Germany ▶ Russian Federation ▶ France	Value	▶ 99% ▶ 62% ▶ 29% ▶ 20%
Higher Prices	▶ Republic of Korea ▶ Switzerland ▶ Japan ▶ Belgium ▶ France	Import Price	▶ Republic of Korea:USD2484/MT ▶ Switzerland: USD1361/MT ▶ Japan: USD1404/MT ▶ Belgium USD1242/MT ▶ France USD1206/MT
Emerging markets	▶ Saudi Arabia ▶ Poland	Long term focus	▶ 5% volume & 53% value ▶ -2% volume & 109% value Markets with growth in consumer income. Higher choice of consumers with substitute fruits

Figure 28: Export Destinations for Sweet Orange

Source: ITC trade maps

The detailed graphs and analysis are presented in Annexure IV.

4.1.8. Proposed Interventions

i. Pre- production

Land Preparation: Sweet Orange grows well between altitudes of 500 m to 1000 m, having rainfall up to 500 mm. Its orchards develop well in light soils with good drainage. Deep soils with pH range of 5.5 to 7.5 are considered ideal.

The site selected should be close to the market centers and roads, besides being agro climatically suitable. Windbreaks should be provided on the sides from which high winds are expected. Plants suitable for providing windbreaks are Eucalyptus, Jamun, Mulberry and Shisham among others.

The land to be prepared on terraces across the slope. In hilly areas, planting is done on terraces against the slopes. In such land, high density planting is possible as aerial space available is more than that in flat land.

Planting: The best time for planting is between June and August. The planting distance in high density planting is recommended at 3x3 sq. metre. A raised bed planting is beneficial for sweet orange cultivation. At the time planting, bud union should be 20 cm above from soil.

ii. Production:

Irrigation: The maintenance of optimum soil moisture is critical for growth, development, and trend production. It also reduces the fruit drops and increases the fruit size. Under unirrigated condition chances of damage to spring blossom is high and the next crop maturing in October-November may be heavier. Earlier heavy bearing makes plant weak and reduce vegetative which reduces the overall age of plant.

Under waterlogged condition diseases like root rot and collar rot may occur. Light irrigation with high frequency is beneficial. Irrigation water containing more than 1000 ppm salts is injurious to the plant's health. The quantity of water and frequency of irrigation depends on the soil texture and growth stage. Partial drying out of the soil in spring may be acceptable.

Nutrition Management: Nutrient play a critical role in flowering, fruit set, fruit size, fruit quality, and the overall health of plant. It requires judicious application of fertilizer for sustainable economic growth. The recommended nutrient doses are 100 N, 50 g P and 75 g K in foliar feeding. Apart from major nutrients, these fruits also require other micronutrient like iron, copper, boron and magnesium etc. also for healthy plant growth so one need to look for deficiency of these nutrient in orchard

Manures and fertilizers: Among the several factors associated with production of sweet orange production, balanced nutrition is considered to be the most important which determines productivity & quality. Plants should be manured in three equal doses three times in a year- February, June and September. The doses should be defined by the soil, age, and growth rate of the specific plants. The dose should increase every year proportionately to reach full quantity on the eighth year.

Fertilizers are spread on the ground up to the leaf drip and mixed with soil by light spading. The area should be irrigated if there is moisture stress after application of fertilizers. One or two sprays of micro nutrient mixtures may be given to promote good plant growth and better fruit quality.

Inter-culture: Activities such as ploughing, spading of basins, and weed control among others are important inter-culture operations for soil aeration and health. Chemical control of weeds with weedicides may be done

Intercropping could be conducted, but only during the initial three years. Leguminous vegetables such as cow peas, french bean and peas, among others may be grown in citrus orchards.

Training and Pruning: To allow the growth of a strong trunk:

- All shoots in the first 40-50 cm from ground level developed in the early stage should be removed.
- The centre of the plant should remain open.
- Branches should be well distributed to all sides.
- Cross twigs and water suckers are to be removed early.
- The bearing trees require little or no pruning.
- All diseased, injured and drooping branches and dead wood are to be removed periodically for initiating citrus greening.
- After the crop is picked, the branches touching the ground should be cut close to the laterals so that no stubs were formed.

Major disease and Pests: The table below provides an overview of the diseases and pests that may adversely affect the citrus plants in Himachal Pradesh.

Table 17: Major diseases and pests in Himachal Pradesh

Pest	Symptoms	Control
Citrus psylla	- Both Nymph and Adult suck Plant sap - Heavy de-blossoming, leaf chlorosis, distorted shape and curling occur - Insect Excreta Honey dew attract sooty mold, major different from Aphid and Scale	Spray of Dimethoate and Imidacloprid or thiamethoxam or horticulture mineral oil
Citrus Leaf Minor	- Most harmful for citrus Nursery, - Many occur in new flush period - Larva feed epidermis and make serpentine silvery mine on leaves - Leaf curl from margin	Spray of Fenvalerate or Cypermethrin or Chloropyrifos or thiamethoxam
Aphid	- Nymph and adult suck sap from tender part - Sooty mold occurs on honeydew excreta - Leaf turn yellow, curl and dry	Spray of Dimethoate, Oxydemeton-S-Methyl, Imidacloprid or thiamethoxam
Citrus trips	- Cannot be seen through with the naked eye - Cause damage to leaves, flower and growing fruit, affected part dry up - Leaves Become distorted, cup shaped, leathery and wrinkles - Circular ring appears near the fruit	Spray Trizophos or Ethion
Citrus Mite	- Not visible through eyes - Suck sap from Upper surface of Leaf - Affected leaf surface losses normal colour, become dull Yellowish-brown Imparting Photosynthesis activity, Zigzag lining on fruits appear	Spray of Ethion and Dimethoate
Die Back/Anthracnose	- Leaf spotting rotting of Dropping of fruit - Drying of twig start from tip downward - Leaves turn light green which turn Brown and finally become grey in center with brown margin - Fruits remain immature	- Prune and destroy infected part - Spray of Bordeaux Mixture or copper oxychloride
Citrus Canker	- Tiny circular water soaked yellowish spot which generally enlarge and give a rough corky and brownish appearance surrounded by chlorotic Yellowish halo or ring - Lesion Raised on both side of leaves	Streptocycline + copper sulphate or Bordeaux Mixture or copper oxychloride
Sooty Mould	- Black Velvety Superficial coat on leave, twig and fruits - Leave exhibit curling and Shrivelling - Symptom followed by poor fruits	Ziram and Ethion
Citrus Greening	Yellowing of Foliage, Characteristic feature of greening is between the veins	Prune and burn dead woods

Pest	Symptoms	Control
		Control citrus psylla vector
Foot rot	- Decaying of Feeder roots, Profuse Gumming of trunk, Pale green leaf and shedding of leaf - Bark develops vertical cracks - Infected tree produces large flower but shed before fruit set	- Avoid water stagnation, collect and destroy diseased bark - Apply paint of Ridomil

iii. Harvesting and Post-harvest Management

Harvesting: The horticulture crop, including citrus fruit are characterized by peculiar problem of being highly seasonal, perishable, and Bulky in nature. Due to this citrus fruit need high degree of care at harvest and post-harvest phase. Citrus fruit do not ripen after picking. At the time of harvesting, they must be fully ripened. Early harvesting produces poor quality fruit and erratic ripening whereas delayed harvesting results in decay of fruit and reduce juice content. Harvesting should be done when fruit attain full colour and TSS range between 12 to 14° brix.

Precautions during harvesting

Harvesting in late morning hours when surface moisture evaporates

- ▶ Harvesting by clippers/secateurs
- ▶ Do not pull or snip
- ▶ Harvesting ladder should not lean on tree
- ▶ Cut it with clean sharp clippers
- ▶ Close to the peel of the fruits retaining shortest stalk and green button
- ▶ Put the fruits gently in crates
- ▶ No overfilling (20 kgs-optimum)
- ▶ Fruits should be placed in solid bins gently

Storage and post-harvest management

- ▶ **Grading and Sorting:** For getting good prices and assuring quality for consumer fruit need to be graded in different sizes and variation grading and sizing of fruits is both mechanical and manual. A mechanical citrus packing line called the primary processing center equipped with washing, sorting, size grading, fungicidal treatment for orange and then packing into corrugated fiber boxes
- ▶ **Storage** Sweet oranges can be stored at 5-7°C with 85-90 % Relative Humidity for four to eight weeks.
- ▶ **Transit preparation:** The ideal transit temperature is 10°C. Forced air systems are used for pre-cooling. Oranges may be packed in well ventilated Corrugated Fiber board Boxes (CFB) boxes (30 cm x 30 cm x 30 cm).

Precautions during transport

- ▶ Crates should be loaded carefully in the transport vehicle
- ▶ No overloading
- ▶ Don't transport in heap
- ▶ Drive carefully, prefer smooth roads
- ▶ Do not delay transport
- ▶ Fruit inspection and weighing at the arrival

Pack house operations

- ▶ Washing done with chlorinated water
- ▶ After washing surface drying
- ▶ Waxing with fruit grade wax (Shellac, Carnauba and bees wax)
- ▶ Wax coating helps in checking the water loss from fruit surface and imparts fresh glossy appearance
- ▶ The waxing of fruits can be done either mechanically (spray brush or spray nozzle type application) or manually (with foam pad, mist spray or dip method)
- ▶ After waxing, the fruits are again dried at temperature of 30-35°C

Packaging

- ▶ The fruits should be packed in corrugated fibre board boxes, having 10 kg capacity.
- ▶ Usually two pieces, telescopic, CFB boxes of five ply with waterproof coating to tolerate high humidity during shipment are preferred.
- ▶ Normally, a box of size 45 cm x 24 cm x 18 cm having 10 kg capacity is very common and acceptable for export marketing.
- ▶ The box must have 5% area punched as holes for ventilation.
- ▶ A divider/liner having ventilation holes is inserted in between layers, which will act as cushioning material.
- ▶ Overfilling should never be practiced

Pre-cooling/storage and transportation

- ▶ Pre-cooling of the produce as soon as possible to remove the field heat
- ▶ Forced air pre-cooling (4-6 hrs)
- ▶ The distance between the rows should be 1.5 ft apart
- ▶ The temperature to be brought down to 7°C
- ▶ Storage in crates in cold storage (7-10°C & 90-95 % RH)
- ▶ Storage for 1-2 months for off season marketing
- ▶ For storage distance between pallets should be between 4-6 inches
- ▶ Below 1000 km transport can be done in covered trucks
- ▶ Above 1000 km fruits should be transported from packhouse to market in refrigerated maintained at 7-10°C
- ▶ Temperature should not fall below 5°C to prevent chilling injury
- ▶ At no point the temp control to be switched off

The additional details about sweet orange packaging is presented in Annexure VI.

Marketing and Branding:

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.2. Value Chain Analysis of Guava

4.2.1. Overview

i. Global Scenario:

The production of guava in 2020 in the world is recorded as 55 million tons. India is the top producing country of about 24.7 million MT in 2020 and has approximate share of 45% followed by Indonesia 6.6% in world's production²⁴ (Guava, Mango, Mangosteens). The international trade is increasing and is currently valued at USD 3764 million. The major importing countries are China, USA, Netherlands²⁵.

ii. Indian Scenario:

India recorded production of about 4 million MT in 2017- 18. The top producing state in India is Uttar Pradesh which constitutes about 23% of Indian production. This was followed by Madhya Pradesh and Bihar²⁶. The total production of Guava in Himachal Pradesh is around 2800 MT in 2019-20²⁷. The current major export markets for Guava from India are Nepal, UK and Germany²⁸.

4.2.2. Guava Production in Himachal Pradesh

i. Area and Production:

The area cultivated under Guava in Himachal Pradesh is 2344 ha and Production volume is 3012 MT with a productivity of 1.28 MT/ha.

Table 18: District wise Guava Productivity (MT/ha) in Himachal Pradesh (2018-19)

District	Productivity (MT/ha)
Bilaspur	4.99
Una	2.50
Solan	2.37
Hamirpur	1.49
Sirmaur	1.11
Kangra	1.01
Mandi	0.46
Kullu	0.36
Chamba	0.33
Shimla	0.04
Kinnaur	0.00
Lahaul- Spiti	0.00
Total	1.28

Source: Department of Horticulture

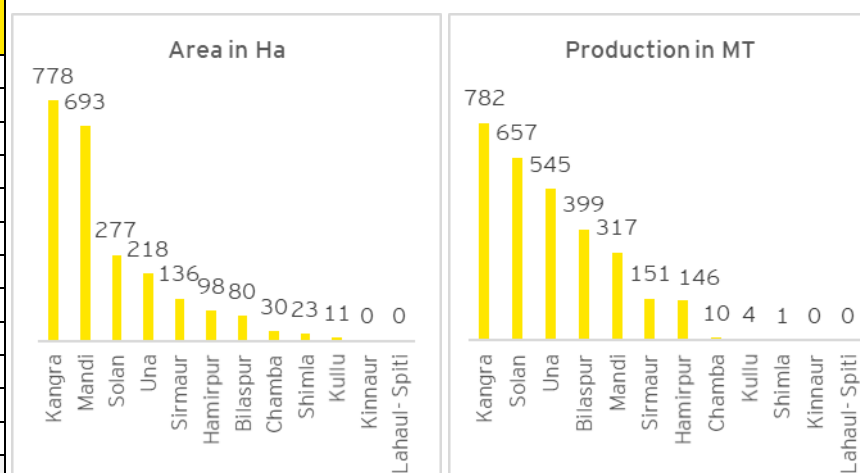


Figure 29: Guava Production Area and Volume in HP (2018-19)

From the above figure, it is understood that Kangra, Mandi and Solan are the top three districts in terms of area covered under Guava. The districts namely Kangra, Solan, Una recorded the highest production volume and however, top 3 districts with highest productivity are Bilaspur, Una, Solan.

²⁴Food & Agricultural Organisation (FAO) 2020- Mangoes, Mangosteens, Guavas

²⁵UN Comtrade

²⁶National Horticulture Board (NHB)

²⁷ Department of Horticulture, Himachal Pradesh

²⁸DGCIS Annual Export

ii. Guava Varieties²⁹

Allahabad Safeda along with Sardar shares the major share in the guava industry of India. “Lalit” variety and the area of production for this variety has immensely increased in the recent³⁰. Other major varieties include Shweta, VNR Bihi Dhareedar, Arka, Amulya etc., The varieties selected considered for the project are L-49, Shwetha and Allahabadi.

Lalit: Fruits are saffron yellow in colour with red blush with an average fruit weight of 185-200g. It has Pulp which is firm and pink with good blend of sugar and acid. Lalit has TSS of 12 °Brix and vitamin C- 250 mg per 100g pulp. This variety is suitable for both table as well as processing. Pink colour of beverage remains stable for more than a year in storage.

Shweta: This variety fruits are medium, globose, each weighing on an average 225g. It has few soft seeds, creamy white epicarp with red spots or blush and snow-white pulp. This variety has TSS 12.5-14.0 °Brix and Vitamin C content of 300mg per 100g pulp.

iii. Seasonality:

The peak season of Guava in Himachal Pradesh is mid-November - February. The harvesting seasons of the major neighbouring states are provided below:

Guava	January				February				March				April				May				June				July				August				September				October				November				December			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV								
Himachal Pradesh																																																
Haryana																																																
Jammu & Kashmir																																																
Punjab																																																
Uttar Pradesh																																																
Uttarakhand																																																

■ Peak season ■ Lean season

Figure 30: Guava harvesting season in major states

Source: EY analysis

²⁹<https://vikaspedia.in/agriculture/crop-production/package-of-practices/fruits-1/guava-1/guava-production-practices> and <https://www.vnrnursery.in/vnr-bihi-pop/>

³⁰<http://nhb.gov.in/model-project-reports/Horticulture%20Crops/Guava/Guava1.htm>

4.2.3. SWOT Analysis of Guava Value Chain

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Guava Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 19: SWOT Analysis of the Guava Value Chain in Himachal Pradesh

Strengths ▶ Guava plants are hard and produce good yield even with little care and fits in to extended harvest. ▶ A special pink tinge develops on the ripen fruit due to cool night which increases its appearance and improves marketability ▶ Soil with high organic matter and cool night offers improved flavour and sweetness of fruits making it preferred fruits in the market.	Weaknesses ▶ Allowing the central leader to grow untrained branches result in dense canopy. ▶ Harvesting of rainy season crop leads to poor winter season crops. ▶ Harvesting by pulling damages the fruits. ▶ High organic matter, and better water holding capacity of soil favours more vegetative grown
Opportunities ▶ Potential for value added products: Pectin, Jelly, Nectar, Jam opens lots of secondary processing opportunities. ▶ The extended harvesting and less competition in the market may result in better prices	Threats ▶ Competition from neighbouring states may pose threat ▶ High temperature during flowering and fruit development stage can cause fruit drop and lower the yield ▶ Guava wilt and fruit fly can create significant damage to orchard and fruits

4.2.4. Value Chain Analysis:

i. Commodity Flow Analysis

The key players involved in the Guava value chain are:

- ▶ Growers
- ▶ Pre- harvest contractor
- ▶ Wholesalers
- ▶ Traders
- ▶ Retailers
- ▶ Consumers



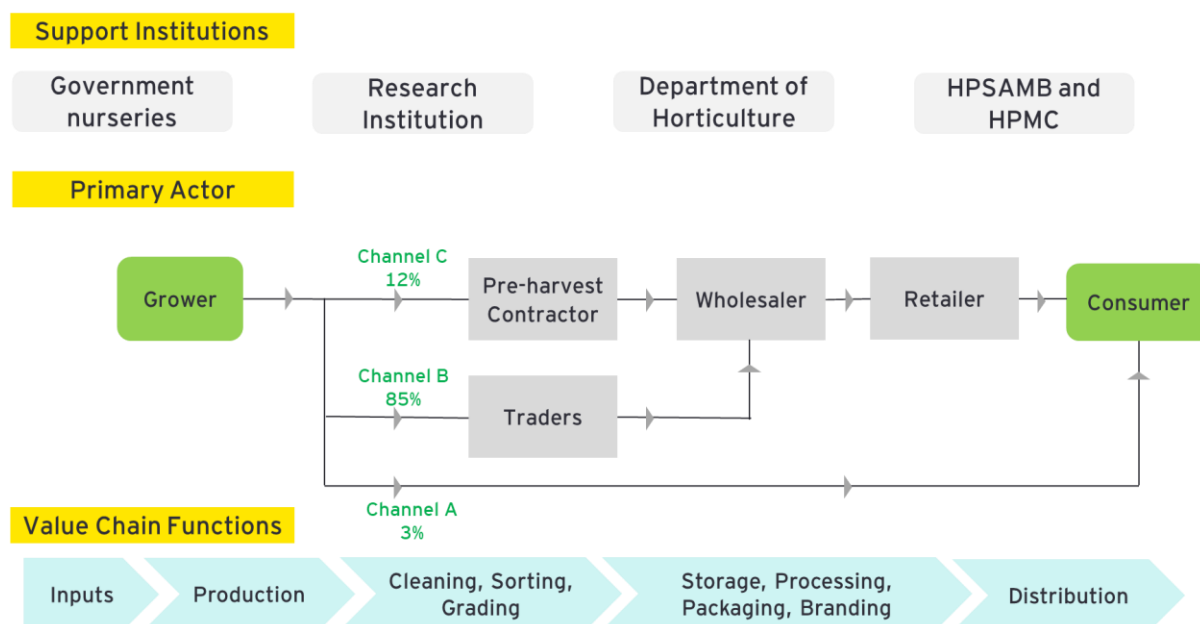
Figure 31: Pink Tinge on Guava Fruit due to UV Rays. Speciality of HP Guava

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified three main channels in the study area:

- ▶ Channel -A Producer → Consumer
- ▶ Channel -B Producer → Trader→ Wholesaler → Retailer → Consumer
- ▶ Channel -C Producer → Pre-harvest contractor→ Wholesaler → Retailer → Consumer

The existing marketing channel of Guava is as below:



Most of the farmers sell their produce through Channel- B.

Channel A: Some of the guava farmers sell directly to the consumers, but this channel is very less prevalent, and less than 3% of the total volume of produce found to be going through this channel.

Channel B: This was the most common channel found in the field areas, where bulk of the produce (85%) pass through this channel. The farmers sell the produce to wholesalers through traders, who normally visit the farms during the harvesting season and fix a price of the Guava for whole farm. Afterward, they organize harvesting, sorting, loading and transportation.

Channel C: This channel was used by the farmers/growers at a very limited scale (12%). The pre-harvest contractors visit the farmers during flowering or fruit setting stage, decide a price, and then manage the cultivation, harvesting and marketing of the produce.

The detailed price- build up analysis for these marketing channels is present in 4.2.5 (ii)

ii. Value Chain Activities

Preharvest Activities

Land Preparation: Land is prepared during the summer season by removing of bushes and other weedy vegetation and is levelled with a mild slope in the opposite direction of water source, harrowing, levelling, and removing weeds.

Planting: The planting is done at 6*6 m under normal planting density. During crop management, random training and pruning of plants is done which is not scientific and thus result in bushy growth habit and also unequal distribution of sunlight and nutrition.

The insect pests mostly observed are fruit fly, stem borer, bark eating caterpillar, thrips, nematodes, mealy bug and scale insect. The main diseases reported are wilt, fruit canker, fruit rot, anthracnose, and grey leaf spot. Spurious chemical and pesticides are in rampant usage which have no authenticity.

Harvesting and Postharvest Activities

Harvesting: Farmers harvest all the three bahars: Mrig, Ambe and Haste which result in poor quality fruits and high incidence of fruit fly.

Manual Harvesting of the fruits is done by pulling and twisting the stem which causes development of white patch on the stem and bruising injury on the fruits.

Posts Harvesting: Sorting and grading is carried out in the field itself in the shaded area which is practiced in the surveyed districts. The fruits are packed in baskets made from locally available plant material. In the current situation, farmers do package them in crates but don't use cushioning material which results in damage to the skin. For distant markets, wooden or Corrugated Fibreboard (CFB) boxes are used along with cushioning materials.

4.2.5. Cost Economics and Price build-up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and the field visits. The data collected from field visits are also validated with the data provided by Department of Horticulture. All the values are considered at constant prices without inflation. The lump sum cost of 1 lakh is considered for land preparation. The spacing of the plant is considered as per the suggested spacing in nursery report, i.e., 3 X 3 in Guava High Density Planting. Mulching sheets are assumed to be replaced for every 5 years. The table presents the annual cost and component wise breakup in 1 ha land and corresponding revenue from expected yield.

Table 20: Guava cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	100000														
Pitting and Plantation (@Rs.50/- per pit)	55550														
Mulching (including labour) (@Rs.32 per running metre for 2.5 metre per plant)	88880					88880					88880				
Micro irrigation development (as per PMKSY rate)	120000														
Planting Materials (1111 plants/hectare @ INR 50 per plant)	55550														
Planting equipment and tools	15000														
Farm yard manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertiliser	13,250	13,250	15,000	16,000	18,000	20,000	22,500	25,000	27,500	30,000	30,000	30,000	30,000	30,000	30,000
Integrated Pest & Disease Management and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,000	3,000	3,000	3,000	3,000
Guava boxes (@10 per 5 kg)	-	-	33,330	44,440	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour (INR 203 / Person day)	74,095	74,095	81,200	83,230	84,245	85,260	87,290	88,305	89,320	90,335	90,335	90,335	90,335	90,335	90,335
Total Cost	5,28,880	93,900	1,39,446	1,56,503	1,81,988	2,74,133	1,90,033	1,93,798	1,97,563	2,01,328	2,90,208	2,01,328	2,01,328	2,01,328	2,01,328

Table 21: Annual revenue per hectare from Guava cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (kg/hectare)	-	-	16,665	22,220	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33330
Return to farmer at Farmgate price (Rs.30/kg)		-	4,99,950	6,66,600	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900	9,99,900
Benefit-Cost Ratio		-	3.59	4.26	5.49	3.65	5.26	5.16	5.06	4.97	3.45	4.97	4.97	4.97	4.97

The establishment cost of Guava cultivation is approximately INR 5.28 lakhs, and annual cost is from INR 0.94 lakhs to INR 2.90 lakhs in the later years. It is observed that the labour component is the major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers. There is cost spike in 6, 11 years, which is due to cost for replacement of mulch.

The table below explains different cost of cultivation in percentage of total cost every year.

Table 22: Year wise cost of Guava cultivation components in percentage of total cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	18.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pitting and Plantation	10.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	16.8%	0.0%	0.0%	0.0%	0.0%	32.4%	0.0%	0.0%	0.0%	0.0%	30.6%	0.0%	0.0%	0.0%	0.0%
Micro irrigation development	22.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting material	10.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting equipment and tools	2.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Farm yard manure	1.1%	5.9%	4.8%	5.3%	4.6%	3.0%	4.4%	4.3%	4.2%	4.1%	2.9%	4.1%	4.1%	4.1%	4.1%
Fertiliser	2.5%	14.1%	10.8%	10.2%	9.9%	7.3%	11.8%	12.9%	13.9%	14.9%	10.3%	14.9%	14.9%	14.9%	14.9%
Insect and pestmanagement	0.2%	1.1%	0.9%	1.0%	1.0%	0.7%	1.2%	1.3%	1.4%	1.5%	1.0%	1.5%	1.5%	1.5%	1.5%
Guava Boxes	0.0%	0.0%	23.9%	28.4%	36.6%	24.3%	35.1%	34.4%	33.7%	33.1%	23.0%	33.1%	33.1%	33.1%	33.1%
Irrigation system maintenance	0.0%	0.0%	1.4%	1.9%	1.6%	1.1%	1.6%	1.5%	1.5%	1.5%	1.0%	1.5%	1.5%	1.5%	1.5%
Labour	14.0%	78.9%	58.2%	53.2%	46.3%	31.1%	45.9%	45.6%	45.2%	44.9%	31.1%	44.9%	44.9%	44.9%	44.9%

Guava starts fruiting from 3rd year and achieve optimum yield in 5th year. The annual return for the farmers ranges from Rs.4.99 lakh to Rs.9.99 lakhs per hectare per annum.

ii. Price Build-up and Market Margins of Guava

The price builds up analysis is presented below for the 3 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders met during field visits and also validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 23: Marketing costs and margins of different functionaries in the various marketing channels of Guava (Rs/kg)

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
(I)	Marketing cost incurred by the producers									
1	Net price received by the farmer	28.00	65.12%	28.00	20.00	31.25%	20.00	18.00	28.13%	18.00
2	Picking and sorting	2.00	4.65%	30.00						
3	Transportation cost	5.00	11.63%	35.00						
4	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)	1.00	2.33%	36.00						
5	Loading / unloading	4.00	9.30%	40.00						
6	Spoilage (approx 10%)	3.00	6.98%	43.00						
	<i>Total</i>	15.00								
	Farmer's selling price	43.00	100.00%	43.00	20.00	31.25%	20.00	18.00	28.13%	18.00
(II)	Marketing cost incurred by the Traders									
A	The gross price paid by Traders				20.00	31.25	20.00			
B	Cost components of Traders									
1	Loading / unloading				4.00	6.25	24.00			
2	Basket				0.25	0.39	24.25			
3	Transportation cost				2.00	3.13	26.25			
4	Mandi Tax				0.20	0.31	26.45			
5	Commission charge				1.00	1.56	27.45			
6	Spoilage at Trader level (approx 10%)				2.00	3.13	29.45			
C	<i>Total</i>				9.45					
D	Traders' Margin				3.55	5.55%	33.00			

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
E	Traders' Selling price				33.00	51.56%	33.00			
(III)	Marketing cost incurred by the Pre-harvest Contractors									
A	The gross price paid by Pre-harvest contractors							18.00	28.125	18.00
B	Cost components of Pre-harvest contractors									
1	Harvesting/picking							2.00	3.125	
2	Loading / unloading							3.00	4.69	21.00
3	Transportation cost							2.00	3.13	23.00
4	Mandi Tax							0.18	0.28	23.18
5	Commission charge							0.90	1.41	24.08
6	Spoilage at Pre-harvest contractors level (approx 10%)							1.80	2.81	25.88
C	Total							9.88		
D	Pre-harvest contractors' Margin							5.12	8.00%	5.12
E	Pre-harvest contractors' Selling price							33.00	51.56%	31.00
(IV)	Marketing cost incurred by the wholesaler									
A	The gross price paid by wholesaler				33.00	51.56%	33.00	33.00	51.56%	33.00
B	Cost components of wholesaler									
1	Loading / unloading				0.50	0.78%	33.50	0.50	0.78%	33.50
4	Transportation cost				0.50	0.78%	34.00	0.50	0.78%	34.00
5	Mandi Tax				0.33	0.52%	34.33	0.33	0.52%	34.33
6	Commission charge				1.65	2.58%	35.98	1.65	2.58%	35.98
7	Spoilage at Wholesaler level (approx 10%)				3.00	4.69%	38.98	3.00	4.69%	38.98
C	Total				5.98			5.98		
D	Wholesalers Margin				3.52	5.50%	3.52	3.52	5.50%	3.52
E	Wholesaler Selling price				42.50	66.41%	42.50	42.50	66.41%	42.50
(V)	Marketing cost incurred by the retailer									

S. No.	Particular	Channel A			Channel B			Channel C		
		<i>In Rs.</i>	<i>in %</i>	<i>Price-built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>
A	The gross price paid by retailer				42.50	66.41%	42.50	42.50	66.41%	42.50
B	Cost components of retailer									
1	Loading / unloading				0.50	0.78%	43.00	0.50	0.78%	43.00
3	Transportation cost				1.00	1.56%	44.00	1.00	1.56%	44.00
4	Mandi Tax				0.43	0.66%	44.43	0.43	0.66%	44.43
5	Commission charge				2.13	3.32%	46.55	2.13	3.32%	46.55
6	Storage/rent				0.50	0.78%	47.05	0.50	0.78%	47.05
7	Spoilage at Retailer Level (15%-20%)				6.38	9.96%	53.43	6.38	9.96%	53.43
C	<i>Total</i>				10.93			10.93		
D	Retailer Margin (20%-25%)				10.57	16.52%	10.57	10.57	16.52%	10.57
E	Retailer Selling price				64.00	100.00%	64.00	64.00	100.00%	64.00
(VI)	Consumer' Purchase Price	43.00	100.00%		64.00	100.00%	64.00	64.00	100.00%	64.00

The price spread among different marketing channel is described below. The price spread found to be maximum in channel A INR 15/-, followed by channels B.

Table 24: Price spread of Guava among the different marketing channels (Rs/kg)

S. No.	Particular	Channel A	Channel B	Channel C
1	Producer price	28.00	20.00	18.00
2	Consumer's price	43.00	64.00	64.00
3	Price spread	15	44.00	46.00
4	Producer's Share	65.12	31.25	28.13

The producer's share in Channel A is high (65.12%) as compared to that of in Channel B (31.25%) and Channel C (28.13%). The more the intermediaries the more is price spread and the less is producer's share in consumers' price.

While the Channel B found to be very common, small quantities of guava were also sold through Channel A (<5%). Though the farmers and consumers both have win-win situation in this Channel, it has limited scope of selling large volume of the produce.

Table 25: Marketing efficiency of Guava among the different marketing channels

S. No.	Particular	Channel A	Channel B	Channel C
1	Farmer's Price	28.00	20.00	18.00
2	Marketing cost	15.00	26.36	26.79
3	Marketing Margin	0.00	17.64	19.21
4	Marketing efficiency	1.87	0.45	0.39

As calculated above, the marketing efficiency in Channel C is much lower than that of in Channel A and B. This is because of higher marketing cost and margin in Channel C.

4.2.6. Gaps in the Value Chain

The gaps observed at different stages are as follows:

i. Pre- production

- ▶ Guava can tolerate high temperatures and drought conditions but is susceptible to severe frost as it can kill the young plants.
- ▶ Majority of guava growers had difficulties in nonavailability of raw material for guava farming.
- ▶ The farmers did not practice soil testing, in absence of which soil fertility status was unknown.
- ▶ Un-even terrain was also found to be a limiting factor in land preparation.

ii. Production

- ▶ The major technical problems observed in guava are observed as lack of adherence to Package of Practice (POP).
- ▶ Fruit cracking is a serious disorder. This physiological disorder observed in young fruits is due to boron deficiency and that in fully grown fruits is mainly due to moisture imbalances.
- ▶ During field visits, it was learned that mainly fertilization used is FYM 5kg/pit. Some farmers also reported using 10 gm/lt SSP and 10 gm /lt MOP from FLD clusters.
- ▶ Plants were not properly maintained in few clusters.
- ▶ Phosphorus and potassium deficiency was observed
- ▶ Regular pruning of plants was not practised
- ▶ Few clusters drip is installed and fully functional, whereas in few clusters drip is installed but not operational due to lack of power
- ▶ Lack of proper irrigation and drying of young plants were also noticed during the field visits.
- ▶ Presence of fruit fly noticed in some of the fields visited.

iii. Harvesting and post- harvest

- ▶ Technical knowledge of correct stage of harvesting were found lagging. Earlier harvested fruits will not ripen whereas late harvested fruits may crack open.
- ▶ Lack of equipment for harvesting, bagging and collection of fruits in crates/buckets were other limiting factors.
- ▶ Rotten fruits were not picked from the field

v. Transportation and Marketing

Market is also found to be one of the major components for any business. In this regard of the respondents stated the problem that transportation cost upto the market minimizes their profit. Fluctuation in the demand of the product was also one of the major market problems.

4.2.7. Market Overview

Guava Farm also provides value addition opportunities in terms of processed produce like Jam, Jelly, squash, nectar, leather and also value-added industrial product like pectin. The tropical pink guava puree shares a market share of 55.3% and the white guava puree shares a market share of 40%. The remaining 5% is shared by the other varieties. In recent years, Guava drink is getting the popularity³¹.

i. Domestic Market for Guava

The Guava arrival to the markets of Himachal Pradesh in 2021 started in February and had a second highest arrival for the year (79.3 MT). Then there was a gap of two months (April & May) and thereafter extending till December with the highest arrival level of 80.17 MT. The entire year culminated with a total arrival of 132.39 MT.

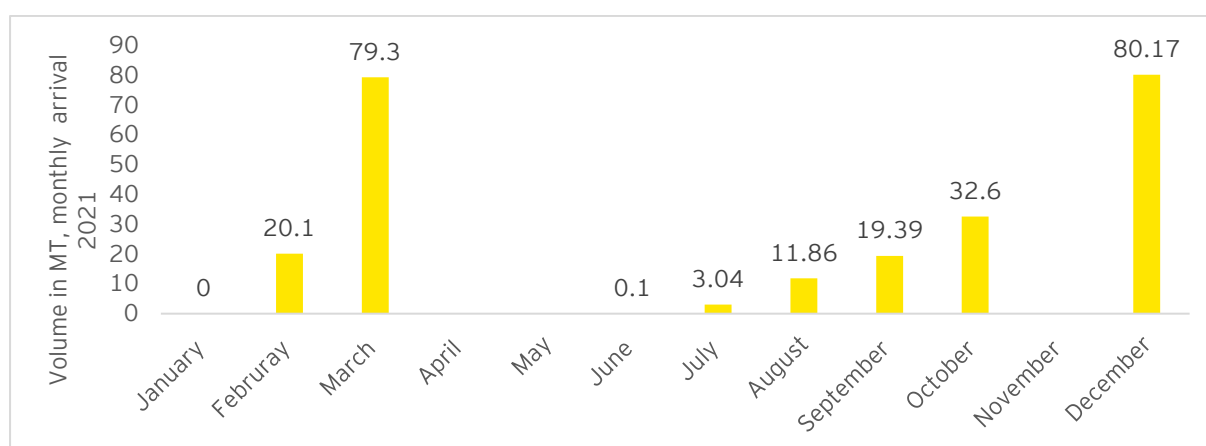


Figure 32: Volume of Guava Arrival in Himachal Pradesh Market in MT, 2021

Source: Agmarknet

In the past five years, we see that there has been an increase in the arrival from 2017 to 2019 and then a drastic dip to around 24.25 MT and then picking up to around 246 MT. However, the trend is declining and may likely to continue if the production inside Himachal Pradesh don't increase. The numbers show that there is an existing domestic demand in the state, but the deficit has to be made up by boosting internal production and importing from outside the state.

³¹<https://www.abcfruits.net/guava-processing-industry-in-india-production-capacities-future-trends-and-key-opportunities/>

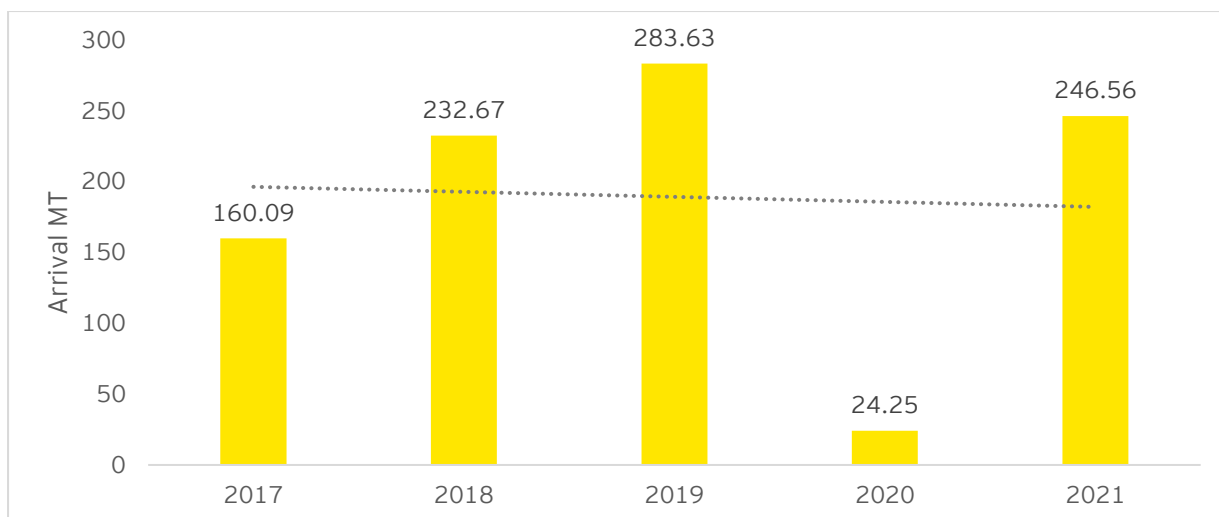


Figure 33: Trend in the arrival volume in MT

Source: Agmarknet

During this season in 2021 the highest wholesale price was INR 7000/ QTL in the month of June followed by INR6450/QTL the next month. The price was dropped in September to INR 2527 /QTL. Overall, the wholesale price of Guava increased from INR 11.12/KG, or INR1112/ QTL in 2008 to 42.21/ KG, or 4210/ QTL in 2021. The trend is positive and rising.

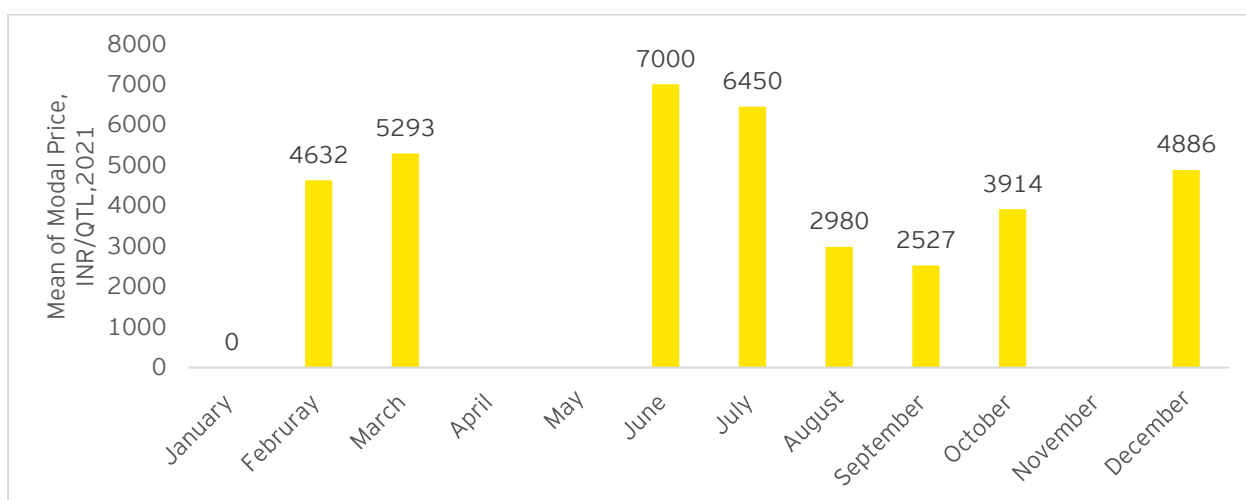


Figure 34: Mean of Modal Price in Himachal Pradesh Markets for various months INR/QTL in 2021

Source: Agmarknet

In the domestic markets in 2021 Hamirpur APMC and Kangra received the highest wholesale mean of modal price of INR 71.21/KG and INR70.11/KG respectively. The next set of markets that received higher prices were Kangra (Nagarkota) and Palampur witnessing around INR 68 .68 /KG. Markets in Una, Kangra (Jaisinghpur), and Knagra (Jessore) witnessed higher than INR60/KG.

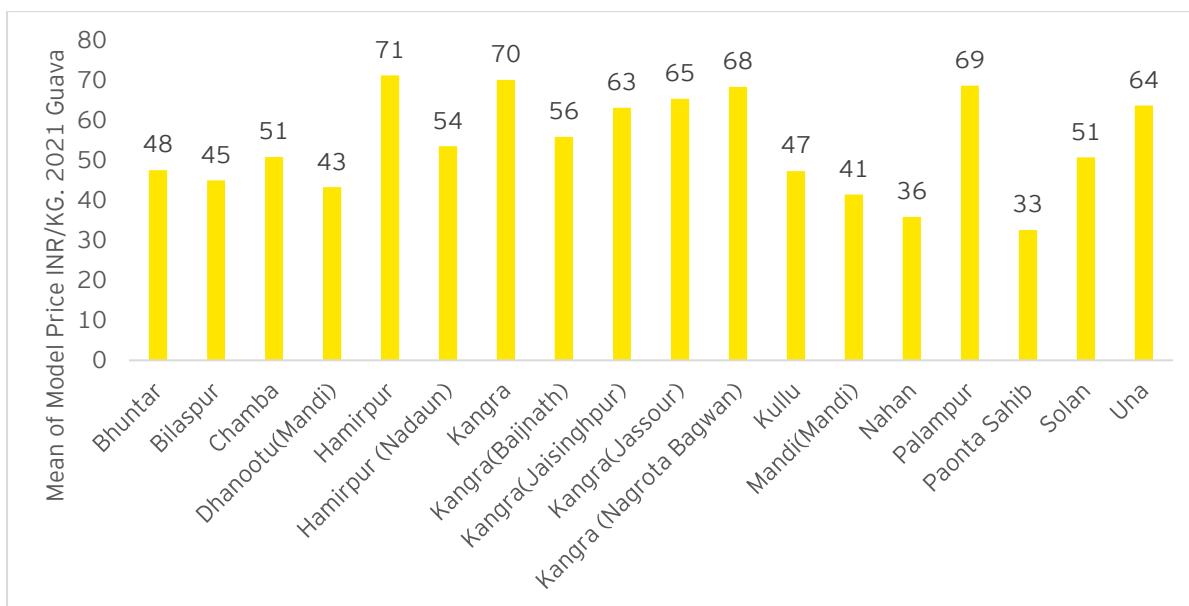


Figure 35: Mean of Modal Price in Himachal Pradesh APMC Markets, INT/QTL in 2021

Source: Agmarknet

In the J&K Markets arrival season started in January and ended in the month of April. The total arrival during the season was 132 MT which is almost an equivalent quantity that arrived in the Himachal Pradesh markets in the same year. The month of January witnessed the highest arrival of 96.7 MT, then a drop of 16.17 MT in February. The arrival season ended in April with a mere 1.0 MT arrival in the market.

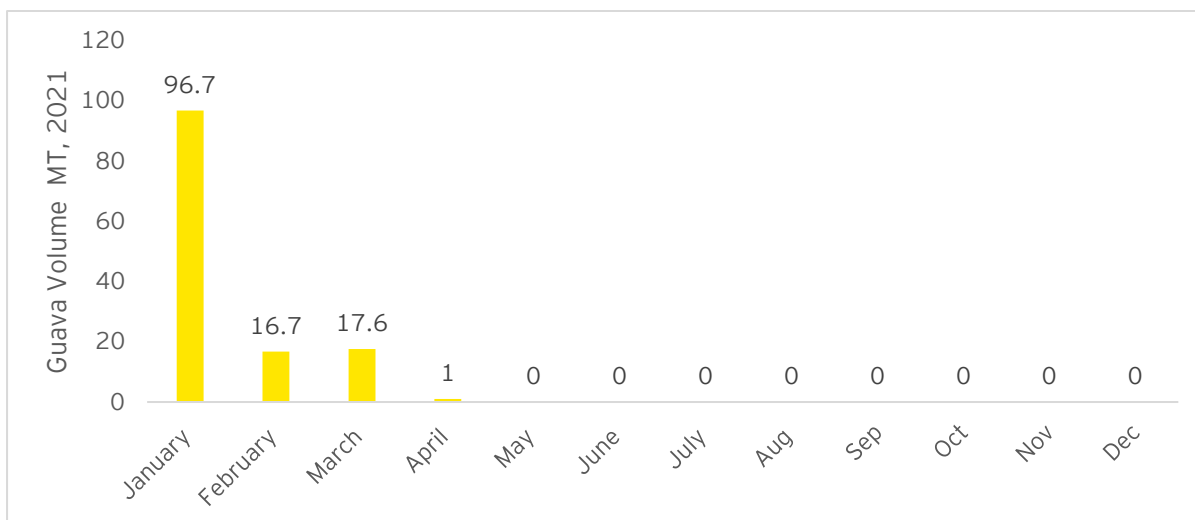


Figure 36: Volume of Guava Arrival in J&K Markets in MT, 2021

Source: Agmarknet

With the volume decreasing the Mean of Modal Price in market increases a representation of demand and supply affecting price. The arrival price in January in J&K was INR4162/QTL and peaked to a highest point of 1.0 MT at INR9738/QTL in 2021.

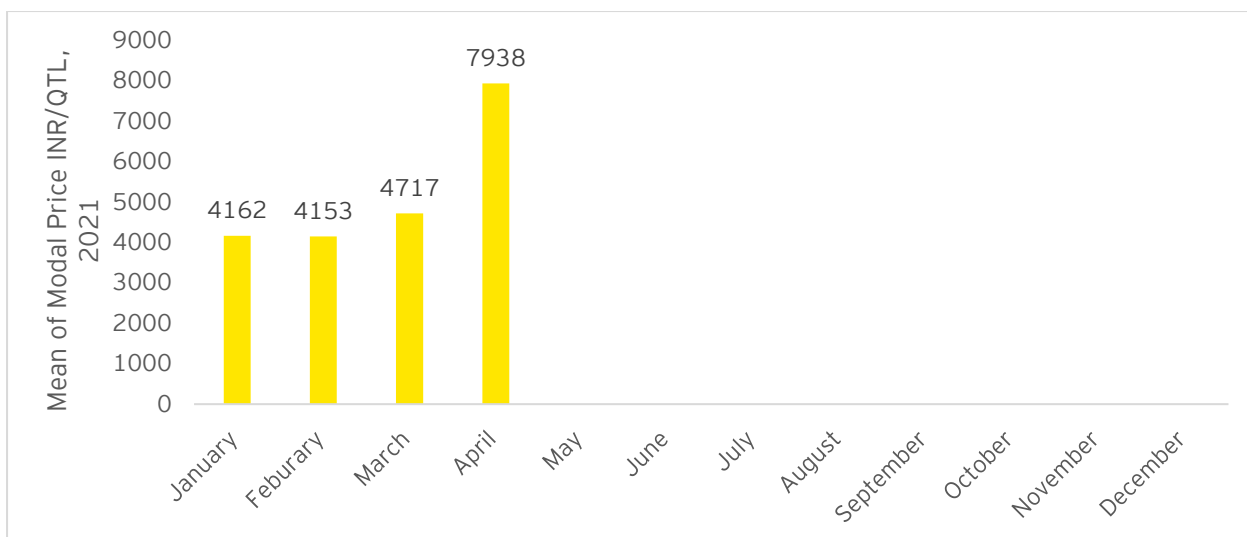


Figure 37: Mean of Modal Price in J&K markets for various months INT/QTL in 2021

Source: Agmarknet

Akhnoor and Reasi are the two markets in J&K where Guava arrives during the season. In 2021 the Mean of the Modal price of Guava in Akhnoor was INR4304/QTL and in Reasi INR 4188/ QTL.

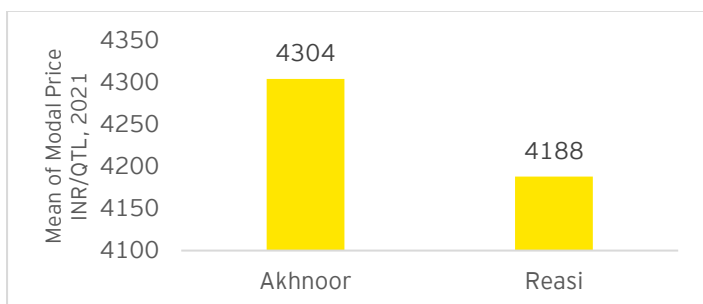


Figure 38: J&K Major Markets Mean of Modal Price

Source: Agmarknet

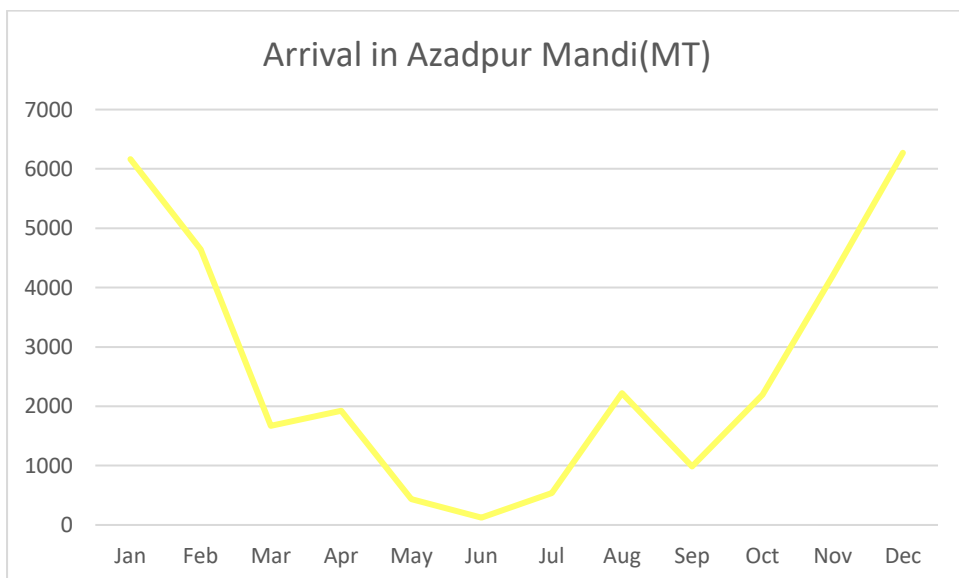


Figure 39: Azadpur Mandi Arrival of Guava (MT) 2021

The maximum arrival in Azadpur mandi for Guava is noticed in December and January which corresponds to harvesting season of the fruit in the state.

ii. Snapshot of International Market Analysis of Guava

Import markets

The combined analysis of Guava and Mango is presented below as international data of Guava and mango is available together³².

- ▶ The World import market of these fruits witnessed a positive annual average growth of 6% which is higher than the B20 group of countries, which experienced a growth rate of 3% however this trend is likely to continue. Among the B20 countries the highest annual average growth rate is experienced is Uganda with 58% in the volume of import of Guava, and Mangoes, followed by China, Russian Federation, and Thailand with rates 25% and 24%, respectively. These are also attractive export destination for absorbing Indian export of these fruits which are cultivated in Himachal Pradesh and other states of India.
- ▶ World market for Guava and Mango is experiencing an annual average growth rate of 7% in terms of value and this growth is going to continue in the future. The total value was USD2.57 billion in 2016 and is forecasted to grow in value up to USD7.2 billion by 2030. The Emerging Market group of countries has with growth rate of 19% in value, and will continue to grow, which covers a share of 14% of the value of the B20 group. The EM group's value was USD 3 billion in 2016, which is forecasted to grow up to USD30.7 billion by 2030.
- ▶ Overall, India has a trade surplus both in volume and value. In India export volume, value and price development of Guava experienced average volume of 180043MT, 980,000 USD, and an average export price of USD 990 per MT, but with considerable variations between years. In case of these fruits the import prices are far lower than the export prices. The average import price is USD 193 per MT, which is less than USD 695 than the export price in 2020. The export price over the period 2012 to 2020 is USD 990 per MT which has a growth rate of 4% so there is a high possibility of better export prices, the average import price is around USD 797 per MT during the same period, with a higher growth rate of 9%, which is one of the reasons for a negative growth in the Trade Balance by value.
- ▶ There was a cumulative trade balance surplus of 1,27,370 MT and USD 136 million in 2020. India is trade balance deficit in value since 2018, but trade surplus in volume was witnessed thereafter.

Suggested Export Destinations

Market criteria	Priority country destination (By Growth rate and Trend)	Growth Rate and Import Price	
Higher volume	▶ Uganda ▶ China ▶ USA ▶ Russian Federation	Volume	▶ 58% ▶ 25% ▶ 3% ▶ 24%
Higher value	▶ Russian Federation ▶ China ▶ Netherlands ▶ Germany	Value	▶ 28% ▶ 26% ▶ 7% ▶ 4%
Higher Prices	▶ Japan ▶ Republic of Korea ▶ Switzerland ▶ Italy	Import Price	▶ Japan:USD:4552/MT ▶ Rep. Korea: USD3939/MT ▶ Switzerland: USD3157/MT ▶ Italy USD2576/MT
Emerging markets	▶ Saudi Arabia ▶ Poland	Long term focus	▶ 5% volume & 2% value ▶ 7% volume & 11% value Markets with growth in consumer income. Higher choice of consumers with substitute fruits

Figure 40: Export Destinations for Guava

Source: ITC trade maps

³²ITC Trade Map- Trade Statistics for International Business Development database

The export markets for India for these products are China, Russian Federation, Netherlands, Germany, and Thailand. Countries paying higher price are Japan, Republic of Korea, Switzerland, Italy and Saudi Arabia and Poland.

The detailed graphs and analysis are presented in Annexure IV

4.2.8. Proposed Interventions

The major points to be taken care at the production stage are field preparation, optimum nutrition, adequate irrigation, mulching and management of pest and diseases. For high quality and higher production pruning and training of plants from the Year 1 is utmost requirement. With supply of quality inputs, maintenance of the plants, gentle harvesting, sorting grading and packaging in pack house and exposure to proper marketing the project expects to increase the income of the farmers.

i. Pre- production

Availability of disease free true to type quality planting material of known varieties Lalit and Shweta to be purchased from reputed nurseries and for BIhi planting material to be only procured from VNR seeds.

Land Preparation: Heavy clay to very light sandy soils having pH between 4.5-8.2 are suitable for cultivation of guava. The land preparation for Guava involves deep ploughing, cross ploughing, harrowing and soil levelling followed by digging pits measuring 0.6x0.6 m before monsoon. Pits should be left for 15-20 days to allow breathing. After 15-20 days they should be filled with soil using 500 gms of superphosphate and 20 kg of organic manure. Planting shall be done as soon as Monsoon arrives or in Feb-Mar. The spacing to be followed in the project is 3X3 m in high density planting.

ii. Production

Planting: The planting is suggested under high density planting with spacing of 3 x 3 metre. High density planting supports straight growth of branches making the plant tall, compact, and also gives higher yield/unit area in early years of fruiting. Proper pruning of the plants from Year 1 to develop a strong and uniform canopy.

Nutrient management: Apply well decomposed cow dung @ 120-150qtl per acre as basal dose. Overall Guava crop required Nitrogen@36kg per acre in form of Urea@80kg/acre. Apply half dose Nitrogen at time of sowing and remaining after first picking of fruits. For high density planting the recommended dosage is 80 g N, 40 g P and 50 g K with foliar spray.

To obtain good yield spray of 19:19:19 is done along with micronutrients @ 2.5 to 3 gm per litre. 2nd spray is done 10 to 15 days post the first spray with the dosage of 4-5 gm per litre. To get good flowering and fruiting spray of 00:52:34 is taken at 50 gm / litre at the onset of flowering followed by another spray during fruiting. At fruit development stage spray of 13:00:45 (Potassium Nitrate) @ 100 gm / litre is taken. The manure and fertilizer applied in the soil 2-3 ft. away from the main stem. Nutrient should be applied based on soil testing report.

Irrigation: Pre sowing plants irrigation should be given in summer season crop to ensure good germination. The next irrigation is given after 15 days. Then the field is irrigated after 4 to 5 days in summer and 10 to 12 days in rainy season. Yearly average water requirement of guava was estimated to be 206 mm after subtracting the effective rainfall. Irrigation was supplied to each plant using two emitters (online) of 4 L h⁻¹ capacity.

Inter-Cropping: In guava orchard up to age of 3-4 years the inter-space can be used by planting pulses crop like cow pea, gram etc. can be grown.

Crop Regulation: Guava bears two main crops in a year. First crop is ready during July-August and other during November-January. Only winter crop is recommended. To avoid rain season crop, do not irrigate the orchard during February to mid-May or de-blossom spring flowers by hand picking or spraying with 30 gm. NAA. For this 30 gm. NAA dissolve in 50 ml. alcohol or spirit and add 100 Litre water.

Bagging: Bagging is a procedure in which fruits are bagged or covered with different materials like foam net, anti-fog polythene bags, and papers respectively, with a view to protect fruits from various biotic and abiotic stresses. It should be done at an early stage after fruit set probably when the fruit attains the size of a Ber i.e., when fruit attains 1.5 inches diameter.

Insect Pest & their control: The major insect pest attacking are fruit fly, mealy bug and bark eating caterpillar. The major control measures which can be applied are:

- ▶ As far as possible avoid rainy season crop because in this season fruits are damaged by the fruit fly.
- ▶ The affected fruit should be collected daily, and it should be buried into the soil 2 ft. deep or fed to the goat and sheep.
- ▶ Give deep chlorine in summer season so that the pupae of the fruit fly can be destroyed.
- ▶ 500 ml. malathion, cythion 50 EC + 5kg Gur or sugar should be added in 500 liters of water and spray in one acre. If the infestation of the fruit fly is still observed, then the spray should be repeated 7-10 days.

Diseases & their control

a. Guava Wilt: The symptoms are appeared after late period when the roots of the trees are mostly damaged. First symptoms start with yellowing of leaves and subsequently gradually tree become wilting.

Control Measures: The guava should be planted on that field where there is proper drainage facility. The heavy soil should be discarded from the planting of the guava. At the time of irrigation water should not stand around the stem. The infested plants should be uprooted with the roots and destroy them. The soil should be treated with Formalin in and after sterilization of the soil the new plantation should be done. Where there is an incidence of this disease on those area guava variety L-49 or Sardar should be selected. This variety is resistant up to some extent to guava wilt. In each plant where the irrigation is applied by ring method in each ring of 15 cm. Bavistin should be applied three times in a year i.e., March, June and September and apply irrigation after this treatment. In the month of September, a spray of zinc sulphate @ 0.3% should be sprayed. Where there is wilting problem, this treatment is very effective.

b. Fruit Rot and dieback: The infested fruits are in a small size and developed black colour and sometimes these symptoms appeared in a very late stage. At the time of fruit ripening there are development of circular spots, or many spots have developed and later stage there is a growth of orange fungus on sunken spot. If there is an infestation of the branches, then the branches start drying from the tail and spread towards stem.

Control Measures: Cut the infested branches and spray 0.3% copper oxychloride 3 gm. blight ox or blue copper in one litre of water and spray should be done 2-3 times after setting of the fruit.

iii. Harvest and Post-harvest

Maturity Indices:

- ▶ For long distance transportation, fruit should be harvested at the mature, firm stage without any signs of ripening
- ▶ For short distance marketing, fruits should be harvested when they show some sign of colour change from green to yellow, as well as initial softening.
- ▶ Later harvesting, when fruit are riper, can lead to a high number of fruit fly stings and later larvae in the flesh.

Precautions during harvesting

- ▶ The fruit should not be pulled from the stock and cut from stock with a clipper or knife
- ▶ The fruit must be placed in the tray lightly so that it is not damaged by while dropping
- ▶ Guava is graded on the basis of size, colour, and quality. The graded Guava fetches better price realization

Pre-Cooling, Storage, and transport: Pre-cooling facilities to be provided if the fruits are to be shipped long distance to about 10oC. Mature green and partially ripe fruit can be held for 2 to 3 weeks

Packaging: The packaging of guava should be done invariably in crates with cushioning material or CFB boxes.



Figure 42: Packaging in crates with crate line



Figure 41: Foam net packaging

Marketing and Branding:

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.3 Value Chain Analysis of Pomegranate

4.3.1. Overview:

i. Global Scenario:

The global pomegranate and pomegranate arils market was valued at USD 8.2 billion in 2018 and is expected to reach USD 23.14 Billion by year 2026, at a CAGR of 14.0 percent. Currently, the market in Asia Pacific is dominating the global market in terms of revenue and major production countries are India, China and Iran³³. The top five importers of Pomegranate from India are UAE, Bangladesh, Qatar, Nepal and Netherlands in 2020³⁴.

ii. Indian Scenario:

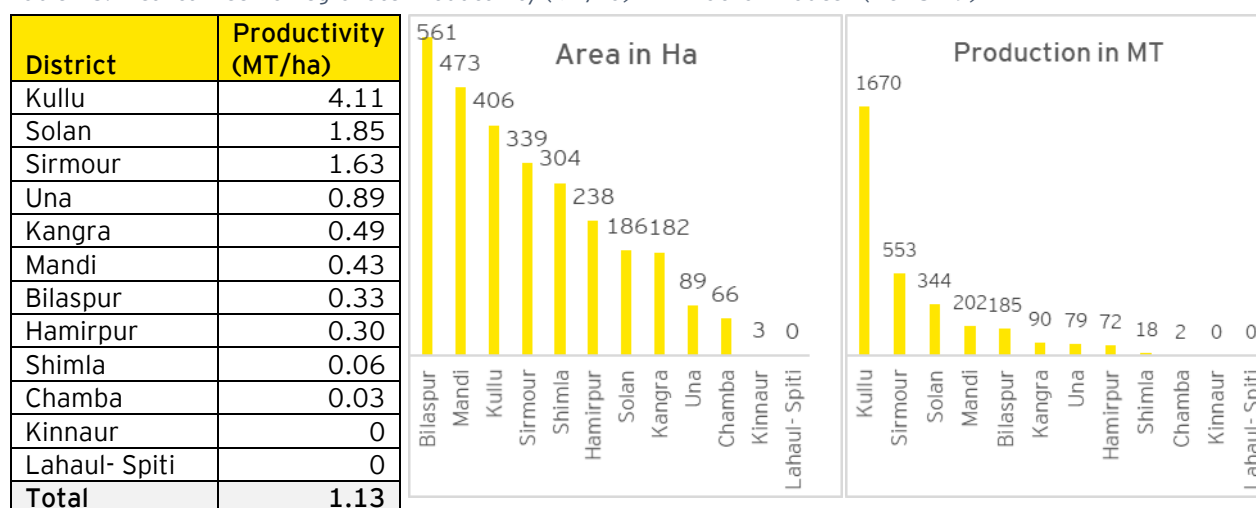
Pomegranate (*Punica granatum*) is one of the commercially important fruit crops of India. Pomegranate is cultivated mainly in North west, southern and central states in India. The top production states in terms of production volume (2017-18) along with their percentage of overall production are Maharashtra (63%), Gujarat (16%), Karnataka (9%), Andhra Pradesh (5%). Himachal Pradesh stands at 11th position in terms of pomegranate production³⁵.

4.3.2. Pomegranate Production in Himachal Pradesh

i. Area and Production:

Pomegranate in Himachal Pradesh has been cultivated as wild since centuries but the last decade has seen the shift towards cultivated varieties. The shift is mainly attributed to climate change which resulted in less chilling hours and less profitability for Apple and enforced farmers to rethink their fruit cultivation strategy resulting in shift to commercial pomegranate cultivation.

Table 26: District wise Pomegranate Productivity (MT/ha) in Himachal Pradesh (2018-19)



Source: Department of Horticulture

Figure 43: Pomegranate Production Area and Volume in HP (2018-19)

³³https://agriexchange.apeda.gov.in/Weekly_eReport/Pomegranate_Report.pdf

³⁴ITC Trade Map- Trade Statistics for International Business Development database

³⁵National Horticulture Board (NHB) 2017-18

The area cultivated under Pomegranate in Himachal Pradesh is 2847 ha and Production volume is 3215 MT with a productivity of 1.13 MT/ha. From the above Figure, it is understood that Bilaspur, Mandi and Kullu are the top three districts in terms of area covered under Pomegranate. However, districts namely Kullu, Sirmour and Solan recorded the highest production volume and also are top 3 districts with highest productivity. The current productivity (1.13 MT/ha) is very low because of cultivation in wild. However, with high density planting and appropriate and proven scientific cultivation practice the productivity of Bhagwa Pomegranate is expected to reach the top place in India.

ii. Pomegranate Varieties

There are more than 50 pomegranate varieties/cultivars identified from different organizations so far. Important pomegranate varieties cultivated in India are Alandi, Bhagwa, Kandhari, Kabul, Spanish Ruby, and Ganesh. However, real boost in cultivation of pomegranate was achieved with the release of new pomegranate cultivar in 2003-04 named as '**Bhagwa**'³⁶. This is due to its unique fruit and aril colour, flavour and aroma and better keeping quality. All these features made it popular in domestic as well as in international market. After release of cultivar Bhagwa, the pomegranate cultivation in India has picked up steadily and area under pomegranate has increased from 0.97 lakh hectare (2003-04) to 2.16 lakh hectare (2016-17)³⁷. Total production and export of pomegranate have also gone up.

Characteristics of the Bhagwa cultivar³⁸

- ▶ Spreading type, evergreen bush with dark green foliage and spiny branches.
- ▶ The leaves are opposite, ovate, and lanceolate and flowers are dark saffron colour borne terminally or auxiliary in single or cluster.
- ▶ There are three sex forms of flowers viz., male, hermaphrodite and intermediate.
- ▶ The fruits are very attractive having smooth glossy dark saffron thick rind with dark red colour, bold arils and soft seeds and hence fetches very good price in the market.
- ▶ The fruits of Bhagwa are in high demand both in domestic and export market.
- ▶ It is suitable for long distance market as it has thick rind and better keeping quality (15-20 days at ambient conditions).
- ▶ It is a late maturing cultivar, which takes 180-190 days for maturity. Fruits are medium to large in size (average weight 405.97 g).
- ▶ The average yield under drip is 30-40 kg fruits/ plant. Under high density orcharding and good horticultural practices, farmers are harvesting fruits to the tune of 25-30 tonnes/ha.
- ▶ Arils are sweet in taste with dark red colour having 15.38% T.S.S. and 0.37% acidity.
- ▶ The attractive fruit and aril colour and excellent quality, it fetches better market price which is 2-3 times higher than that of Ganesh.
- ▶ There is a high demand of Bhagwa for export markets particularly in European countries.
- ▶ The cultivar is less susceptible to fruit cracking and fruit spot (PDI-4.68), relatively free from blackening of aril and tolerant to thrips and mites.

iii. Seasonality:

Pomegranate is expected to be harvested in mid-September to mid-November in Himachal Pradesh. In that period, less fruits come from major pomegranate growing regions.

³⁶<https://nrcpomegranate.icar.gov.in/files/Publication/44.pdf>

³⁷ National Horticulture Board- Production data

³⁸<https://krishi.icar.gov.in/jspui/bitstream/123456789/47001/1/Status%20report%20of%20Bhagava.pdf>

Figure 7-10 Pomegranate harvesting season in major states

Pomegranate Major States	January				February				March				April				May				June				July				August				September				October				November				December			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV								
Himachal Pradesh																																																
Maharashtra																																																
Haryana																																																
Punjab																																																
Rajasthan																																																
Karnataka																																																
Gujarat																																																

■ Peak season ■ Lean season ■ Round the year

Source: EY analysis

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Pomegranate Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 27: SWOT Analysis of the Pomegranate Value Chain in Himachal Pradesh	
Strengths ▶ Deep pink color of fruits and aril gives competitive market advantage and better price realization ▶ Soil with high organic matter and cool night offers improved flavor and sweetness of fruits making it preferred fruits in the market. ▶ Agro- climatic conditions prevailing in the region is highly suitable for pomegranate cultivation. ▶ Harvesting of pomegranate in season October - November, is favorable for better price realization, considering poor supply from major growing region ▶ Low temperature in December to February favors leaf fall, essential for flowering and fruiting, saving on cost of chemical needed for defoliation.	Weaknesses ▶ High organic matter content in soil and better water holding capacity favors more vegetative growth necessitating frequent pruning. ▶ Insufficient availability of disease- free quality planting material.
Opportunities ▶ The extended harvesting and less competition in the market may result in better prices ▶ Pomegranate has potential for export which provides an excellent opportunity for growing pomegranate.	Threats ▶ Competition from neighbouring states may pose threat

i. Commodity Flow Analysis

The key players involved in the Pomegranate value chain are:

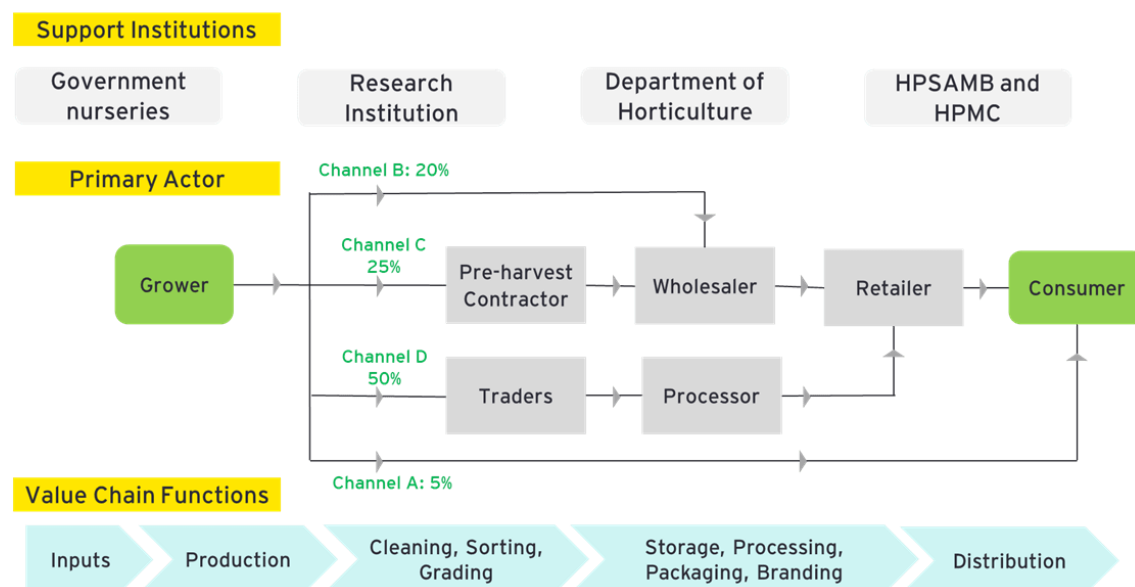
- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Wholesalers
- ▶ Traders
- ▶ Processor
- ▶ Retailers

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified four main channels in the study area:

- ▶ Channel -A Producer → Consumer
- ▶ Channel -B Producer → Wholesaler → Retailer → Consumer
- ▶ Channel -C Producer → Pre-harvest contractor → Wholesaler → Retailer → Consumer
- ▶ Channel-D Producer → Traders →Processor → Retailer → Consumer

The existing marketing channel of Pomegranate is as below



Most of the farmers sell their produce through traders i.e., Channel-D, followed by pre-harvest contractors, i.e., Channel C.

Channel A: This channel was used by the farmers/growers at a very limited scale (<5%), mainly to meet the short-term cash requirement at the household. Sometimes, the farmers themselves bring the produce in the nearby markets or put a stall in the market to sell directly to the consumers. Depending on the cash requirement, the farmers harvest the fruits and bring them to the market. In such cases, the transport is arranged by the farmers themselves. In this channel also the farmers have limited bargaining power.

Channel B: In certain cases, the farmers directly sell to distant wholesalers in Delhi, Mumbai and far away distance. This channel is normally opted by bigger farmers who have larger volume of fruit produce, and who have ability to organize and market the fruit produce of fellow farmers. In such cases, the price negotiation is done beforehand, normally over phone. Based on that the harvested fruits produce is brought to the market. They sometimes sell the produce to local retailers through which it finally reaches the consumers.

Channel C: In this channel, the pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. They inspect the field, forecast the estimated production, and then negotiate price with the farmers. Thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation and marketing of produce.

Channel D: This was another common marketing channel observed during the field assessment. The traders normally visit the farms during the harvesting season and fix a price of the pomegranate for whole farm. Afterward, they organize harvesting, sorting, loading and transportation.

The detailed price- build up analysis for these marketing channels is present in 4.3.5 (ii)

ii. Value Chain Activities

Preharvest Activities

Land preparation: Pomegranate tree is deciduous in areas of low winter temperature and an evergreen or partially deciduous in tropical and sub-tropical conditions. It can tolerate frost to a considerable extent in dormant stage. Well drained, sandy loam to deep loamy or alluvial soils is suitable for cultivation.

Planting: Farmers do the planting as per traditional method with spacing 6*6. Currently farmers train the plants on a single tier system. Farmers remove ground suckers, water shoots, cross branches, dead and diseased twigs along with little thinning of old spurs.

Disease management: Insect pests mostly observed are fruit borer, mealy bugs, aphids, white fly and fruit sucking moths. Spraying with dimethoate, deltamethrin or malathion etc. depending upon the type of pest infestation has been found to be effective in most cases. The main diseases reported are leaf spot and fruit rot.

Harvesting and Postharvest Activities

Farmers harvest the fruit during morning or late evening but are not able to judge the proper stage of harvesting resulting into fruit cracking. Late harvesting of fruits results in a physiological disorder known as internal breakdown. i.e., the discoloration of affected arils from that of rest of the arils.

The sorting of the fruits is done at the farm itself. Grading of the fruits is done as per size. The fruits are packed in wooden crates and transported to market in open trolleys or sometimes even as headloads.

4.3.5. Cost Economics and Price build-up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and the field visits. The data collected from field visits are also validated with the data provided by Department of Horticulture. All the values are considered at constant prices without inflation. The lump sum cost of 1 lakh is considered for land preparation. The spacing of the plant is considered as per the suggested spacing in nursery report, i.e., 3 m * 3 m in Pomegranate High Density Planting. Mulching sheets are assumed to be replaced for every 5 years. The table below present the annual cost and component wise breakup in 1 hectare land and corresponding revenue from the expected yield.

Table 28: Pomegranate cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Input Cost															
Land clearing and	1,00,000	-	-	-			-								
Pitting and Plantation (1111 pits @Rs.50/- per pit)	55,550														
Planting material (@Rs.125/- per plant)	1,38,875														
Mulching sheet (2 metre each @Rs.32/- running metere)	71,104	-	-	-		71,104	-	-	-		71,104	-	-	-	
Planting equipment and tools	15,000	-	-	-			-								
Micro-irrigation system (as per PMKSY)	1,20,000	-	-	-			-								
Agro-chemicals & fertilizers															
FYM	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertilizer	13,250	13,250	15,000	16,000	18,000	20,000	22,500	25,000	27,500	30,000	30,000	30,000	30,000	30,000	30,000
IPDM & GR	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,000	3,000	3,000	3,000	3,000
Packaging (Rs.10 per 5 Kg)	-	-	33,330	44,440	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660	66,660
Irrigation system	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour	74095	74095	76125	78155	80185	82215	84245	86275	88305	90335	90335	90335	90335	90335	90335
Total Cost per hectare	5,94,429	93,900	1,34,371	1,51,428	1,77,928	2,53,312	1,86,988	1,91,768	1,96,548	2,01,328	2,72,432	2,01,328	2,01,328	2,01,328	2,01,328

Table 29: Annual revenue per hectare from pomegranate cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (Kg/ha)	-	-	16,665	22,220	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330	33,330
Income (Rs.50/kg)		-	8,33,250	11,11,000	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500	16,66,500
Benefit-Cost Ratio		-	6.20	7.34	9.37	6.58	8.91	8.69	8.48	8.28	6.12	8.28	8.28	8.28	8.28

The establishment cost of Pomegranate cultivation is approximately INR 5.94 lakhs, and annual cost is from INR 93.9 lakhs to INR 2.72 lakhs in the later years. It is observed that the labour component is the major component in the cultivation, and it is also the main issue for the farmers to find skilled and unskilled labourers. There is cost spike in 6, 11 years, which is due to cost for replacement of mulch.

The table below explains different cost of cultivation in percentage of total cost every year.

Table 30: Year wise cost of pomegranate cultivation components in percentage of total cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	16.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pitting and Plantation	9.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting material	23.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	12.0%	0.0%	0.0%	0.0%	0.0%	28.1%	0.0%	0.0%	0.0%	0.0%	26.1%	0.0%	0.0%	0.0%	0.0%
Planting equipment & tools	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Micro irrigation system	20.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FYM	0.9%	5.9%	5.0%	5.5%	4.7%	3.3%	4.5%	4.3%	4.2%	4.1%	3.1%	4.1%	4.1%	4.1%	4.1%
Fertilizer	2.2%	14.1%	11.2%	10.6%	10.1%	7.9%	12.0%	13.0%	14.0%	14.9%	11.0%	14.9%	14.9%	14.9%	14.9%
IPDM & GR	0.2%	1.1%	0.9%	1.0%	1.0%	0.8%	1.2%	1.3%	1.4%	1.5%	1.1%	1.5%	1.5%	1.5%	1.5%
Packaging	0.0%	0.0%	24.8%	29.3%	37.5%	26.3%	35.6%	34.8%	33.9%	33.1%	24.5%	33.1%	33.1%	33.1%	33.1%
Irrigation system maintenance	0.0%	0.0%	1.5%	2.0%	1.7%	1.2%	1.6%	1.6%	1.5%	1.5%	1.1%	1.5%	1.5%	1.5%	1.5%
Labour	12.5%	78.9%	56.7%	51.6%	45.1%	32.5%	45.1%	45.0%	44.9%	44.9%	33.2%	44.9%	44.9%	44.9%	44.9%

Pomegranate starts fruiting from 3rd year and achieve optimum yield in 5th year. The annual return for the farmers ranges from INR 8.33 lakhs to INR 16.67 lakhs per hectare per annum.

ii. Price Build-up and Market Margins of Pomegranate

The price build up analysis is presented below for the 4 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders met during field visits and also validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 31: Marketing costs and margins of different functionaries in the various marketing channels of Pomegranate (Rs/kg)

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
(I)	Marketing cost incurred by the producers												
1	Net price received by the farmer	40.00	80.00%	40.00	32.00	38.10%	32.00	30.00	35.29%	30.00	20.00	13.33%	20.00
2	Transportation cost	2.00	4.00%	42.00	3.80	4.52%	35.80						
3	Cost of Packing Materials	1.00	2.00%	43.00	0.00	0.00%	35.80						
4	Cost of basket	1.00	2.00%	44.00	1.00	1.19%	36.80						
5	Loading / unloading	2.00	4.00%	46.00	1.00	1.19%	37.80						
6	Spoilage (10%)	4.00	8.00%	50.00	3.20	3.81%	41.00						
A	Total	10.00			9.00								
B	Farmer's selling price	50.00	100%	50.00	41.00	48.81%	41.00	30.00	35.29%	30.00	20.00	13.33%	20.00
(II)	Marketing cost incurred by the pre-harvest contractor/ Traders												
	Gross price paid by the pre-harvest contractor							30.00	35.29%	30.00	20.00	13.33%	20.00
1	Loading / unloading							0.50	0.59%	30.50	0.50	0.33%	20.50
2	Packing material cost							1.00	1.18%	31.50	1.00	0.67%	21.50
3	Transportation cost							2.00	2.35%	33.50	2.00	1.33%	23.50
4	Mandi Tax							0.30	0.35%	33.80	0.20	0.13%	23.70
5	Commission Agent charge							1.50	1.76%	35.30	1.00	0.67%	24.70
6	Spoilage at Trader's level (10%)							3.00	3.53%	38.30	2.00	1.33%	26.70
B	Total							8.30			6.70		

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
C	Pre-harvest contractor/ traders margin (approx 15%-25%)							9.20	10.82%	47.50	3.30	2.20%	30.00
D	Pre-harvest contractor Selling price							47.50	55.88%	47.50	30.00	20.00%	30.00
(III)	Marketing cost incurred by the wholesaler												
A	A The gross price paid by wholesaler				41.00	48.81%	80.00	47.50	55.88%	47.50			
B	B Cost components of wholesaler												
1	Loading / unloading				0.50	0.60%	83.00	0.50	0.59%	48.00			
2	Room rent				0.50	0.60%	85.00	0.50	0.59%	48.50			
3	Transportation cost				1.00	1.19%	86.00	1.00	1.18%	49.50			
4	Mandi Tax				0.41	0.49%	86.80	0.48	0.56%	49.98			
5	Commission charge				2.05	2.44%	90.80	2.38	2.79%	52.35			
6	Spoilage at Wholesaler level (5%)				2.05	2.44%	94.80	2.38	2.79%	54.73			
C	Total				14.80			7.23					
D	Wholesalers Margin (approx. 10%)				4.70	5.60%	98.00	5.27	6.20%	60.00			
E	Wholesaler Selling price				60.50	72.02%	98.00	60.00	70.58%	60.00			
(IV)	Marketing cost incurred by the Processor												
A	A The gross price paid by processor										30.00	20.00%	30.00
B	B Cost components of processor												
1	Loading / unloading										0.50	0.33%	30.50
2	Processing unit charge										2.00	1.33%	32.50
3	Processing charge (50%)										15.00	10.00%	47.50
4	Packaging and Branding										7.00	4.67%	54.50

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
5	Marketing Promotion										2.00	1.33%	56.50
6	Spoilage at Processing level (60%)										18.00	12.00%	74.50
C	Total										44.50		
D	Processor Margin (45%-50%)										35.50	23.67%	110.00
E	Processor Selling price (canned juice, slice)										110.00	73.33%	110.00
(V)	Marketing cost incurred by the retailer												
A	The gross price paid by retailer				60.50	72.02%	60.50	60.00	70.58%	60.00	110.00	73.33%	110.00
B	Cost components of retailer												
1	Loading / unloading				0.80	0.95%	61.30	0.50	0.59%	60.50	0.50	0.33%	110.50
2	Transportation cost				1.00	1.19%	62.30	1.00	1.18%	61.50	2.00	1.33%	112.50
3	Mandi Tax (1%)				0.61	0.72%	62.91	0.60	0.71%	62.09	0.00	0.00%	
4	Commission charge (5%)				3.03	3.60%	65.93	3.00	3.53%	65.09	0.00	0.00%	
5	Spoilage at Retailer level (5%)				3.03	3.60%	68.96	3.00	3.53%	68.09	5.50	3.67%	118.00
C	Total				8.46			8.10			8.00		
D	Retailer Margin (15%-25%)				15.04	17.90%	84.00	16.91	19.89%	85.00	32.00	21.33%	150.00
(VI)	Consumer' Purchase Price	50.00	100%	50.00	84.00	100%	84.00	85.00	100%	85.00	150.00	100%	150.00

The price spread among different marketing channel is described below. The price spread found to be maximum in channel D Rs.130/-, followed by channels C, B and A.

Table 32: Price spread of Pomegranate among the different marketing channels (Rs/kg)

#	Particular	Channel A	Channel B	Channel C	Channel D
1	Producer price	40.00	32.00	30.00	20.00
2	Consumer's price	50.00	84.00	85.00	150.00
3	Price spread	10.00	52.00	55.00	130.00
4	Producer's Share in consumer rupee	80.00	38.10	35.29	13.33

The producer's share in Channel A is high (80.00%) as compared to that of in Channel B (38.10%), Channel C (35.29%) and Channel D (13.33%). However, Channel D also involves value addition for preparing pomegranate canned juice and slices pulp.

The marketing efficiency through different channels are given below. The marketing efficiency was found to be highest in channel-A followed by channels B and C respectively. Though channel A has been found to be most efficient, but the volume transacted was very less (<5.0%).

Table 33: Marketing efficiency of Pomegranate among the different marketing channels

#	Particular	Channel A	Channel B	Channel C	Channel D
1	Farmer's Price	40.00	32.00	30.00	20.00
2	Marketing cost	10.00	17.46	16.40	59.20
3	Marketing Margin	0.00	15.04	26.11	70.80
4	Marketing efficiency	4.00	0.98	0.71	0.15

As calculated above, the marketing efficiency in Channel D is lowest, however as there was subsequent value addition and price enhancement, it should not be taken as comparison to marketing efficiency through other Channels.

4.3.6. Gaps in the Value Chain

In Himachal Pradesh pomegranate as traditional cultivation, fruits were growing in wild and under commercial plantation without much care. The gaps observed at different stages are:

i. Pre- production

- ▶ Lack of timely availability of quality planting material and inputs in terms of bio fertilizer, pesticides. Availability of blight resistant cultivars in Pomegranate was also found to be a major constraint.
- ▶ Farmers often purchase planting material from local nurseries and are not sometime aware of the quality and variety of planting material.
- ▶ Solar fencing was completed in FLD clusters. But in some places, these were not working which can create wild animals' menace.

ii. Production

- ▶ The major gaps observed in the production phase are lack of knowledge of scientific cultivation practices, training and pruning, disease and pest control, Lack of water resources and timely supply of quality fertilizers and pesticides.
- ▶ Drip irrigation at many places are being installed along with water storage tanks.
- ▶ Mulching is not properly spread. Trees were not pruned regularly.

- ▶ Yellowing of leaves due to aphid infestation, Zinc deficiency, and Fruit fly and stem borer were observed at few places.

iii. Harvesting and post- harvest

- ▶ Technical knowledge of correct stage of harvesting.
- ▶ Cracking of mature fruit was observed as important physiological disorder which causes great economic loss to pomegranate. Causes associated with fruit cracking may be improper irrigation, environmental factors, and nutritional deficiency, especially boron, calcium, and potash. The cracking is more evident when the fruits are at maturity stage.
- ▶ Lack of equipment for harvesting, bagging and collection of fruits were other major gaps observed in harvesting and post-harvest management.

4.3.7 Market Overview

i. Domestic Market for Pomegranate

In the domestic market, pomegranate has a market from June to December in Himachal Pradesh. All the pomegranate arrives in one APMC that is Mandi (Mandi). It fetches the highest wholesale price when it arrived in the market in the month of June 2021 INR 9,464/QTL, which is the mean of the daily modal price, which corresponds to a low volume of 0.42 MT and the lowest price registered in 2021 was INR 4,120/QTL in the month of September 2021 corresponding to the highest volume of 17.63 MT registered that year.

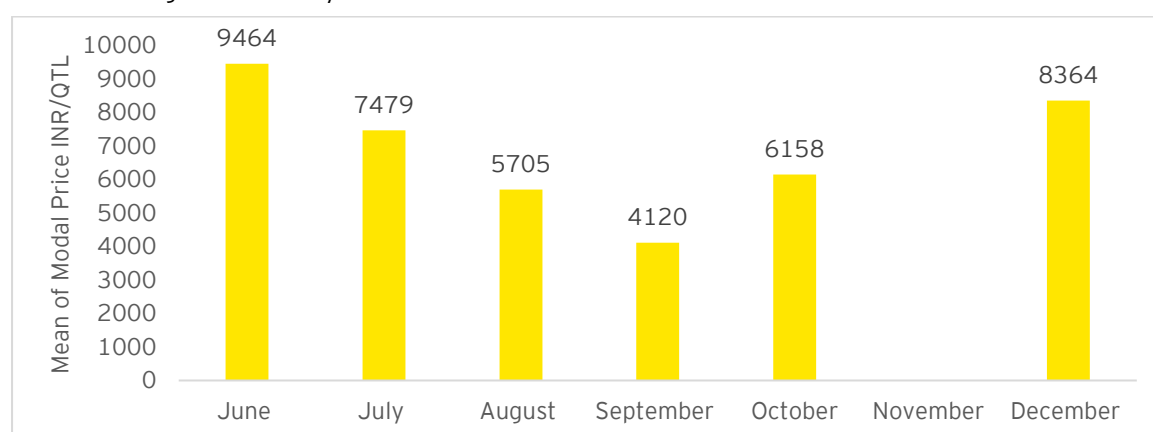


Figure 45: Mean of Modal Price of Pomegranate in INR/QTL at wholesale, 2021

Source: Agmarknet

The volume of Pomegranate starts arrival in the month of June although confined to the Mandi APMC and the season peaks in September where prices and volume tapers down with higher prices and ends in the month of December.

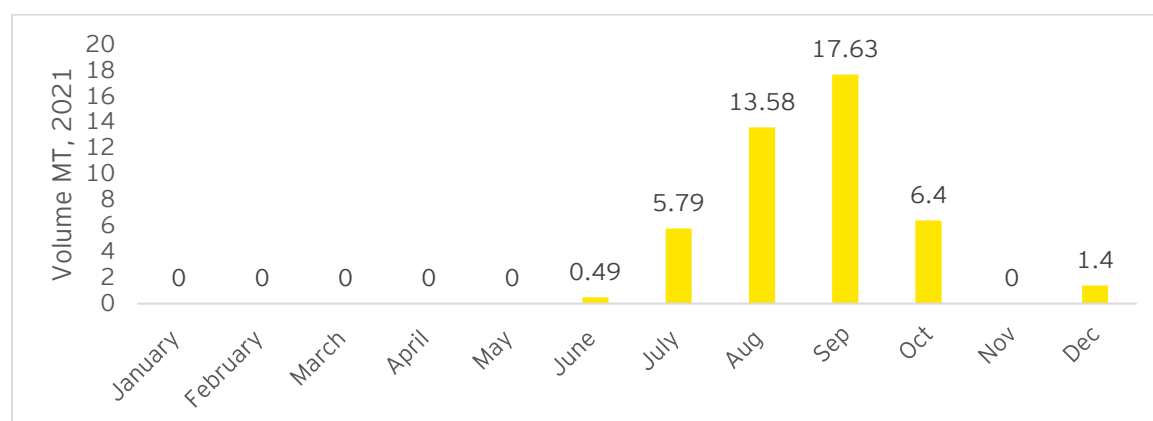


Figure 46: Arrival volume of Pomegranate in MT in Himachal Pradesh
Source: Agmarknet

The neighbourhood of Himachal Pradesh have two more large markets which are Azadpur Market in NCR Delhi and the J&K Market. In J&K the arrival season of Pomegranate began in the month of January in 2021 and peaked to 7.71 MT in the month July and after a lapse of almost three months peaked to 8.1 MT in the month of December 2021

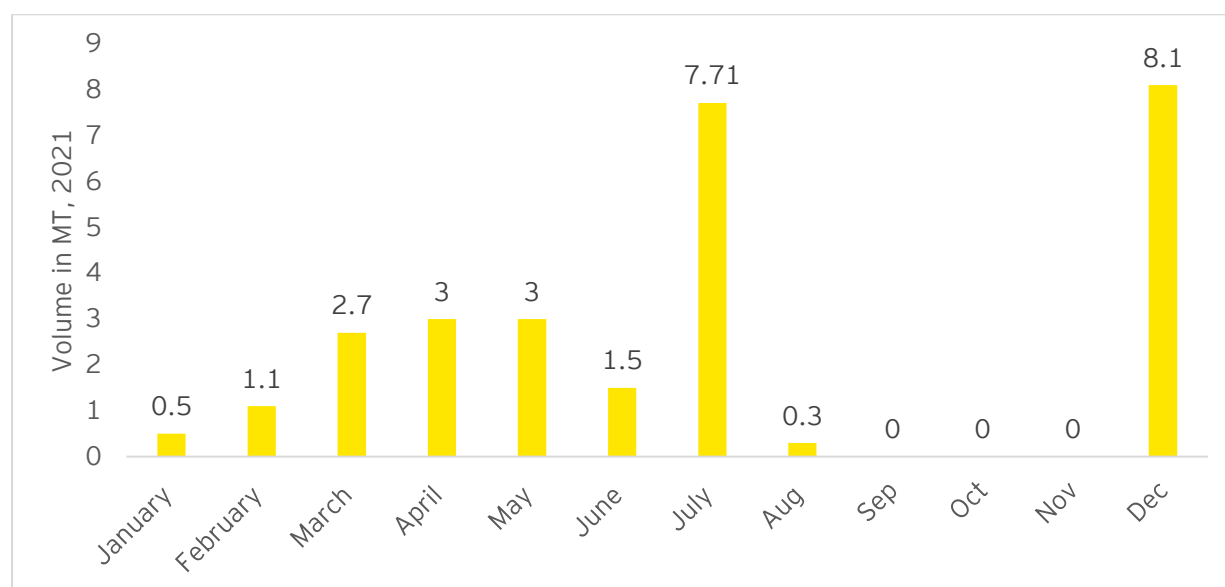


Figure 47: J&K Markets arrival volume in MT, in 2021
Source: Agmarknet

The J&K Markets at the whole sale offer higher prices for Pomegranate. We have seen that the arrival of Pomegranate in J&K markets starts with a INR14,000/ qtl wholesale price, which is much higher than the price in the Himachal markets (Average price in Shimla Mandi (INR 5,536/qtl). The prices taper down till April and then again has a higher price around INR13,000/qtl and the lowest price offered was in December 2021 to INR 7,500/qtl.

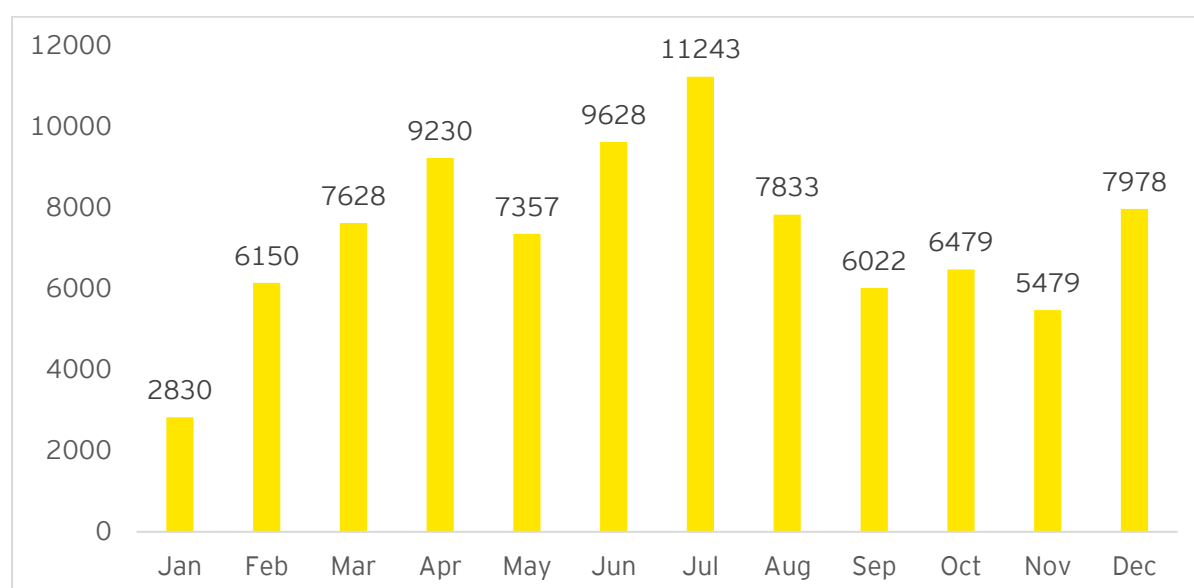


Figure 48: Arrival of Pomegranate (MT) in Azadpur Mandi, Delhi
Source: Agmarknet

The maximum arrival in Azadpur Mandi is noted in the month of July 11,243 MT. The arrivals in the main harvesting period i.e., September, October and November are comparatively low which gives a clear advantage for marketing.

The domestic market ability clearly describes an opportunity window for Pomegranate in the months from September-November with minimal arrival in Jammu and comparatively less arrival in Azadpur mandi compared to other months.

ii. Snapshot of International Market Analysis of Pomegranate

Import markets

- ▶ The top five importers of Pomegranate from India are UAE, Bangladesh, Qatar, Nepal, and Netherlands.
- ▶ UAE and Bangladesh market has a high growth rate of 49% and 44% respectively.
- ▶ The B20 (Argentina, Australia, Brazil, Canada, China, Germany, France, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, The United Kingdom, the United States, and the European Union) countries formed 18% of the total market in 2020 and imported 12,351 MT of the fruit from India, and has an average annual growth rate of 3% which will continue to grow
- ▶ Hong Kong China, France, Singapore, Switzerland, Oman, Sri Lanka, Netherlands, and Bangladesh show growth and this trend is expected to continue. In terms of market value and better export price these countries need to be targeted for export of Pomegranate from India.
- ▶ India has a deficit Trade Balance in Value but a surplus in terms of volume of trade in Pomegranate. The trade surplus in 2013 was 24199.79 MT which grew to 67372 MT in 2020, however the growth rate is -4% for this period shows a declining trend.
- ▶ Likewise, export seem to have grown from 25504.21 MT in 2013 to 67979.67 MT, the volume dropped in 2020, and has a -4% growth.

Suggested Export Destinations

The best export destination for Indian Pomegranate are Oman, Sri Lanka, Switzerland, and Qatar. The highest price payers for Pomegranate are UAE, USA, and Switzerland. In the EM group, it is China.

Market criteria	Priority country destination (By Growth rate and Trend)	Growth Rate and Import Price	
Higher volume	▶ UAE ▶ Qatar ▶ Sri Lanka ▶ Bahrain ▶ Switzerland	Volume	▶ 49% ▶ 44% ▶ 57% ▶ 83% ▶ 27%
Higher value	▶ Bangladesh ▶ Oman ▶ Sri Lanka ▶ Switzerland	Value	▶ 42% ▶ 25% ▶ 14% ▶ 4%
Higher Prices	▶ UAE ▶ USA ▶ Switzerland	Import Price	▶ Russian Fed:USD2388/MT ▶ China: USD2329/MT ▶ Brazil: USD2096/MT ▶ Kazakhstan: USD1890/MT ▶ Netherlands: USD1704/MT
Emerging markets	▶ China	Long term focus	▶ 86% value

Figure 49: Export Destinations for Pomegranate

Source: ITC trade maps

The detailed graphs and analysis are presented in Annexure IV

4.3.8. Proposed Interventions

i. Pre- production

Land Preparation: It is recommended to plant tissue cultured pomegranate saplings in raised beds of 30 to 45 cm. Pits are dug at 3X3m spacing with 1'x1'x1' dimension, centre to centre distance of the beds will be 3 m. The canopy is maintained by pruning every year to eliminate plant to plant competition. High density planting is adopted in HPSHIVA project areas, with a spacing of 3m x 3m. Drip irrigation helps to save on irrigation and helps to increase the yield by 30-35%.

Planting: After the pits are made, sprinkle bleaching powder on to the floor and the surrounding wall of the pit (2-5 g/pit) and wet the inner surface by spraying water. Pits are to be filled at least a week before planting of the saplings. Pit filling is done by a 1:3 mixture of FYM and garden soil plus 250g SSP, 5g COC, and 1kg Neem cake. Hardened TC plants come in polybags transported by trucks. These plants should be unloaded and kept under shade for about 24-30 hours before planting. They should not be kept under dark or in an enclosure. Sprinkle water to keep the growing media in the polybags wet. Spray any fungicide (COC, for example) at 2 g/l rate on to the foliage. At planting cut the polybag vertically without damaging the root system and disturbing the surrounding medium. Keep the TC plant along with the growing medium carefully at the centre of the pit (by wading the filled-up material to the sides of the pit) and press the soil mixture gently all around the base of the sapling.

ii. Production

Irrigation: Irrigation is to be provided with drip system. In disease hot spot areas, it is recommended to drench the newly filled soil mixture surrounding the sapling by a fungicide (COC) at 1 g/l concentration. Precision in irrigation is very critical for pomegranate; excess soil water would result in root water logging and subsequently increase in bacterial and fungal diseases. Drip system with 4 or 8 lph drippers based on soil texture is recommended. Two lateral lines one on either side of the tree is found to wet the tree basin uniformly with two laterals with 4 lph emitters at 60 cm is recommended.

Training and Pruning: Plants are trained on a single stem or in multi-stem system. Since the crops trained on single stem training system are more susceptible to pests viz. stem borer and shoot hole borer, the other system is more prevalent in the country. Pruning is not much required except for removal of ground suckers, water shoots, cross branches, dead and diseased twigs and to give shape to the tree. A little thinning and pruning of old spurs are done to encourage growth of new ones.

Inter-cropping: Inter-cropping with low growing vegetables, pulses or green manure crops is beneficial. In arid regions, inter-cropping is possible only during the rainy season, whereas winter vegetables are feasible in irrigated areas.

Plant protection measures:

Insect Pests: Insect pests mostly observed are fruit borer, mealy bugs, aphids, white fly and fruit sucking moths. Spraying with dimethoate, deltamethrin or malathion etc. depending upon the type of pest infestation has been found to be effective in most cases.

Diseases: The main diseases reported are leaf spot and fruit rot. Application of Mancozeb (2g./l.) during rainy season in case of the former and application of Kavach (2g./l) and Carbendazim/Thiophanate methyl/Baycor/Benomyl (1g./l.) during September/October in case of the latter has been found to be effective in most cases.

Disorders: Fruit cracking is a serious disorder. This physiological disorder observed in young fruits is due to boron deficiency and that in fully grown fruits is mainly due to moisture imbalances. Tolerant

varieties viz. Bedana Bose and Khog may be cultivated and in other cases spraying with calcium hydroxide soon after fruit set has been found to be beneficial.

Bagging

- ▶ Sunscald, uneven colour development of fruits and aril paleness during summer are some of the problems reducing the marketability of fruits.
- ▶ Bagging the developing fruits 3 months before harvest helps to overcome these problems.
- ▶ Butter paper, white colour cellulose-based bags or zipped polyethylene bag (15x15cm) are suitable for bagging.
- ▶ Bagging is done on a bright sunny day when there is no moisture deposition around the fruits.
- ▶ White colour bags reflect sunlight and reduce the temperature around developing fruits.
- ▶ The optimal temperature helps in biosynthesis of anthocyanin pigments and prevents their denaturation during hot months.
- ▶ About 10-12% higher anthocyanin is available in the arils of bagged fruits, compared to unbagged fruits.

iii. Harvest and Post- harvest

Maturity Indices:

- ▶ The fruits should be harvested before they become overripe and crack (split) open
- ▶ The arils attain deep intensity of colour
- ▶ Red colour of juice

Harvesting: The fruit is generally clipped from the tree when ripe, and its quality improves on storing. Pomegranate tree sometimes tends to split open the fully ripe fruits as it is the natural means of seed release and dispersal.

Late harvesting of fruits results in a physiological disorder known as internal breakdown. ie. the discoloration of affected arils from that of rest of the arils. Hence, harvesting should be done at appropriate time. The pomegranate fruits are harvested only after attaining maturity. Harvest only the mature fruits (ie. semi ripe- ripe stage) as it is not possible to ripen the fruits once they are plucked immature even with ethylene treatment.

Harvesting time: Early morning or evening hours is the most suitable time for harvesting to avoid accumulation of field heat.

Precaution during harvesting

- ▶ The fruits should not be pulled from branches to prevent damage.
- ▶ Make use of sterile scissors/ clippers for picking (clean with wet cloth & dip in 1% sodium hypochlorite for sterilization).
- ▶ Cut the stem close to the base of the fruits to overcome the damage of other fruits.
- ▶ Exercise care not to inflict any injury to the rind during harvest.
- ▶ Pay attention to harvest the fruits intact with crown
- ▶ Climb the ladders/tripod stands to harvest the fruits from upright branches.
- ▶ Collect the fruits in plastic crates of 20kg capacity washed with detergent
- ▶ Don't heap too many layers of fruits in crates.
- ▶ Place the cushioning material at the bottom of the crates viz., dried grass, paddy straw or paper.

Sorting: Cracked, split, diseased and infested fruits are removed which is done manually by trained sorter.

Grading: Presently, manual grading is done by the farmers in orchard. It is suggested to install mechanical grading line in pack house to undertake grading in below mentioned four grades.

Table 34: Pomegranate Grades

S.No.	Grade	Characters
1	Super	Attractive red colour fruits, > 750g / fruit, free from spot in the rind
2	King	Attractive red colour fruits, 500-750g/ fruit
3	Queen	Bright red colour fruits, 400-500g/fruit, free from spot
4	Prince	Red colour fruits, fully ripe fruits, 300-400g/ fruit

The white coloured boxes having 5 plies are generally used for export purpose, whereas red-coloured ones having 3 plies are used for domestic markets. The red coloured boxes are cheaper than white coloured ones.

Pre- cooling: The pre- cooling of pomegranate is normally done to 6°C with 90-95% RH as soon as possible after harvest which will help the produce to maintain the best quality till market and consumer.

Packaging for storage: In bulk storage, fruits are packed in layers, in wooden crates each containing about 16-18 kg of fruits. Dry grass, rice straws, or paper are used as cushioning material.

Retail Packaging: The fruits are then packed in corrugated fibre board (CFB) boxes. In a single box, 4-5 fruits of Super size, 6 fruits of King size, 9 fruits of Queen size and 12 fruits of prince size are generally packed



Figure 50: Pomegranate Handling

Shrink Film Wrapping

- ▶ Fruits having large surface to volume ratio are particularly more susceptible to water loss.
- ▶ Individual shrink wrap packaging extends shelf life by preventing moisture loss, maintaining the firmness, and reducing the respiration rate (10-20%)
- ▶ Protection against abrasion, maintains attractive appearance, avoids condensation of water droplets within the package, prevents secondary infection
- ▶ Heat shrinkable polymeric film of 20μ thickness used for packaging is low in thickness with high tensile strength, low in permeability to oxygen and water, high in permeability, glossy and transparent, ability to shrink at low₂ temperature.

Storage: Pomegranate can be best stored at low temperature and high humidity. Fruits stored at 4-5° C and 80-85 % relative humidity did not undergo any shrinkage or spoilage in a few months. CA storage with 5% Oxygen and 15% Carbon dioxide has been shown to extend pomegranate postharvest life for up to 5 months at 7°C.

Processing and Value Addition

Pomegranate contains 48 to 52 per cent of edible part on the whole fruit basis, which comprises of 78 percent juice and 22 percent seed. The seeds along with arils are crushed and juice is extracted and marketed as a fresh juice due to its excellent flavour, attractive fragrance, delicious taste, and high nutritive and medicinal value. Production of juice from the pomegranate arils proved to be one of the important methods of value addition. The juice can be processed possible into the squash, syrup, nectar, jelly, concentrate and such other products. Pomegranate juice can be used as an ingredient providing colour to the other products. The packaging of pomegranate juice should be done in tetra packs. Oxygen and light have destructive effect on the anthocyanin during storage.

In recent years, minimally processed “ready-to-eat” pomegranate arils have become popular due to their convenience, high value, unique sensory characteristics, and health benefits. The other value-added product can be frozen arils, jelly, wine, and molasses.

Marketing and Transportation

For short distance transportation trolleys can be used in which packed CFB boxes should be stacked neatly. Long distance transportation should be done only in reefer trucks maintained at 4-5°C with 80-85% RH.

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.4. Value Chain Analysis of Litchi

4.4.1. Overview

i. Global Scenario:

The world litchi production is estimated about 3.5 million MT of which 80% of litchi was produced in China in 2018. The other major producers are India (0.67 million MT), Vietnam, Madagascar, and Thailand³⁹. Other countries growing litchis include Bangladesh, Australia, South Africa, Reunion, Brazil, and Israel. The top producer China's main fresh litchi export markets are Hong Kong, USA, and Malaysia.

ii. Indian Scenario:

The area of cultivation under Litchi in India is about 92,000 ha. Litchi has specific climate and soil requirements, thus limiting its cultivation to a few states. Bihar is the leading litchi producing state followed by West Bengal, Jharkhand, Assam, and Chhattisgarh⁴⁰. Very small amount of litchi of about 100 tonnes was exported from India in 2017-18. The major destinations are Nepal, UAE, Saudi Arabia.⁴¹

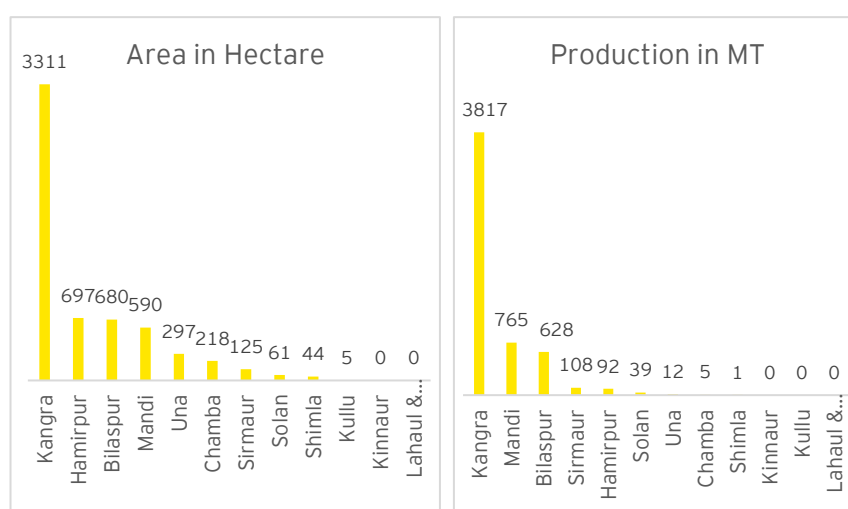
4.4.2. Litchi Production in Himachal Pradesh

i. Area and Production:

In Himachal Pradesh, the area cultivated under Litchi is 6028 ha and Production volume is 5467 MT with a productivity of 0.9 MT/ha.

Table 35: District wise Litchi Productivity (MT/ha) in Himachal Pradesh (2018-19)

District	Productivity (MT/ha)
Mandi	1.3
Kangra	1.2
Bilaspur	0.9
Sirmaur	0.9
Solan	0.6
Hamirpur	0.1
Chamba	0
Kinnaur	0
Kullu	0
Lahaul & Spiti	0
Shimla	0
Una	0
Total	0.9



Source: Department of Horticulture

Figure 51: Litchi Production Area and Volume in HP (2018-19)

From the above Figure, it is understood that Kangra, Hamirpur, Bilaspur, Mandi are the top districts in terms of area covered under Litchi as well as production volume. However, districts namely Mandi, Kangra, Bilaspur, Sirmaur have the highest productivity of more than 0.9 MT/ha.

³⁹ Litchi and longan production and trade in the world

[10.17660/ActaHortic.2020.1293.1](https://doi.org/10.17660/ActaHortic.2020.1293.1)

⁴⁰<https://www.ijcmas.com/9-4-2020/Ramesh%20Kumar%20Sahni,%20et%20al.pdf>

⁴¹ National Horticulture Board

ii. Litchi Varieties⁴²

In India, about 50 cultivars are under cultivation. Shahi, China and Purbi are ruling commercial varieties for North Bihar and eastern Uttar Pradesh, and Rose scented for Uttarakhand. The other well known varieties are Dehradun, Calcuttia, Ajhauri, Swarna Roopa, Bedana.⁴³ The varieties of Litchi considered for the project are Dehradun, Calcuttia as they have very high potential and some unique characteristics. The characteristics of the varieties are presented below:

Dehradun: Dehradun is an early bearing variety and is well known for its pulpiness. It is mostly used for table purposes. Fruits are medium in size, obliquely heart-shaped to conical, colour at maturity bright rose pink. Pulp is greyish-white, soft moderately juicy with T.S.S. 17%.

Calcuttia: It is a late season variety. Fruits are large in size, oblong, with tyrian rose colour and dark tubercles at maturity. Pulp is dirty creamy white, soft, juicy, very sweet with T.S.S. 18.17%.

iii. Seasonality:

Litchi is expected to be harvested in May-July in Himachal Pradesh as shown below:

Litchi	January				February				March				April				May				June				July				August				September				October				November				December			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Himachal Pradesh																																																
Uttarakhand																																																
Punjab																																																
Bihar																																																
Jharkhand																																																

Figure 52: Litchi harvesting season in major states

 Peak season  Lean season

Source: EY analysis and National Research Centre for Litchi

⁴²<http://nhb.gov.in/pdf/fruits/litchi/lit013.pdf>

⁴³<https://www.nrclitchi.org/uploads/download/Good-Management-Practices-in-Litchi.pdf>

4.4.3. SWOT Analysis of Litchi Value Chain

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Litchi Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 36: SWOT Analysis of the Litchi Value Chain in Himachal Pradesh

Strengths ▶ Favourable agro- climatic conditions for Dehradun and Calcuttia varieties. ▶ Harvesting of litchi late in season, last week of June to July, is favourable for better price realisation, considering no supply from major growing region. ▶ Higher organic matter content in soil and better water holding capacity favours more vegetative growth and subsides reproductive growth	Weaknesses ▶ Insufficient availability of disease free and quality planting material for extension of litchi plantation. ▶ In some part of region there is a pericarp splitting, browning and desiccation, which leads to decline in commercial value
Opportunities ▶ The extended harvesting and less competition in the market may result in better prices ▶ There is an ample opportunity for skillful employment in growing, post-harvest handling, value addition and marketing, leading to economic development of the region.	Threats ▶ Risk of frost damages in many parts of subtropical region.

4.4.4. Value Chain Analysis:

i. Commodity Flow Analysis

The key players involved in the Litchi value chain are:

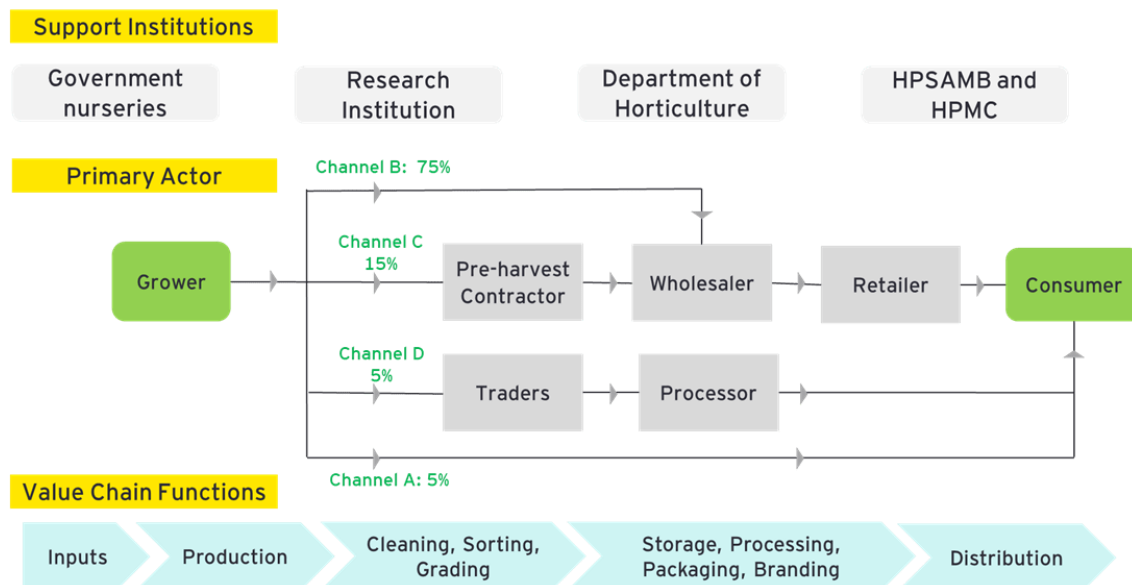
- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Wholesalers
- ▶ Traders
- ▶ Processor
- ▶ Retailers

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified four main channels in the study area:

- ▶ Channel -A Producer → Consumer
- ▶ Channel -B Producer → Wholesaler → Retailer → Consumer
- ▶ Channel -C Producer → Pre-harvest contractor → Wholesaler → Retailer → Consumer
- ▶ Channel-D Producer → Traders →Processor → Consumer

The existing marketing channel of Litchi is as below



Most of the farmers sell their produce through traders i.e., Channel-B, followed by pre-harvest contractors, i.e., Channel C.

Channel A: Channel A involves farmers selling the produce directly. The farmers themselves bring the produce in the nearby markets or put a stall in the market to sell directly to the consumers. Depending on the cash requirement, the farmers harvest the fruits and bring them to the market. In such cases, the transport is arranged by the farmers themselves. In this channel also the farmers have limited bargaining power.

Channel B: In case of Litchi, many farmers sell to distant wholesalers/ traders in Delhi, Chandigarh etc., This channel is normally opted by bigger farmers who have larger volume of fruit produce, and who have ability to organize and market the fruit produce of fellow farmers. In such cases, the price negotiation is done beforehand, normally over phone. Based on that the harvested fruits produce is brought to the market. The traders sometimes sell the produce to local retailers through which it finally reaches the consumers.

Channel C: In this channel, the pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. They inspect the field, forecast the estimated production, and then negotiate price with the farmers. Thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce. In most of the cases, the pre-harvest contractors pay 10-15% less than the negotiated prices during peak harvesting season, by making excuses on various accounts.

Channel D: This is the least preferred marketing channels observed during the field assessment. This is mainly because of lack of required number of processing units, lack of transport facilities from farmers' fields to the processing units, lack of bargaining power, and absence of procurement facilities by the processing unit. Most of the processors are family-owned businesses, having low capacity and capital.

The detailed price- build up analysis for these marketing channels is present in 4.4.5(ii)

ii. Value Chain Activities

Preharvest Activities

Planting Materials: Litchi is commercially propagated through vegetative method. Farmers do the planting with both seed and vegetative means. The plants raised through seed have slow growth, and long juvenile period.

Land preparation: Farmers clear all vegetation and levelled the filled thoroughly. After this, the land is ploughed with disc plough and then with a harrow. Planting is done in the beginning of monsoon and a slight amount of planting in Feb-March. Farmers do pruning if vegetative growth is profuse. Traditional planting is done at the spacing of 10X 10 m.

Intercultural operations: Litchi orchard should be kept clean of unwanted weeds especially during the initial years of growth. Orchards should be ploughed with soil turning plough and harrowed once after the rainy season. The farmyard manure, compost or straw may be used for soil mulching. In the project area, mulching is done with polyethylene sheet to conserve moisture and improving the fruit quality.

Inter-cropping is feasible during initial years of plantation. Apart from giving good annual income during the non-bearing period, inter-crops protect the young litchi plant, enrich the soil, improve the physical condition of the soil and keep the weeds under control. Inter-cropping with leguminous crops and vegetables are recommended.

Pest and Diseases: In litchi, mite and shoot borer are the two serious pests that causes immense damage to the crop. Litchi shoot borer can effectively be controlled by spraying Cypermethrin (0.01%) twice at 7 days interval during flushing. Other pests include bark eating caterpillars, weevil, butterflies, and worm/fruit stone borer.

Litchi is almost free from fungal diseases in India. The rot caused by *Helmenthosporium hawaiiense* and rotting of fruits caused by *Aspergillus* sp. are some of the fungal diseases observed. These can be controlled by spraying with fungicides immediately after the appearance of the symptoms.

Disorders: The two types of physiological disorders which are commonly observed are fruit cracking and fruit drop. Fruit cracking is a major problem in litchi resulting in deterioration of fruit quality. Presence of optimum moisture level in the soil during fruit development is crucial for reducing fruit cracking and quality litchi production.

Harvesting and Postharvest Activities

Harvesting: Harvesting is usually done in late June and July in HP. The maturity of the fruits is judged by the flatness of tubercles and comparative smoothness of the epicarp. Besides that, the fruit colour changes from green to pink on maturity. The fruits are harvested in bunches along with a portion of the branch and a few leaves. This helps in improving the keeping quality of the fruits and at the same time the tree receives a mild pruning.

Post Harvesting activities: Litchi needs specific treatment before packing and transportation for long distance market. For local markets, the fruits should be collected at the ripened stage, while for distant market, the fruits should be harvested when they have started turning reddish. After harvesting, the fruits should be kept in cool, dry and properly ventilated rooms to facilitate the ripening process under high atmospheric temperature. If exposed to sun even for a few hours the quality deteriorates markedly.

The fruits cannot be stored at room temperature for more than a few days. It loses its bright red colour and turns brown within 2 - 3 days after harvesting. Mature litchi fruits can be stored for a period of 8 to 12 weeks at the temp. of 1.6 to 1.7 Degree Celsius and relative humidity ranging between 85 to 90%.

- ▶ The farmyard manure, superphosphate and muriate of potash are applied as soil nutrients.
- ▶ Nitrogenous fertilizer is applied twice, first in the month of February and the other after harvesting of fruits. Growers failed to give the figures of the exact amount of FYM/fertilizers used
- ▶ Along with macro nutrients application of zinc and boron is very important
- ▶ Light irrigation at weekly intervals is done
- ▶ Training and pruning is done regularly.
- ▶ Weeding is done manually

4.4.5. Cost Economics and Price build-up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and the field visits. The data collected from field visits are also validated with the data provided by Department of Horticulture. All the values are considered at constant prices without inflation. The lump sum cost of 1 lakh is considered for land preparation. The spacing of the plant is considered as per the suggested spacing in nursery report, i.e., 4X4 in Litchi High Density Planting. Mulching sheets are assumed to be replaced for every 5 years. The table below present the annual cost and component wise breakup in 1 hectare land and corresponding revenue from the expected yield.

Table 37: Litchi cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Inputs Cost															
Land clearing and development	1,00,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pitting and Plantation (@Rs.50/- per pit for 625 pits)	31,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting material (@80 per planting material)	50,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mulching (including labour) (@Rs.32 per running metre 4 metre per plant)	80,000	-	-	-	-	80,000	-	-	-	-	80,000	-	-	-	-
Planting equipment and tools	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micro irrigation development	1,20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm yard Manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertiliser	10,250	10,250	12,000	15,000	18,000	20,000	22,500	25,000	27,500	30,000	32,500	32,500	32,500	32,500	32,500
IPDM and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,250	3,250	3,250	3,250	3,250
Litchi packing boxes (@ 6 Rs per 5 Kg)	-	-	-	-	3,750	11,250	18,750	26,250	33,750	48,750	52,500	52,500	52,500	52,500	52,500
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour (Rs.203/ person day)	74095	75516	75516	84448	83636	83636	90132	90132	90132	90132	90132	90132	90132	90132	90132
Total Cost	4,87,150	92,321	97,432	1,12,281	1,18,469	2,08,219	1,44,965	1,55,215	1,65,465	1,83,215	2,69,715	1,89,715	1,89,715	1,89,715	1,89,715

Table 38: Annual revenue per hectare from Litchi cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (kg/hectare)	-	-	-	-	3,125	9,375	15,625	21,875	28,125	40,625	43,750	43,750	43,750	43,750	43,750
Revenue (@Rs.50/kg)					1,56,250	4,68,750	7,81,250	10,93,750	14,06,250	20,31,250	21,87,500	21,87,500	21,87,500	21,87,500	21,87,500
BC Ratio				-	1.32	2.25	5.39	7.05	8.50	11.09	8.11	11.53	11.53	11.53	11.53

The establishment cost of Litchi cultivation is approximately INR 4.87 lakhs, and annual cost is from INR 0.92 lakhs to INR 2.697 lakhs in the later years. It is observed that the labour component is the major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers. There is cost spike in 6,11 years, which is due to cost for replacement of mulch.

The table below explains different cost of cultivation in percentage of total cost every year.

Table 39: Year wise cost of Litchi cultivation components in percentage of total cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	20.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pitting and Plantation	6.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting material	10.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	16.4%	0.0%	0.0%	0.0%	0.0%	38.4%	0.0%	0.0%	0.0%	0.0%	29.7%	0.0%	0.0%	0.0%	0.0%
Planting equipment and tools	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Micro irrigation development	24.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Farm yard manure (FYM)	1.1%	6.0%	6.8%	7.4%	7.0%	4.0%	5.7%	5.4%	5.0%	4.5%	3.1%	4.4%	4.4%	4.4%	4.4%
Fertilizer	2.1%	11.1%	12.3%	13.4%	15.2%	9.6%	15.5%	16.1%	16.6%	16.4%	12.0%	17.1%	17.1%	17.1%	17.1%
IPDM & Growth hormones	0.2%	1.1%	1.3%	1.3%	1.5%	1.0%	1.6%	1.6%	1.7%	1.6%	1.2%	1.7%	1.7%	1.7%	1.7%
Litchi packin boxes	0.0%	0.0%	0.0%	0.0%	3.2%	5.4%	12.9%	16.9%	20.4%	26.6%	19.5%	27.7%	27.7%	27.7%	27.7%
Irrigation system manitenance	0.0%	0.0%	2.1%	2.7%	2.5%	1.4%	2.1%	1.9%	1.8%	1.6%	1.1%	1.6%	1.6%	1.6%	1.6%
Labour	15.2%	81.8%	77.5%	75.2%	70.6%	40.2%	62.2%	58.1%	54.5%	49.2%	33.4%	47.5%	47.5%	47.5%	47.5%

Litchi starts fruiting from 5thyear and achieve optimum yield in 11thyear. The annual return for the farmers ranges from Rs.1.56 lakhs to Rs. 21.9 lakhs per hectare per annum.

ii. Price Build-up and Market Margins of Litchi

The price builds up analysis is presented below for the 4 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders met during field visits and also validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 40: Marketing costs and margins of different functionaries in the various marketing channels of Litchi (Rs/kg)

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
(I)	Marketing cost incurred by the producers												
1	Net price received by the farmer	70.00	82.35%	70.00	60.00	50.00%	60.00	55.00	42.31%	55.00	50.00	25.00%	50.00
2	Transportation cost	5.00	5.88%	75.00	3.00	2.50%	63.00						
4	Cost of basket/Crates	1.00	1.18%	76.00	1.00	0.83%	64.00						
5	Loading / unloading	2.00	2.35%	78.00	2.00	1.67%	66.00						
6	Spoilage at Farmers' Level (approx. 10%)	7.00	8.24%	85.00	6.00	5.00%	72.00						
	<i>Total</i>	15.00			12.00								
	Farmer's selling price	85.00	100.00%	85.00	72.00	60.00%	72.00	55.00	42.31%	55.00	50.00	25.00%	50.00
(II)	Marketing cost incurred by the pre-harvest contractor												
	Gross price paid by the pre-harvest contractor							55.00	42.31%	55.00			
1	Loading / unloading							5.00	3.85%	60.00			
3	Mandi Charge (1%)							0.55	0.42%	60.55			
4	Commission Agent Charge (5%)							2.75	2.12%	63.30			
5	Transportation cost							2.00	1.54%	65.30			
6	Spoilage at pre-harvestor level (approx. 8%)							4.40	3.38%	69.70			
B	<i>Total</i>							14.70					
C	Pre-harvest contractor margin (approx. 5% - 8%)							5.30	4.08%	75.00			
D	Pre-harvest contractor Selling price							75.00	57.69%	75.00			

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
(III)	Marketing cost incurred by the Traders												
	Gross price paid by the traders										50.00	25.00%	50.00
1	Loading / unloading										0.50	0.25%	50.50
2	Transportation Charge										1.00	0.50%	51.50
	Spoilage at Traders' Level (5% to 8%)										2.50	1.25%	54.00
B	Total										4.00		
C	Traders' margin										6.00	3.00%	60.00
D	Traders' Selling price										60.00	30.00%	60.00
(IV)	Marketing cost incurred by the wholesale												
A	A The gross price paid by wholesaler				72.00	60.00%	72.00	75.00	57.69%	75.00			
B	B Cost components of wholesaler												
1	Loading / unloading				0.50	0.42%	72.50	0.50	0.38%	75.50			
2	Room rent				0.50	0.42%	73.00	0.50	0.38%	76.00			
4	Transportation cost				1.00	0.83%	74.00	1.00	0.77%	77.00			
5	Mandi Tax				0.72	0.60%	74.72	0.75	0.58%	77.75			
6	Commission charge				3.60	3.00%	78.32	3.75	2.88%	81.50			
	Spoilage at Wholesalers' level (approx 5%)				3.60	3.00%	81.92	3.75	2.88%	85.25			
C	Total				9.92			10.25					
D	Wholesalers Margin				4.08	3.40%	86.00	4.75	3.65%	90.00			
E	Wholesaler Selling price				86.00	71.67%	86.00	90.00	69.23%	90.00			
(V)	Marketing cost incurred by the Processors												
A	The gross price paid by processor										60.00	30.00%	60.00
B	Cost components of the processor												
1	Loading / unloading										0.50	0.25%	60.50
2	Processing Charges (50%)										30.00	15.00%	90.50

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
3	Spoilage (40%-50%)										30.00	15.00%	120.50
4	Packaging and branding										5.00	2.50%	125.50
5	Transport Charges (to & fro)										4.00	2.00%	129.50
C	Total										69.5		
	Processors' Margin (15%-25%)										25.50	12.75%	155.00
	Processors' Selling price										155.00	77.50%	155.00
(VI)	Marketing cost incurred by the retailer												
A	The gross price paid by retailer				86.00	71.67%	86.00	90.00	69.23%	90.00	155.00	77.50%	155.00
B	Cost components of retailer												
1	Loading / unloading				0.50	0.42%	86.50	0.50	0.38%	90.50	0.50	0.25%	155.50
3	Transportation cost				1.00	0.83%	87.50	2.00	1.54%	92.50	2.00	1.00%	157.50
4	Mandi Tax				0.86	0.72%	88.36	0.90	0.69%	93.40	0.00	0.00%	157.50
5	Commission charge				4.30	3.58%	92.66	4.50	3.46%	97.90	0.00	0.00%	157.50
	Spoilage at Retailer's Level (approx 15%-20%)				12.90	10.75%	105.56	13.50	10.38%	111.40	15.50	7.75%	173.00
C	Total				19.56			21.40			18.00		
D	Retailer Margin (15% to 30%)				14.44	12.03%	120.00	18.60	14.31%	130.00	27.00	13.50%	200.00
E	Retailer Selling price				120.00	100.00%	120.00	130.00	100.00%	130.00	200.00	100.00%	200.00
(VII)	Consumer' Purchase Price	85.00	113.33%	85.00	120.00	100.00%	120.00	130.00	100.00%	130.00	200.00	100.00%	200.00

The price spread among different marketing channel is described below. The price spread found to be maximum in channel D, followed by Channel C, B and A.

Table 41: Price spread of Litchi among the different marketing channels (Rs/kg)

#	Particular	Channel A	Channel B	Channel C	Channel D
1	Producer price	70.00	60.00	55.00	50.00
2	Consumer's price	85.00	120.00	130.00	200.00
3	Price spread	15	60	75	150
4	Producer's Share in consumer rupee	82.35	50.00	42.31	25.00

The producer's share in Channel A is high as compared to that of in Channel B and Channel C. The more the intermediaries the more is price spread and the less is producer's share in consumers' price.

The pre-harvest contractors perform all the tasks and pay the farmers a pre-determined price. Small quantities of Litchi were also sold through Channel A (less than 5%). Though the farmers and consumers both have win-win situation in this Channel, it has limited scope of selling large volume of the produce.

The marketing efficiency through different channels are discussed below. The marketing efficiency was found to be highest in channel-A followed by channels D, B and C respectively. Though channel A has been found to be most efficient, but the volume transacted was very less (5.84%).

Table 42: Marketing efficiency of Litchi among the different marketing channels

#	Particular	Channel A	Channel B	Channel C	Channel D
1	Farmer's Price	70.00	60.00	55.00	50.00
2	Marketing cost	15.00	41.48	46.35	91.50
3	Marketing Margins	0.00	18.52	28.65	58.50
4	Marketing efficiency	4.67	1.00	0.73	0.33

As calculated above, the marketing efficiency in Channel D is lowest, and Channel A is highest. The more the intermediaries, the less is the marketing efficiency. This is because of higher marketing costs and margins as the number of intermediaries increases.

4.4.6. Gaps in the Value Chain

The gaps observed at different stages are:

i. Pre- production

- ▶ The land holdings are small and fragmented. It was observed that farmers are either planting lesser number of plants in their backyard or in the farming fields, thereby having difficulties in reaching to economic threshold.
- ▶ Due to lack of soil testing and knowledge about the soil quality, appropriate quality and quantity of compost/ fertilizers are not being used.
- ▶ Farmers are key actors and as such confronts many uncertainties, like - lack of finance, poor quality inputs, inadequate access to market, challenges of findings laborer at fair price.
- ▶ Availability of quality planting materials in sufficient quantities is one of the major limiting factors. The farmers normally procure planting materials from various sources like nurseries, government departments, and sometimes from fellow farmers. The farmers are also many times not sure about the variety of the planting material till fruiting occurs.

ii. Production

- ▶ The fruit cultivation is mostly rainfed and there is a lack of irrigation and water storage facilities/ facilities near the orchards. The drip irrigation was not working in the fields, visited by the experts. The water storage tanks were also not properly connected to water source.
- ▶ Dry, dead and diseased twigs were not removed. Water suckers were also observed.
- ▶ FYM is not well decomposed.
- ▶ Thinning has not been done. Spots of dead tissue scattered over young leaves looks like Mn deficiency.
- ▶ A heavy black sooty mould develop on the honeydew like droplets secreted by mealy bugs.
- ▶ Fruit drop is a major problem in litchi which is due to internal nutritional status, hormonal and external factors like high temperature, low humidity, and strong winds/hailstorms. Many farmers reported fruits drops as a common issue in their field.
- ▶ Sun burning and fruit cracking are also common which affect adversely the yield of marketable fruits.
- ▶ Increasing incidence of crop damage due to temperature fluctuations, and hailstorm were also reported.

iii. Harvesting and post- harvest

- ▶ Inadequacy of training in identifying the proper maturity stage sometimes results in early or delayed harvesting.
- ▶ Deficiency of Zinc and Boron were also found during field visits which can lead to fruit cracking.
- ▶ Lack of post-harvest management facilities results into immediate selling.

4.4.7 Market Overview

i. Domestic Market for Litchi

The arrival season of Litchi started in the month of June with an entry of 20.38 MT in Himachal Pradesh in 2021. There was a drop in less than half the volume in July to around 9 MT, and thereafter no arrivals till December. A very short season in Himachal Pradesh with a total arrival of 29.32 MT.

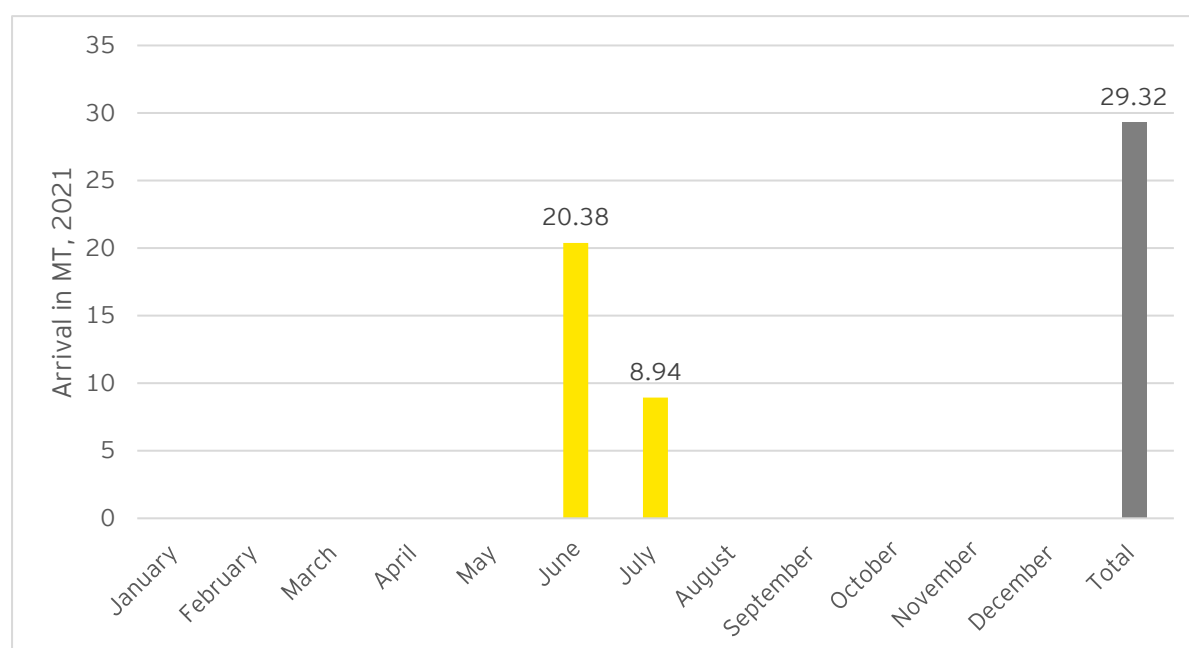


Figure 53: Arrival of Litchi during the season in 2021 in Himachal Pradesh

Source: Agmarknet

The arrival trend of Litchi in Himachal Pradesh market in the past five years seem to be showing a declining trend. In 2017 the arrival was a volume of 57.3 MT, which in 2021 is 29.32 MT, a reduction of almost 44% in the past five years. This declining trend can be arrested by procuring Litchi from other Litchi producing states of India or by increasing production in Himachal Pradesh.

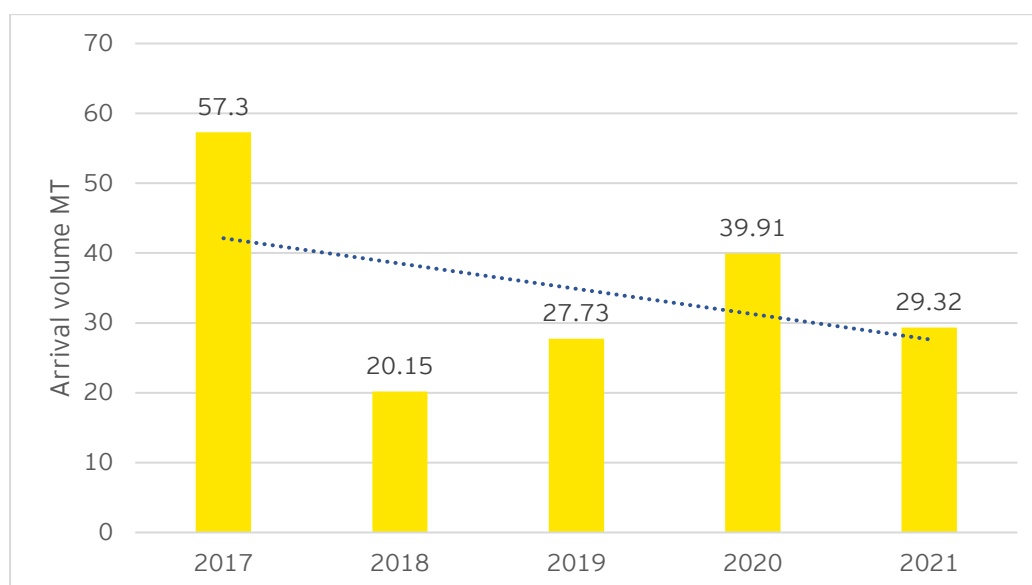


Figure 54: Arrival Trend of Litchi in Himachal Pradesh from 2017

Source: Agmarknet

Litchi arrived in seven APMCs of Himachal Pradesh in 2021. From the analysis of the mean of the modal prices we find that highest price was witnessed in Bilaspur INR95/KG followed by Shimla, Palampur and Kullu, INR88/KG, INR80/KG and INR79/KG. The lowest price was witnessed in Kangra (Jaisinghpur) INR 49/KG.

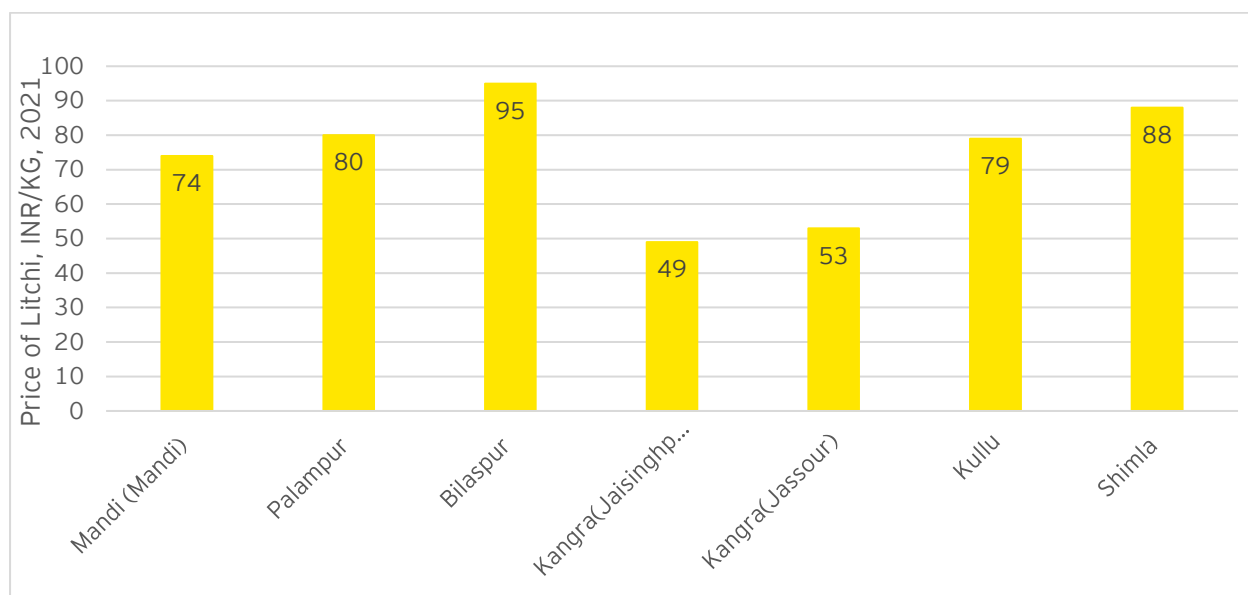


Figure 55: Mean of Modal price per kilogram of Litchi in the markets of Himachal Pradesh in 2021

Source: Agmarknet

The analysis of the mean of the modal price in Himachal Pradesh from 2008 to 2021 shows that the price of Litchi to be increasing every year. There is growth in price and this trend is positive and likely to grow in the future. In the last ten years the price rose by around 30% from INR48.51/KG in 2012 to INR63.31 in 2021.

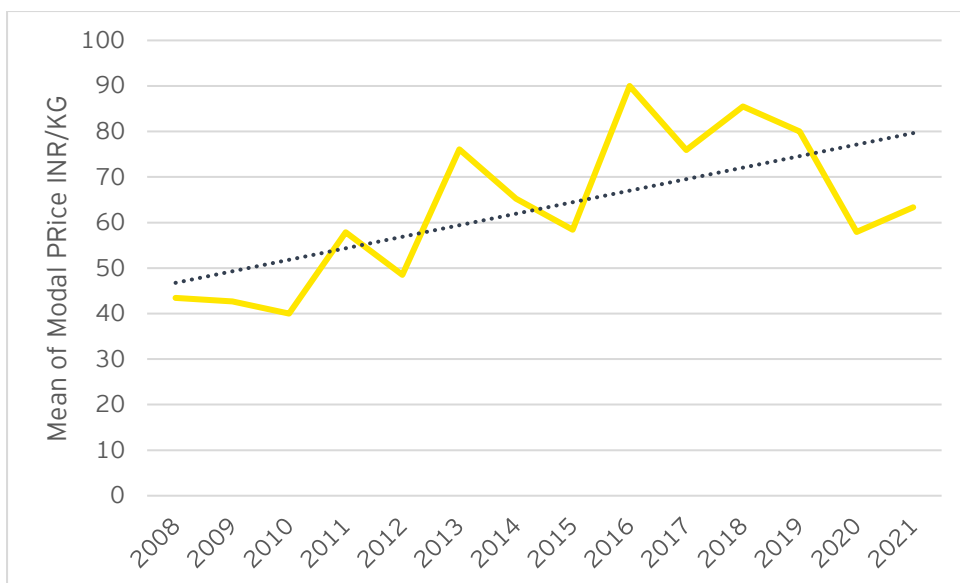


Figure 56: Trend in the Mean of Modal Price from 2008 to 2021

Source: Agmarknet

Outside the state, the Azadpur Market does not report arrival volume or prices for Litchi. In the J&K markets only the Akhnoor APMC reported the arrival of 0.20 MT of Litchi only in the month of July in 2021.

ii. Snapshot of International Market Analysis of Litchi

Import markets

Export volume of Indian Litchi dropped in 2013 after that it spiked in 2012 and again dropped in 2015 after a spike in 2014, this was perhaps because of the bold initiatives taken by India exporters to exploit the export markets of Litchi. However, the volumes of export slowed down over 2015 to 2020. On the other hand, the volume imported remained low but maintained a steady level with a declining trend.

The Import values are higher than the export values which is also a reason for a trade deficit for Litchi trade. The export and import value of Litchi are cyclic and the trend is stable over 2012 to 2020. On the one hand, Litchi has a trade surplus in terms of volume of export and imports, and on the other hand a deficit trade balance in terms of value of export and imports.

Suggested Export destination

From the data available, we have analysed and conclude that the future export destinations for Litchi are Austria and United Kingdom in Europe; Bangladesh and Nepal in South Asia; and UAE and Qatar in the Middle East.

The detailed analysis is present in Annexure IV.

4.4.8. Proposed Interventions

i. Pre- production

Sourcing of plants from reputed nurseries and timely availability of inputs ie. FYM, fertilizer and pesticides.

ii. Production

The farmyard manure, superphosphate and muriate of potash are applied as soil nutrients. Nitrogenous fertilizer is applied twice, first in the month of February and the other after harvesting of fruits. Along with macro nutrients application of zinc and boron is very important. Light irrigation at weekly intervals is done. Training and pruning is done regularly. The recommended dosage of fertilizer is 150 g N, 75 g P and 50 g K per tree.

Intercultural operations: Weeding is done manually. The annual pruning is recommended to control growth of the tree as in case of high- density planting and / or promoting the flowering. Pruning of the bearing shoot 40 cm below the panicle have been found to increase the fruit yield, fruit weight and pulp recovery of litchi.

Integrated Pest Management

- ▶ Timely planting should be done, regular orchard sanitation, destroy the alternate host plants, apply manures and fertilizers as per soil test recommendations
- ▶ Deep summer ploughing of orchards to control soil borne pathogens and subsequently reduces their initial population build up.
- ▶ Adopt the intercropping of recommended crops between the rows of litchi depending upon the stage of orchard pests, soil-borne pathogens
- ▶ Well decomposed farmyard manure coupled with *Trichoderma viride*/ *harzianum* should be used. Nursery beds should be raised.
- ▶ Spray Neem oil 5% (50 ml/l) once on the base and upto 2 m height of the trunk for effective control
- ▶ Avoid water logging and water stress during flowering stage
- ▶ Use yellow sticky trap for monitoring whitefly@4-5 traps/acre
- ▶ Use light trap @ 1/acre and operate between 6 pm and 10 pm

iii. Harvest and Post- harvest

- ▶ Fruit is harvested when it turns red that is full ripe stage. Once harvested, there is no further ripening of fruits. The fruits are harvested in bunches along with a portion of the branch and a few leaves. At the time of harvesting care is taken to harvest the selected bunch which has attained the desirable maturity as determined by colour development.
- ▶ The harvesting tool is a contraption in which hook is tied at the top of a long pole.
- ▶ Produce is harvested by farmers' family and hired labour in early morning and afternoon.
- ▶ Plastic crates and baskets with liner of jute cloth, litchi leaves and old newspaper are commonly used for packaging on farm.

Care to be taken during harvesting

- ▶ In case, harvesting is being carried out from the ground, harvested bunches should be placed in plastic field crates.
- ▶ In case ladders are used the picker places harvested bunches into a cotton bag which is regularly lowered to ground and transferred to field crates.
- ▶ When picking tools are used to cut the panicles, a bag should be attached to the pole so the fruits do not fall on the ground.
- ▶ To avoid breaking of fruits skin, the fruit should not be pulled from the bunch.
- ▶ The ideal time for harvesting the fruit is when temperature and humidity are congenial which gives longer shelf life to the fruit.

Sorting and Grading

- ▶ Fruits should be cleanly clipped from bunches using secateurs, with 0.5 cm of the stem left attached. Fruits that are brown or not uniform in colour or undersized or showing any damage or disease or have cracked skin should be rejected at this point.
- ▶ Fruit infested with fruit borer or litchi moth should also be sorted out because these fruits after fermentation results secondary fungal infection in the packed cartons.

- ▶ The remaining fruits should be graded into various classes as per the shape, size and colour of the fruits according to the fixed standard.

Cleaning and Washing

- ▶ Washing with water is not preferred
- ▶ Cleaning of fruit is recommended by dry brushing

Other treatment: Sulphitation and acidification:

- ▶ Anthocyanin content of litchi fruits is lost immediately after harvest if not treated properly. This spoils the market appearance of the fruit.
- ▶ Bleaching of the colour by sulphur fumigation and regaining it through acidification has been found more convenient and effective practice in case of litchi.
- ▶ At the time of fumigation sulphur: air ratio of 1:5 should be maintained. Immediately after this process, the fruits turn yellow which regain the bright red colour after 20-25 days of storage at 4°C. No change in sulphur or acid content of the aril and its eating quality after sulphuring and acidification has been observed.

Pre-cooling

- ▶ The fruit should be pre-cooled to remove the heat which extends shelf life.
- ▶ Further the fruits should be brought to the cold storage within two-three hours.
- ▶ Litchi fruits are harvested at the peak summer period and hence require immediate removal of field heat through pre-cooling to retard the different enzymatic activity continuously taking place in the fruit.
- ▶ The air-cooling method is quite prevalent method for pre-cooling litchi which is done by maintaining 4-6°C temperature in a room. The well-ventilated containers with fruits are kept for 3-4 hours which facilitate air exchange and thereby induce effective cooling to the fruits.
- ▶ Forced air cooling can also be used for pre-cooling if vertical column palletization is available and carton ventilation is appropriate.

Note: Pre-cooled litchi fruits, stored at 0-1°C can be kept fresh for approximately 30 days and transported to distant markets of the country.

Cold Storage

Unlike other tropical and sub-tropical fruits litchis are not chilling sensitive and should be stored at temperature of 0°C to 1°C with 90- 95 percent relative humidity. Fungal growth at this temperature is minimized and the fruits retain their colour texture and flavour.

The probability of browning increases when fruits are stored at low humidity. If normal cold -room cooling is used, cartons should be stacked to enable air movement around each carton. Cooling in this manner takes 8-12 hours.

Packaging

- ▶ Packing should be done at low temperature.
- ▶ Fruit should be completely dry before packing because moisture content increases the chance of developing disease on the fruits.
- ▶ Litchi should be packed in lined containers.
- ▶ Pack them in large bins or crates lined with plastic sheets with suitable holes so that air circulation can take place.
- ▶ The packages should be well ventilated

For short distance, transportation (200 km or less) tractors with trailers are used. For long distance the most common vehicle is the truck.

Transport and marketing

- ▶ Transport facility from packing facility to the market should be in reefer trucks if the fruits have already cooled.

- ▶ In all cases, trucks should be covered to prevent contact with wind, rain, direct sun light and heat.
- ▶ The post-harvest disease of litchi is predominantly secondary infection that develops because of mechanical damage.
- ▶ Use crates for packaging and transport for better ventilation and palletization which will also prevent shaking and bruising
- ▶ Transport during cooler part of the day as heated litchi will lose their quality and dehydrate more quickly
- ▶ Careful handling, prevention of mechanical damage, and rapid cooling minimize secondary infection

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.5 Value chain Analysis of Persimmon

4.5.1 Overview

i. Global Scenario

In 2019, 4.27 million MT of persimmon was produced globally. China is the world's leading producer of persimmon, contributing 75.12% (3.21 MMT) of the total global persimmon production. The other major producers include South Korea, Japan, Azerbaijan, Brazil, Uzbekistan, Taiwan, Israel, and Iran⁴⁴. The production of persimmon is expected to grow at CAGR of 2.3% from 2020-25⁴⁵.

ii. Indian Scenario

Production of persimmon in India is a fraction of the global persimmon production wherein domestic production is not enough to meet local consumption. They are grown in Jammu & Kashmir, Himachal Pradesh, Tamil Nadu, and Uttarakhand. The major producer of persimmon in India is Himachal Pradesh, with a production of 990 MT in 2019-20.

4.5.2 Persimmon Production in Himachal Pradesh

i. Area and Production

Evident from figure below, Kullu, Mandi and Shimla are the major persimmon producing districts in Himachal Pradesh. Further, Mandi has the highest area under persimmon cultivation followed by Kullu and Shimla. However, Mandi lags behind Kullu in terms of production even after having more area under cultivation due to poor productivity per hectare.

Table 43: Productivity (MT/ha) of Persimmon in HP (2018-19)

Districts in HP	Productivity (MT/ha)
Kullu	3.68
Sirmour	1.50
Kangra	0.86
Shimla	0.48
Mandi	0.35
Solan	0.00
Chamba	0.00
Kinnaur	0.00
L/Spiti	0.00
Bilaspur	0.00
Una	0.00
Hamirpur	0.00
Total	1.68

Source: Dept. of Horticulture

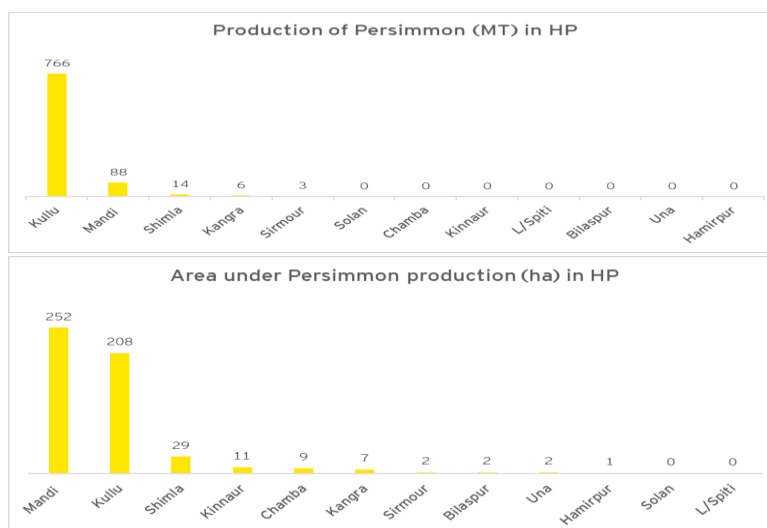


Figure 57: Production and Area under cultivation of Persimmon in Himachal Pradesh

⁴⁴<https://www.tridge.com/intelligences/persimmon/production>

⁴⁵<https://www.businesswire.com/news/home/20201207005638/en/Global-Persimmons-Market-2020-to-2025---Growth-Trends-and-Forecast---ResearchAndMarkets.com>

ii. Persimmon varieties

Persimmon, Japani Phal, a fruit which is not very common in most parts of India, is consumed fresh and dried. Unlike mangoes, Apple or Oranges, Persimmon is not widely available. The seasonal fruit is also called Amarphal in Hindi and Japani Phal colloquially. The taste of the fruit depends on the variety and the ripeness of the fruit. Persimmons are consumed fresh during the seasons, but they are peeled and dried in shade to be consumed in winter, when its off season.

The Persimmon fruit comes in two types. The Astringent type and the Non astringent type. Astringent persimmons are best picked and ripened for a few days until soft and nearly mushy before they are sweet enough to eat. They are the sweetest: richer and juicier than the non-astringents. Non-astringent persimmons can be eaten fresh right from the tree and are crisp like an apple.

The selected varieties for the Himachal Pradesh are:

Key characteristics of Fuyu persimmon -

- ▶ Non-astringent type of persimmon lacking core, seeds, and tannins
- ▶ They are squat, round shaped and capped with indented leaf
- ▶ They are of pumpkin orange colour
- ▶ They contain significant amounts of fibre and vitamin A. Additionally they contain vitamin C and trace amounts of vitamin E, K and B-6.

Key characteristics of Jiro persimmon -

- ▶ Cold hardy cultivars
- ▶ Trees grow best in loamy, well-drained soils with a pH of 6.0 to 6.5 in full sun but thrive on a wide range of soils
- ▶ No serious insect or disease problems, and it does not require annual pruning like some other deciduous fruit trees. It may be pruned as a hedge, screen, or espalier. However, it does produce root suckers. May be promptly removed unless a naturalized effect is wanted.
- ▶ Large, round, reddish-orange fruit, slightly flattened, with sweet, firm, orange flesh. Non-astringent, one of the very best for fresh eating, does not have male flowers. It will not have seeds unless planted with other varieties.

iii. Seasonality

Persimmon is harvested in last week in September - mid December period in Himachal Pradesh

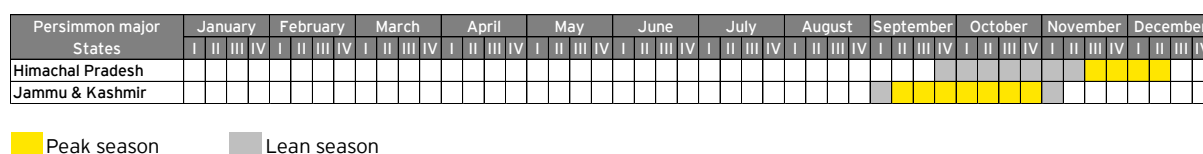


Figure 58: Persimmon harvesting season in major states

4.5.3 SWOT Analysis of Persimmon Value Chain

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Persimmon Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 44: SWOT Analysis for Persimmon Value Chain in Himachal Pradesh

Strengths ▶ Selected non-astringent variety - Fuyu & Jiro, have high market demand locally and Internationally ▶ Persimmon trees are winter hardy / tolerates severe winters and harsh weather, unlike other fruits. ▶ Promotion from the government and exposure to foreign market has made this fruit relatively popular ▶ Do not require the winter chilling and is suitable for mid hill conditions	Weakness ▶ Quality and disease free, true to type planting materials of persimmon are hardly available to the farmers ▶ High humidity and rains during harvest may lead to losses due to diseases
Opportunities ▶ International markets can be targeted due to geographical location and availability of produce. ▶ There is an appreciable potential for growing non-astringent persimmon on mid hill region of HP owing to competitive advantages in marketing and better price	Threats ▶ Lack of social agreement among the farmers may lead to domination & disruption by agents

4.5.4 Value Chain Analysis

i. Commodity flow analysis

The key players involved in Persimmon value chain include -

- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Wholesalers
- ▶ Traders
- ▶ Processors
- ▶ Retailers

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified 3 main channels in the study area:

- ▶ Channel -A: Producer → Consumer
- ▶ Channel -B: Producer → Traders → Wholesaler → Retailer → Consumer
- ▶ Channel - C: Farmer → Pre-harvest Contractor → Wholesaler → Retailer → Consumer

Figure 59: Commodity flow analysis through various channels

Channel A: This is the least preferred marketing channels observed during the field visits (5% or less). Sometimes, the farmers sell to the consumers directly. This is normally to meet immediate cash requirement.

Channel B: The most prevalent supply channel observed in the cluster was sale via traders. It was learnt during interactions with the farmers/ clusters' members that in most cases, the traders

approach the farmers and buy the fruits directly at the farm gate. The transportation from the farm-gate is arranged by the traders.

Channel C: Another prevalent marketing chain involves farmers selling the produce through pre-harvest contractors. The pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. They inspect the field, forecast the estimated orchard production, and then negotiate price with the farmer based on distance of orchard from road and destination markets, expected price during the season etc. Accordingly, a price is mutually decided and thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce. In most of the cases, the pre-harvest contractors pay 10 less than the negotiated prices during peak harvesting season, by making excuses on various issues.

The detailed price- build up analysis for these marketing channels is present in 4.5.5 (ii)

ii. Value Chain Activities

Pre-Production

Farmers plough the land to fine tilth by giving deep ploughings. Any clods or weed is destroyed.

Production

Traditional planting is done at the spacing of 10m X10m. Farmers train the tree as per their experience leaving 2 branches per intersection. Farmers mulch the tree with organic straw

Intercultural operations: Weeds are removed by hand weeding regularly. Plants are provided with manure and fertilizers.

Plant protection: Pests are minimal in persimmon and the most common problems include thrips, whitefly and mites. Farmers remove the dead bark after winter as this attracts a range of pests including termites. Dry and smaller branches are also pruned by farmers.

Harvest and Post-Harvest Activities

Farmers harvest ripe and tender fruits based on the colour. Under ripe fruits are chalky in texture whereas if not properly ripened they will not develop the desired taste.

4.5.5 Cost Economics and Price Build up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and discussions with concerned stakeholders. All the values are considered at constant prices without inflation. The initial cost of Persimmon plantation in 1st year is INR 4.71 lakhs, and in subsequent years range from INR 0.83 lakhs/ha to INR 2.26 lakh/ha. The table on cost of production is given below.

Table 45: Persimmon Cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Inputs Cost															
Land clearing and development	80,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pitting and Plantation (@Rs.50/- per pit for 625 pits)	31,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting material (4 x 4 m spacing) = 625 trees/ha @Rs.100/plant	62,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mulching (including labour) (@Rs.32 per running metre 4 metre per plant)	80,000	-	-	-	-	80,000	-	-	-	-	80,000	-	-	-	-
Planting equipment and tools	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micro irrigation development (as per PMKSY rate)	1,20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm yard Manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertiliser	2,450	2,450	2,450	2,450	2,650	2,850	3,050	3,250	3,450	3,650	3,650	3,650	3,650	3,650	3,650
IPDM and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,000	3,000	3,000	3,000	3,000
Persimmon packing boxes (INR 10 per 5 kg)	-	-	18,750	25,000	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500	37,500
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,001	3,002	3,003	3,004	3,005
Labour (MNREGA rate of Rs.203/- day labour)	74095	74095	74095	74095	83636	83636	90132	90132	90132	90132	90132	90132	90132	90132	90132
Total Cost	4,71,850	83,100	1,05,211	1,14,378	1,36,869	2,17,319	1,44,265	1,44,715	1,45,165	1,45,615	2,25,616	1,45,617	1,45,618	1,45,619	1,45,620

Table 46: Annual revenue per hectare from Persimmon cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (kg/hectare)	-	-	9,375	12,500	18,750	18,750	18,750	18,750	18,750	18,750	18,750	18,750	18,750	18,750	18,750
Return (@Rs.50/kg)			4,68,750	6,25,000	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500	9,37,500
BC Ratio			4.46	5.46	6.85	4.31	6.50	6.48	6.46	6.44	4.16	6.44	6.44	6.44	6.44

The labour component is major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers. There is cost spike in 6, 11 years, basically due to replacement of mulch.

The table below explains different cost of cultivation in percentage.

Table 47: Year wise cost of Persimmon cultivation components in percentage of total cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	17.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pitting and Plantation	6.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting Materials	13.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	17.0%	0.0%	0.0%	0.0%	0.0%	36.8%	0.0%	0.0%	0.0%	0.0%	35.5%	0.0%	0.0%	0.0%	0.0%
Planting Equipment	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Micro-irrigation	25.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FYM	1.2%	6.7%	6.3%	7.3%	6.1%	3.8%	5.8%	5.8%	5.7%	5.7%	3.7%	5.7%	5.7%	5.7%	5.7%
Fertilizer	0.5%	2.9%	2.3%	2.1%	1.9%	1.3%	2.1%	2.2%	2.4%	2.5%	1.6%	2.5%	2.5%	2.5%	2.5%
IPDM & Growth hormones	0.2%	1.2%	1.2%	1.3%	1.3%	0.9%	1.6%	1.7%	1.9%	2.1%	1.3%	2.1%	2.1%	2.1%	2.1%
Packing boxes	0.0%	0.0%	17.8%	21.9%	27.4%	17.3%	26.0%	25.9%	25.8%	25.8%	16.6%	25.8%	25.8%	25.8%	25.8%
Irrigation system manitenance	0.0%	0.0%	1.9%	2.6%	2.2%	1.4%	2.1%	2.1%	2.1%	2.1%	1.3%	2.1%	2.1%	2.1%	2.1%
Labour	15.7%	89.2%	70.4%	64.8%	61.1%	38.5%	62.5%	62.3%	62.1%	61.9%	39.9%	61.9%	61.9%	61.9%	61.9%

Persimmon starts fruiting from 3rd year. The annual return for the farmers ranges from INR 4.68 lakhs to INR 9.37 lakhs per hectare per annum.

ii. Price Build-up and market margins of Persimmon

The price builds up analysis is presented below for the 3 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders and also validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 48: Marketing costs and margins of different functionaries in the various marketing channels of Persimmon (INR/kg)

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
(I)	Marketing cost incurred by the Farmer									
1	Net price received by the farmer	40.00	72.73%	40.00	35.00	41.18%	35.00	30.00	35.29%	30.00
	Picking and sorting	3.00	5.45%	43.00						
2	Transportation cost	5.00	9.09%	48.00						
4	Cost of basket/crate	1.00	1.82%	49.00						
5	Loading / unloading	2.00	3.64%	51.00						
6	Spoilage (approx 10%)	4.00	7.27%	55.00						
	<i>Total</i>	15.00								
	Farmer's selling price	55.00	100.00%	55.00	35.00	41.18%	35.00	30.00	35.29%	30.00
(II)	Marketing cost incurred by the Traders									
A	The gross price paid by Traders				35.00	41.18%	35.00			
B	Cost components of Traders									
1	Labour cost				3.00	3.53%	38.00			
2	Transportation cost				0.50	0.59%	38.50			
3	Mandi Tax				0.35	0.41%	38.85			
4	Commission charge				1.75	2.06%	40.60			
5	Spoilage (approx 5%)				1.75	2.06%	42.35			
	<i>Total</i>				7.35					
6	Traders' Margin (7-8%)				2.65	3.12%	45.00			
	Traders' Selling Price				45.00	52.94%	45.00			

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up
(III)	Marketing cost incurred by the Pre-harvest Contractor									
A	The gross price paid by Pre-harvest Contractor							30.00	35.29%	30.00
B	Cost components of Pre-harvest contractor									
1	Labour cost for picking & sorting							0.50	0.59%	30.50
2	Transportation cost							1.00	1.18%	31.50
3	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)							1.00	1.18%	32.50
4	Loading / unloading							0.40	0.47%	32.90
3	Mandi Tax									
4	Commission charge									
5	Spoilage (approx 10%)							3.00	3.53%	35.90
	<i>Total</i>							5.90	6.94%	
	Pre-harvest contractor's Margin (20%-25%)							9.10	10.71%	45.00
(IV)	Marketing cost incurred by the wholesaler									
A	The gross price paid by wholesaler				45.00	52.94%	45.00	45.00	52.94%	45.00
B	Cost components of wholesaler									
1	Loading / unloading				0.50	0.59%	45.50	0.50	0.59%	45.50
4	Transportation cost				0.50	0.59%	46.00	0.50	0.59%	46.00
5	Mandi Tax				0.45	0.53%	46.45	0.45	0.53%	46.45
6	Commission charge				2.25	2.65%	48.70	2.25	2.65%	48.70
7	Spoilage at Wholesaler level (approx 5%)				2.10	2.47%	50.80	2.10	2.47%	50.80
C	<i>Total</i>				5.80			5.80		
D	Wholesalers Margin (5%-6%)				2.20	2.59%	2.20	2.20	2.59%	53.00
E	Wholesaler Selling price				53.00	62.35%	53.00	53.00	62.35%	53.00
(V)	Marketing cost incurred by the retailer									
A	The gross price paid by retailer				53.00	62.35%	53.00	53.00	62.35%	53.00

S. No.	Particular	Channel A			Channel B			Channel C		
		<i>In Rs.</i>	<i>in %</i>	<i>Price-built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>
B	Cost components of retailer									
1	Loading / unloading				0.40	0.47%	53.40	0.40	0.47%	53.40
3	Transportation cost				1.00	1.18%	54.40	1.00	1.18%	54.40
4	Mandi Tax				0.53	0.62%	54.93	0.53	0.62%	54.93
5	Commission charge				2.65	3.12%	57.58	2.65	3.12%	57.58
6	Storage/rent				0.50	0.59%	58.08	0.50	0.59%	58.08
7	Spoilage at Retailer Level (15%-25%)				10.60	12.47%	68.68	10.60	12.47%	68.68
C	<i>Total</i>				15.68			15.68		
D	Retailer Margin (20%-25%)				16.32	19.20%	16.32	16.32	19.20%	85.00
E	Retailer Selling price				85.00	100.00%	85.00	85.00	100.00%	85.00
(VI)	Consumer' Purchase Price	55.00	100.00%	55.00	85.00	100.00%	85.00	85.00	100.00%	85.00

The price spread among different marketing channel is described below. The price spread found to be INR 55 in channel C, followed by channel B and channel A.

Table 49: Price spread of Persimmon among the different marketing channels (INR/kg)

S. No.	Particular	Channel A	Channel B	Channel C
1	Producer price	40.00	35.00	30.00
2	Consumer's price	55.00	85.00	85.00
3	Price spread	15.00	50.00	55.00
4	Producer's Share	72.73	41.18	35.29

The producer's share in Channel A is high (72.73%) as compared to that of in Channel B (41.18%), and Channel C (35.29%).

The marketing efficiency through different channels are given below. The marketing efficiency was found to be highest in channel-A followed by channels B and C respectively. Though channel A has been found to be most efficient, but the volume transacted was very less (<5.0%).

Table 50: Marketing efficiency of Persimmon among the different marketing channels

S. No.	Particular	Channel A	Channel B	Channel C
1	Farmer's Price	40.00	35.00	30.00
2	Marketing cost	15.00	23.23	27.38
3	Marketing Margin	0.00	18.52	27.62
4	Marketing efficiency	2.67	0.84	0.55

4.5.6 Gaps in the Value Chain

i. Pre-production

- ▶ Persimmon cultivation in India suffers from lack of timely availability of quality planting materials from vegetative propagation, and lack of suitable cultivars.
- ▶ Soil and water analysis were not conducted before the plantation.
- ▶ The farmers are also not aware of the irrigation schedule, and depend on their traditional knowledge.
- ▶ Thrips and mites have been reported at nursery stage

ii. Production

- ▶ The farmers lack knowledge of modern cultivation practices, and mostly follow traditional methods.
- ▶ Poor management practices which result in plenty of weeds in the field with high incidence of pests and diseases.
- ▶ Lack of water resources and un-timely application of fertilizers and pesticides by the farmers due to lack of knowledge.
- ▶ Pre-mature fruit fall noticed primarily due to mite infestation

iii. Harvesting and post-harvest

- ▶ Farmers lack technical knowledge of correct stage of harvesting. Due to astringent nature, the early harvested fruits do not ripen whereas late harvesting leads to spoilage.
- ▶ Improper harvesting methods affect the fruit quality and shelf life as well as lead to fruit damage while transporting.

4.5.7 Market Overview

i. Domestic Market for Persimmon

The price trend of Persimmon at the wholesale market in Mandi is depicted below. The mean wholesale price at Takoli, Mandi district was Rs.39/- per kg while at sadar it was Rs.52/- per kg.

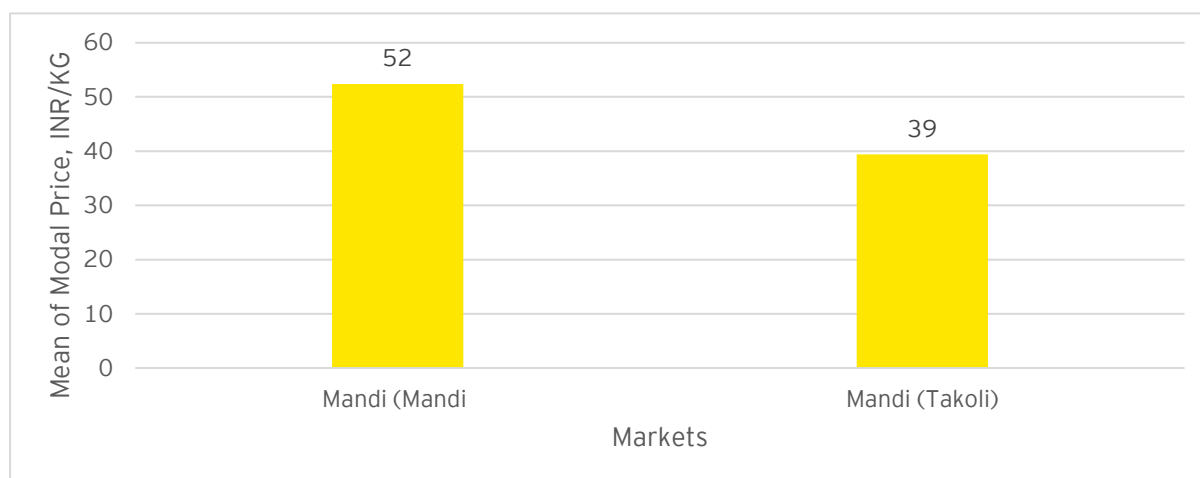


Figure 60: Mandi Persimmon wholesale market trend

ii. Snapshot of International Market Analysis for Persimmon

The import market of Persimmon witnessed a positive annual average growth of 5% which is like B20 group of countries, and this trend is likely to continue. Morocco has shown the highest annual average growth rate of 22% followed by Thailand and Czech Republic (both growing at the rate of 16%) followed by Ukraine, and the United Kingdom.

- ▶ The five top counties that show higher growth trend in the future in terms of value of Persimmon are Russian Federation, Germany, Ukraine, France, and Italy.
- ▶ The total value was USD 402 million in 2016 and is forecasted to grow in value up to USD 840 million. The B20 countries has a growth rate of 6% and will continue to grow with a total value of USD 349 million in 2016, which is forecasted to reach USD 713 million, in 2030.
- ▶ The Emerging Market group of countries are the star markets with growth rate of 13% a point higher than the world markets and covers a share of 34% of the B20 countries with a value of USD 108 million in 2016, which is forecasted to grow up to USD 279 million.
- ▶ India has a trade deficit in case of Persimmon, where the country has been a net importer of the fruit. India imported around 57 MT of the fruit up to 2020 from Spain and South Africa, which comprised a value of USD 130,000. India imported the fruit from Spain and South Africa at USD 1973/MT and USD 1722/ MT respectively.
- ▶ In 2020 India also exported a total of 10 MT of Persimmon. It exported 10 MT to UAE at USD 917 per MT and 1 MT to Kuwait at USD 909/ MT. The total value of export was USD 11,000. This scenario can change if target destination markets can be tapped through B2B or B2C arrangements in the B10 countries more specifically China, Singapore, USA, Switzerland, Canada, Germany, France, and Malaysia

Suggested export destinations:

The four-important market location and destination for Indian export of Persimmon in terms of capturing the volume of market share are Russian Federation, Ukraine, Thailand, and Germany. Higher price markets for export of Persimmon are USA, Singapore, China, Canada, and Switzerland. In the EM group, China, and Poland.

Market criteria	Priority country destination (By Growth rate and Trend)	Growth Rate and Import Price	
Higher volume	▶ Russian Federation ▶ Ukraine ▶ Thailand ▶ Germany ▶ Morocco	Volume	▶ 7% ▶ 11% ▶ 16% ▶ 5% ▶ 22%
Higher value	▶ Russian Federation ▶ Germany ▶ Ukraine ▶ France ▶ Italy	Value	▶ 12% ▶ 13% ▶ 19% ▶ 13% ▶ 12%
Higher Prices	▶ Hong Kong China ▶ USA ▶ Singapore ▶ Canada ▶ Switzerland	Import Price	▶ HK China : USD 3141/MT ▶ USA: USD2407/MT ▶ Singapore: USD 2015/MT ▶ Canada: USD1823/MT ▶ Switzerland: USD1762/MT
Emerging markets	▶ China ▶ Poland	Long term focus	▶ 7% in value ▶ 3% in Volume 15% in value

Source: ITC Trade Maps

The detailed analysis is presented in Annexure IV.

4.5.8 Proposed Intervention

Pre- Production:

Cultivation practices: The recommended tree spacing for persimmon in HDP is 4X4 m. Care is necessary when transplanting to the field, because persimmon roots are fragile and easily damaged by drying or rough handling.

Production:

Nutrient management: It is suggested that using 1 to 2 cups of a balanced fertilizer (like 10-10-10) per year of age is adequate. This should be applied in March, June, and September in the first two years. After that, limit persimmon tree feeding to March and June.

Irrigation: A potential yield increase for higher irrigation levels (40 tons/ha for annual irrigation of 1,000 mm). At high irrigation, the yield response curve levelled off and the marginal contribution of additional water declined

Training system: Young plants are trained to a modified central-leader structure by pruning shoots during the first few seasons, forcing growth into framework branches. The aim is to develop a pyramidal shape with from three to five main limbs at about 30cm intervals on the trunk, beginning at about 91 cm above ground level. Staking with 1.5-m stakes may aid in training young trees. Pruning mature plants is done during the dormant winter months to remove crossover, diseased, or broken branches.

Pruning: Pruning is also done to remove weak, shaded branches, open the canopy to prevent self-shading, reduce excessively vigorous shoot growth, and regulate crop load. Pruning Persimmons should be done once a year, in late winter or early spring when the tree is dormant, to shape-up the structure and prevent alternate bearing. If the limbs crack or the branches break under the weight of the fruit, you should also prune the Persimmon tree during the fruiting season.

Harvesting and Post-Harvest:

Harvesting: Persimmons are harvested when mature but still firm, with color nearly fully developed. 'Maru' fruit is greenish yellow when ripe; 'Fuyu' and 'Jiro' fruits are orange. The fruit is removed from the tree by clipping or breaking the stems, leaving the calyx lobes attached to the fruit. Persimmons must be handled carefully to avoid damage.

Post harvesting: Both 'Fuyu' and 'Jiro' fruits are firm when ripe. 'Jiro' fruit needs to be cured after maturity to remove astringency caused by tannins. The non-astringent 'Fuyu' fruit is ripened on the tree and is ready to eat when harvested.

Physiological disorders: Fuyu' persimmons exhibit chilling injury symptoms if kept at temperatures between 2°C and 15°C. Upon transfer to higher temperatures the severity of the symptoms (flesh softening, browning, and water-soaked appearance) increases and renders the fruits unmarketable. Respiration and ethylene production rates of chilled 'Fuyu' persimmons are higher than those of non-chilled fruits. Exposure to ethylene at 1 ppm or higher aggravates chilling symptoms of persimmons, while controlled atmospheres ameliorate these symptoms.

- ▶ Avoid exposure of persimmons to temperatures between 2°C and 15°C. Optimum storage and transport temperature is 0°C.
- ▶ Avoid exposure to ethylene above 1 ppm throughout postharvest handling of 'Fuyu' persimmons.
- ▶ Use of controlled atmosphere of 3-5% O₂ + 5-8% CO₂ at temperatures below 5°C reduced chilling injury.

Major diseases

- ▶ Crown gall (*Agrobacterium tumefaciens*)
- ▶ Anthracnose (*Colletotrichum* sp.)
- ▶ Fruit drop (physiological causes, including excessive shoot growth, insufficient sunlight, and lack of Pollination)
- ▶ Mealybugs
- ▶ Ants (associated with mealybugs)
- ▶ Thrips
- ▶ Mites
- ▶ Fruit flies
- ▶ Many of the leaf spot pathogens appear when the tree is getting a lot of moisture, so water early to allow the foliage to dry quickly. Usually, fungicide treatment isn't necessary. If you decide it is in your case, use the fungicide chlorothalonil after the buds begin to open.

Pest control

- ▶ Deep summer ploughing reduces the incidence of weeds, mealy bug and soil borne pathogen
- ▶ Sow maize in 4 rows all around the main crop as barrier
- ▶ For better nutrient management well decomposed FYM should be coupled with *Trichoderma viride*
- ▶ Use yellow sticky traps @4-5 trap/acre
- ▶ Use light trap @1/acre and operate between 6 pm and 10 pm
- ▶ Install pheromone traps @4-5/acre for monitoring fruit fly activity

Storage: The recommended temperature is generally 0°C, whereby the fruit is given a storage period of 2-4 months. Storage life can be extended by packaging in sealed polythene bags. Chilling injury is the main physiological disorder. The incidence and severity depend on temperature, cold temperature duration, and the cultivar.

Marketing and Branding:

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.6. Value Chain Analysis of Plum

4.6.1. Overview:

i. Global Scenario:

Plum is one of the commercially grown stone fruit in the world. It is mostly grown in the temperate climatic region of the world. The top 5 plum producing countries in the world are China, Romania, Serbia, USA and Turkey. India is ranked 8th in global plum production⁴⁶. China is ranks top in both production and consumption of plums globally. Driven by increasing demand for plum worldwide, the market is expected to continue an upward consumption trend over the next few year period. Market performance is forecast to retain its current trend pattern, expanding with an anticipated CAGR of +1.8%.

ii. Indian Scenario:

Plum (*Prunus salicina* Lindl.) is one of the commercially grown stone fruit belonging to Prunoideae subfamily of the Rosaceae family. It is native to China. Plum is a temperate fruit, but it also grown in mid-hills of Himachal Pradesh, Jammu & Kashmir and Uttarakhand in north India and to a limited extent in Nilgiri hills in South India on commercial basis.

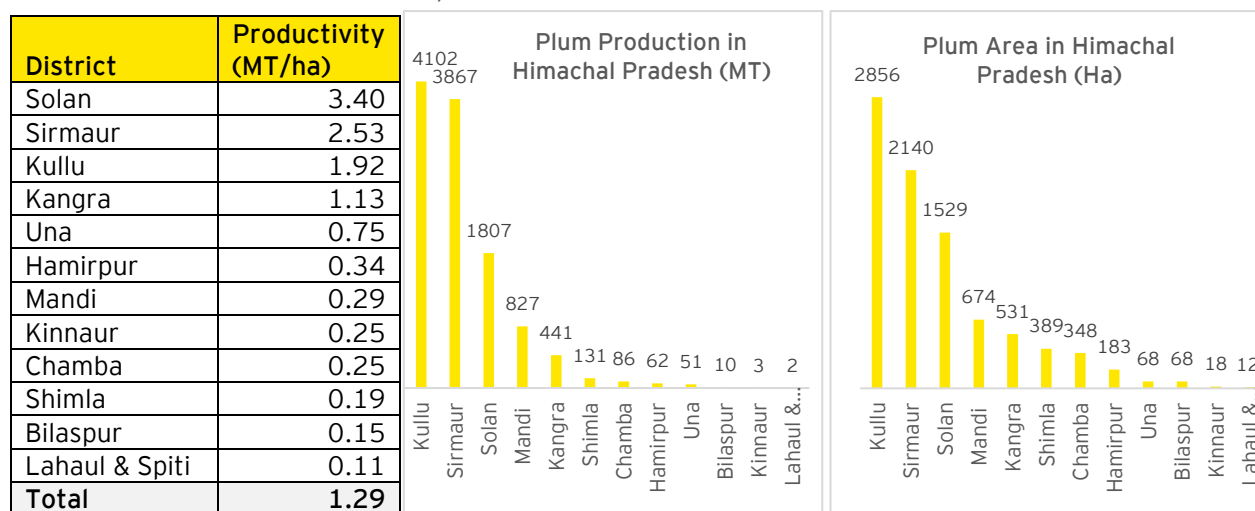
Plums are rich in sugars and carotenes. Plum pits which constitute about 2-7 % of the fruit yield up to 26.7 per cent of kernels. The kernels are bitter in taste.

4.6.2. Plum Production in Himachal Pradesh

i. Area and Production:

The state has recorded production of 11,389 MT on an area of 8,816 ha with an average productivity of 1.29 MT/ha during FY 2018-19. Mandi, Kullu and Sirmaur accounts for nearly 74% area under production whereas Kullu, Sirmaur and Solan accounts for nearly 86% prouction of the state. Though, Mandi district has highest area (32%) under plum cultivation; it only contributes 7% poduction of the state due to low productivity (0.29 MT/ha). The state has recorded highest prouctivity of 3.40 MT/ha (Solan) and lowest prouctivity of 0.11 MT/ha (Lahaul & Spiti). However, with improved package of practices it is expected to achieve the maximum prouctivity across state.

Table 51: District wise Plum Productivity (MT/ha) in Himachal Pradesh (2018-19)



Source: Department of Horticulture

Figure 61: Plum Production Area and Production Volume in Himachal Pradesh (2018-19)

⁴⁶ <https://www.atlasbig.com/en-in/countries-by-plum-production>

ii. Plum Varieties

A large number of cultivars have been introduced into the country. European plums performed better in the hills, while Japanese plums are more adopted in sub-mountainous lower elevations. Leading cultivar in the hills is Santa Rosa. In the north-Indian plains small-fruited cultivars like Titron, Kala Amritsari, Kelsey, and Alubukhara showed better performance. A good number of low-chilling Florida hybrids (Fla-1-2, Fla 73-4, Fla 85-2, 85-3, Fla 86-4) Sungold, Redgold etc, are under evaluation⁴⁷.

The important characteristics of plum varieties considered are as follows:

Angeleno: Fruit is very big and slightly flattened to the ends with very hard textured. The shell is dark violet-black in colour and hazy. Fruit flesh is light yellow, the core is small and is not tied to the flesh.

Friar: Its fruit is round -oval, large, cracking resistant, sweet, juicy, full outer skin of the outer shell is purple-black, smooth and has glossy surface. The flesh is hard textured, yellowish white colour, the core is free and very small

iii. Seasonality:

Plum is expected to be harvested in mid-July to mid-October in Himachal Pradesh.

Figure 62: Plum harvesting season in Himachal Pradesh

Plum	January				February				March				April				May				June				July				August				September				October				November				December			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Himachal Pradesh																																																
Uttarakhand																																																
Jammu and Kashmir																																																
Punjab																																																

Peak season
 Lean season

Source: EY analysis

⁴⁷ <https://www.fao.org/3/ab985e/ab985e07.htm>

4.6.3. SWOT Analysis of Plum Value Chain⁴⁸

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Plum Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 52: SWOT Analysis of the Plum Value Chain in Himachal Pradesh

Strengths	Weaknesses
▶ Suitable climate for Plum cultivation. The state is 2nd in production in country ▶ Plum can tolerate both frost and high summer temperature ▶ Low-chilling varieties are suitable for sub-tropical region	▶ Farmers lack quality planting material, training on package of practices, standardisation of fruits and education ▶ Lack of precise irrigation management
Opportunities	Threats
▶ Growing demand due to taste and health benefits ▶ Diversification possible due to improved cultivars like Black Amber and Santa Rosa cultivars extend harvesting season and fetch better market prices ▶ Special retail packs can be developed	▶ Monoculture of Plum cultivar 'Santa Rosa' increases the risk of disease and pest outbreaks. ▶ Malpractices during packaging threatens plum price parity ▶ Improper post-harvest handling of fruits lead to high losses ▶ Plum pox virus, formation of rosette and ultimately die back

4.6.4. Value Chain Analysis:

i. Commodity Flow Analysis

The key players involved in the Plum value chain are:

- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Wholesalers
- ▶ Traders
- ▶ Processor
- ▶ Retailers

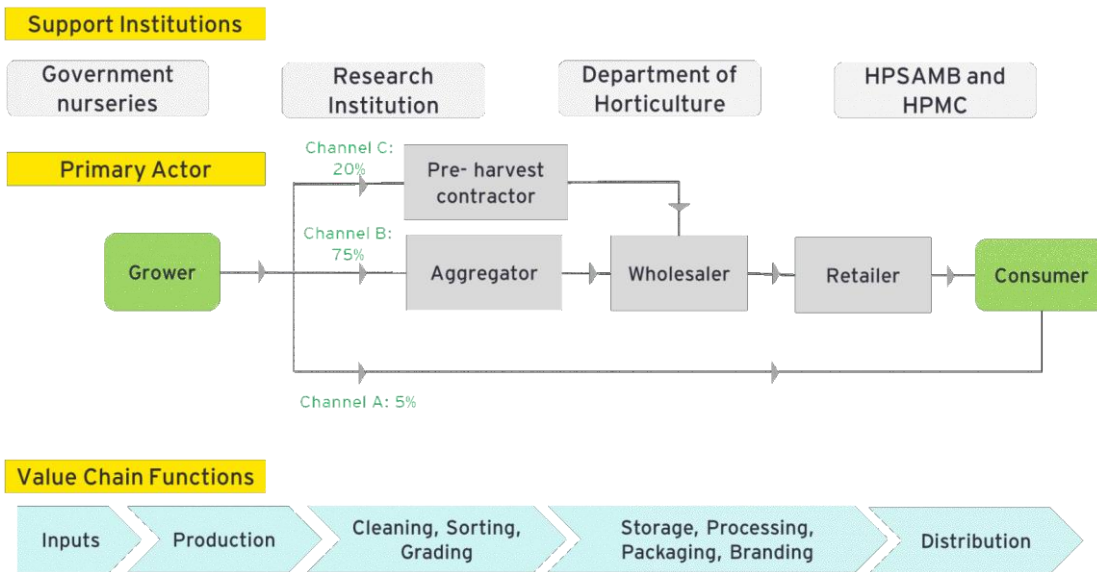
The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified three main channels in the study area:

- ▶ Channel -A Producer → Consumer
- ▶ Channel -B Producer → Wholesaler → Retailer → Consumer
- ▶ Channel -C Producer → Pre-harvest contractor → Wholesaler → Retailer → Consumer

The existing marketing channel of Plum is as below

⁴⁸Mukesh Kumar, DD Sharma, Niranjana Singh and Bunty Shylla, 'Evaluation of newly introduced plum (*Prunus salicina* Lindl.) cultivars under mid-hills of Himachal Pradesh', 2018, International Journal of Chemical Studies, Vol. 6 (2), pag. 2925-2930.



Most of the farmers sold their produce through Aggregators i.e., Channel-B, followed by pre-harvest contractors, i.e., Channel C.

Channel A: This channel was used by the farmers/growers at a very limited scale (<5%), mainly to meet the short-term cash requirement at the household. Sometimes, the farmers themselves bring the produce in the nearby markets or put a stall in the market to sell directly to the consumers. Depending on the cash requirement, the farmers harvest the fruits and bring them to the market. In such cases, the transport is arranged by the farmers themselves. In this channel also the farmers have limited bargaining power.

Channel B: This was the most prominent channel found in case of plum. The harvested plums are collected by one of the big farmers of the area, who seldom work as aggregator, and then brought to the markets.

Channel C: In this channel, the pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. They inspect the field, forecast the estimated production, and then negotiate price with the farmers. Thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce.

The detailed price- build up analysis for these marketing channels is present in 4.6.5 (ii)

ii. Value Chain Activities

Preharvest Activities

Land preparation: Traditionally, Farmers plant Plum at varied spacing ranging from 4m *4 m to 10m*10 m. Farmers prepare the land by ploughing, harrowing, levelling, and removing weeds.

Planting: Farmers propagate plum through hard wood cuttings. The rooting percentage of cuttings can be increased by dipping the cuttings lower ends for 24 hours in 100 ppm of IBA solution before planting during December.

Intercultural operations: Generally, plums set fruit much more than it is capable of maturing. Excessive fruit set in plums results into smaller fruits, which fetch poor price in the market. Hand

thinning is usually done from top of the shoot to bottom. Fruits are kept at 5-6 cm apart there should be 15-20 leaves for some fruits. There should not be two fruits at one point.

Harvesting and Postharvest Activities

The plum fruits are mature when it attained proper size and developed proper colour depending upon the cultivar. The plum fruits are harvested in the month of June-July in Himachal Pradesh. For sale in local markets fruits are harvested when ripe and firm. For distant markets, fruits are picked when firm but have developed 50% colour on the skin. Plums are harvested along with pedicels to avoid any injury to the fruit.

Plum fruit is very perishable in nature, hence should be handled with care. This has made procurement of B and C grade plums from blocks like Naggar, Kullu, Banjar and Sadar very easy and thus, has become a readily available source for processing.

The small baskets padded with rice trash or grass at the bottom and sides are used. Freshly harvested fruits are transferred in these baskets and covered with paper and tied in gunny cloth. The fruits are graded before packing in basket or wooden boxes. Several pickings are made as the entire fruit on a tree do not ripen at one time. Fruit is borne on spurs also so care should be taken to save the spurs from breakage, during harvesting.

For distant markets wooden boxes are preferred over basket. To save fruits from injury each layer of fruit is covered with paper strips and newspaper sheet. Finally, the lid of the box is nailed.

4.6.5. Cost Economics and Price build-up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and discussions with concerned stakeholders. All the values are considered at constant prices without inflation. The lump sum cost of 1 lakh is considered for land preparation. The spacing of the plant is considered as per the suggested spacing in nursery report, i.e., 4 * 4 in Plum High Density Planting. Mulching sheets are assumed to be replaced for every 5 years. The table below present the annual cost and component wise breakup in 1 hectare land and corresponding revenue from the expected yield.

Table 53: Plum cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Inputs Cost															
Land clearing and development	1,00,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pitting and Plantation (@Rs.50/- per pit for 625 pits)	31,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting material (4 x 4 m spacing) = 625 trees/ha @Rs.100/plant	62,500			-	-	-	-	-	-	-	-	-	-	-	-
Mulching (including labour) (@Rs.32 per running metre 2.5 metre per plant	50,000	-	-	-	-	50,000	-	-	-	-	50,000	-	-	-	-
Planting equipment and tools	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micro irrigation development (as per PMKSY rate)	1,20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm yard Manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertiliser	10,250	10,250	12,000	15,000	18,000	20,000	22,500	25,000	27,500	30,000	32500	35000	35000	35000	35000
IPDM and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3250	3500	3500	3500	3500
Plum packing boxes (INR 10 per 5 Kg)	-	-		6,250	12,500	25,000	37,500	50,000	62,500	75,000	87,500	93,750	93,750	93,750	93,750
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour (MNREGA rate of Rs.203/-day labour)	74095	75516	75516	84448	83636	83636	90132	90132	90132	90132	90132	90132	90132	90132	90132
Total Cost	4,69,650	92,321	97,432	1,18,531	1,27,219	1,91,969	1,63,715	1,78,965	1,94,215	2,09,465	2,74,715	2,33,715	2,33,715	2,33,715	2,33,715

Table 54: Annual revenue per hectare from Plum cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (kg/hectare)	-	-	-	3,125	6,250	12,500	18,750	25,000	31,250	37,500	43750	46875	46875	46875	46875
Return (@Rs.40/kg)			-	1,25,000	2,50,000	5,00,000	7,50,000	10,00,000	12,50,000	15,00,000	17,50,000	18,75,000	18,75,000	18,75,000	18,75,000
BC Ratio			-	1.05	1.97	2.60	4.58	5.59	6.44	7.16	6.37	8.02	8.02	8.02	8.02

The establishment cost of Plum cultivation is approximately INR 4.69 lakhs, and annual cost is from INR 0.92 lakhs to INR 2.74 lakhs in the later years. It is observed that the labour component is major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers. There is cost spike in 6 and 11 years, which is due to cost for replacement of mulch.

The table below explains different cost of cultivation in percentage of total cost every year.

Table 55: Year wise cost of pomegranate cultivation components in percentage of total cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	21.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pitting and Plantation	6.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting Materials	13.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	10.6%	0.0%	0.0%	0.0%	0.0%	26.0%	0.0%	0.0%	0.0%	0.0%	18.2%	0.0%	0.0%	0.0%	0.0%
Planting Equipment	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Micro-irrigation	25.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FYM	1.2%	6.0%	6.8%	7.0%	6.5%	4.3%	5.1%	4.7%	4.3%	4.0%	3.0%	3.6%	3.6%	3.6%	3.6%
Fertilizer	2.2%	11.1%	12.3%	12.7%	14.1%	10.4%	13.7%	14.0%	14.2%	14.3%	11.8%	15.0%	15.0%	15.0%	15.0%
IPDM & Growth hormones	0.2%	1.1%	1.3%	1.3%	1.4%	1.0%	1.4%	1.4%	1.4%	1.4%	1.2%	1.5%	1.5%	1.5%	1.5%
Packin boxes	0.0%	0.0%	0.0%	5.3%	9.8%	13.0%	22.9%	27.9%	32.2%	35.8%	31.9%	40.1%	40.1%	40.1%	40.1%
Irrigation system manitenance	0.0%	0.0%	2.1%	2.5%	2.4%	1.6%	1.8%	1.7%	1.5%	1.4%	1.1%	1.3%	1.3%	1.3%	1.3%
Labour	15.8%	81.8%	77.5%	71.2%	65.7%	43.6%	55.1%	50.4%	46.4%	43.0%	32.8%	38.6%	38.6%	38.6%	38.6%

Plum starts fruiting from 4th year and achieve optimum yield in 12th year. The annual return for the farmers ranges from INR 1.25 lakhs to INR 18.75 lakhs per hectare per annum.

ii. Price Build-up and Market Margins of Plum

The price builds up analysis is presented below for the 3 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders and validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 56: Marketing costs and margins of different functionaries in the various marketing channels of Plum (Rs/kg)

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
(I)	Marketing cost incurred by the producers									
1	Net price received by the farmer	40.00	72.73%	40.00	35.00	35.00%	35.00	30.00	33.33%	30.00
2	Picking and sorting	2.00	3.64%	42.00						
3	Transportation cost	4.00	7.27%	46.00						
4	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)	1.00	1.82%	47.00						
5	Loading / unloading	2.00	3.64%	49.00						
6	Spoilage (approx 15%)	6.00	10.91%	55.00						
A	<i>Total</i>	15.00								
B	Farmer's selling price	55.00	100.00%	55.00	35.00	35.00%	35.00	30.00	33.33%	30.00
(II)	Marketing cost incurred by the Traders/Aggregators									
A	The gross price paid by Traders/Aggregators				35.00	35.00%				
B	Cost components of Traders/Aggregators									
1	Labour cost for picking & sorting				1.00	1.00%				
2	Transportation cost				1.00	1.00%				
3	Cost of basket/crate Rs.100/- per crate for 25 Kgs, with 4 years life)				0.50	0.50%				
4	Loading / unloading				2.00	2.00%				
5	Spoilage (approx 10%)				3.50	3.50%				
B	<i>Total</i>				8.00					

[illegible]

S. No.	Particular	Channel A			Channel B			Channel C		
		<i>In Rs.</i>	<i>in %</i>	<i>Price-built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price-built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price-built-up</i>
A	The gross price paid by retailer				62.00	62.00%	62.00	56.50	62.78%	56.50
B	Cost components of retailer					0.00%				
1	Loading / unloading				0.40	0.40%	62.40	0.40	0.44%	56.90
3	Transportation cost				1.00	1.00%	63.40	1.00	1.11%	57.90
4	Mandi Tax				0.62	0.62%	64.02	0.57	0.63%	58.47
5	Commission charge				3.10	3.10%	67.12	2.83	3.14%	61.29
6	Storage/rent				0.50	0.50%	67.62	0.50	0.56%	61.79
7	Spoilage at Retailer Level (15%-25%)				12.40	12.40%	80.02	11.30	12.56%	73.09
C	<i>Total</i>				18.02			16.59		
D	Retailer Margin (20%-25%)				19.98	19.98%	19.98	16.91	18.79%	90.00
E	Retailer Selling price				100.00	100.00%	100.00	90.00	100.00%	90.00
(VI)	Consumer' Purchase Price	55	100%	55	100	100%	100	90	100%	90

The price spread among different marketing channel is described below. The price spread found to be maximum in channel B is Rs. 65/-, followed by channels C and A.

Table 57: Price spread of Plum among the different marketing channels (Rs/kg)

S. No.	Particular	Channel A	Channel B	Channel C
1	Producer price	40.00	35.00	30.00
2	Consumer's price	55.00	100.00	90.00
3	Price spread	15.00	65.00	60.00
4	Producer's Share	72.73	35.00	33.33

The producer's share in Channel A is high (72.73%) as compared to that of in Channel B (35.00%), Channel C (33.33%). The more the intermediaries the more is price spread and the less is producer's share in consumers' price.

While the Channel B found to be very common, Channel C is also emerging as prominent channel because of less hassle to the farmers. The pre-harvest contractors perform all the tasks and pay the farmers a pre-determined price. Small quantities of Plum were also sold through Channel A (less than 5%). Though the farmers and consumers both have win-win situation in this Channel, it has limited scope of selling large volume of the produce.

The marketing efficiency through different channels is given below. The marketing efficiency was found to be highest in channel-A followed by channels B and C respectively. Though channel A has been found to be most efficient, but the volume transacted was very less (<5.0%).

Table 58: Marketing efficiency of Plum among the different marketing channels

S. No.	Particular	Channel A	Channel B	Channel C
1	Farmer's Price	40.00	35.00	30.00
2	Marketing cost	15.00	27.02	30.79
3	Marketing Margin	0.00	22.98	29.21
4	Marketing efficiency	2.67	0.70	0.50

As calculated above, the marketing efficiency in Channel C is lowest. The more the intermediaries, the less is the marketing efficiency. This is because of higher marketing costs and margins as the number of intermediaries increases.

4.6.6. Gaps in the Value Chain

In Himachal Pradesh plum is cultivated as traditional crop, fruits were growing in wild and under commercial plantation without much care. The gaps observed at different stages are:

i. Pre-production

- ▶ Lack of timely availability of quality planting material and inputs in terms of bio fertilizer, pesticides.
- ▶ Farmers often purchase planting material from local nurseries and are not sometime aware of the quality and variety of planting material.

ii. Production

- ▶ The major gaps observed in the production phase are lack of knowledge of scientific cultivation practices, training and pruning, disease and pest control measures.

- ▶ Manual irrigation is noticed in some nurseries and orchards
- ▶ Plum twig borer and plum fruit moth was observed
- ▶ Bacterial canker disease is reported in plum
- ▶ Lack of water resources and timely supply of quality fertilizers and pesticides were also found as major reasons for lower production and poor fruit quality.

iii. Harvesting and post-harvest

- ▶ Improper harvesting methods affect the fruit quality and shelf life as well as lead to fruit damage while transporting.
- ▶ Technical knowledge of correct stage of harvesting. Early harvested fruits do not ripen whereas late harvesting leads to spoilage.
- ▶ Lack of equipment for harvesting, bagging and collection of fruits in crates/buckets, infrastructural facilities for sorting, grading and packaging are some of the challenges.

Currently, the wastage at various levels is very high. Apart from the loss of revenue to the farmers, it leads to additional costs in the supply chain which ultimately enforces the final consumers to pay high charges.

4.6.7 Market Overview

i. Domestic Market for Plum

Plum has a very short season; a window of only around 90 days. It starts in May and ends in August in the region. In 2021 in Himachal Pradesh the season started off in May with an arrival of 4.87 MT, which shot up to 455.05 MT -almost 400 times in June and then dropped to 292.26 MT in July and the season ended. The volume of arrival is low as compared to the arrival of other fruits in Himachal Pradesh.

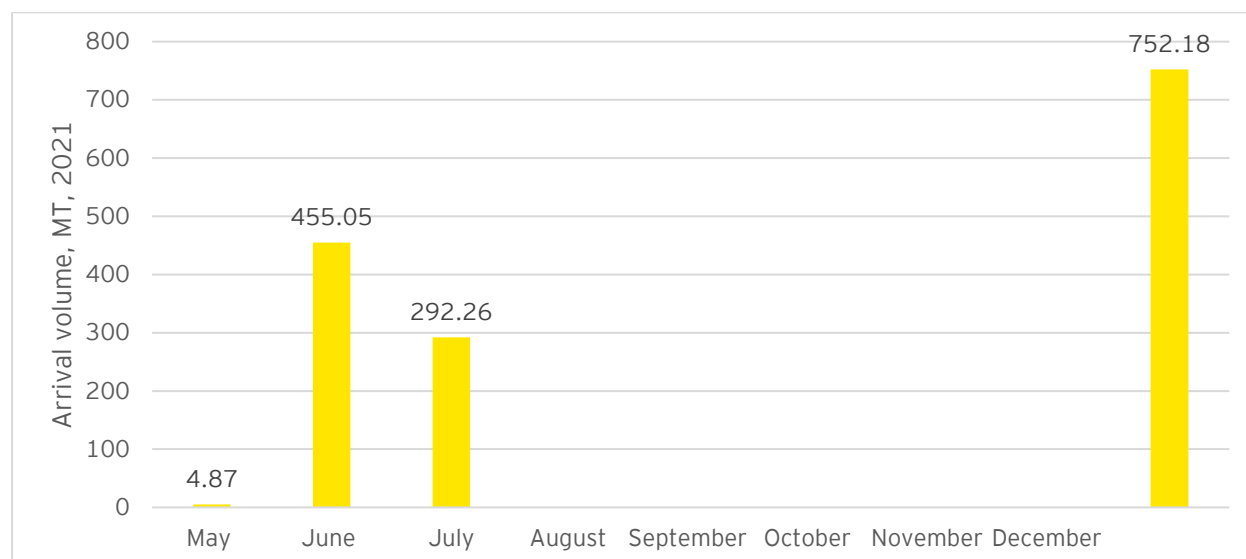


Figure 63: Arrival volume in MT for Plum in the Himachal Markets in 2021

Source: Agmarknet

The last four years data shows that there is growth of 254% in the volume of arrival since 2018 till 2021. In 2018 the arrival was 212.47 MT which rose to 752.18Mt. The trend is positive and arrival volume is likely to continue growing in the future.

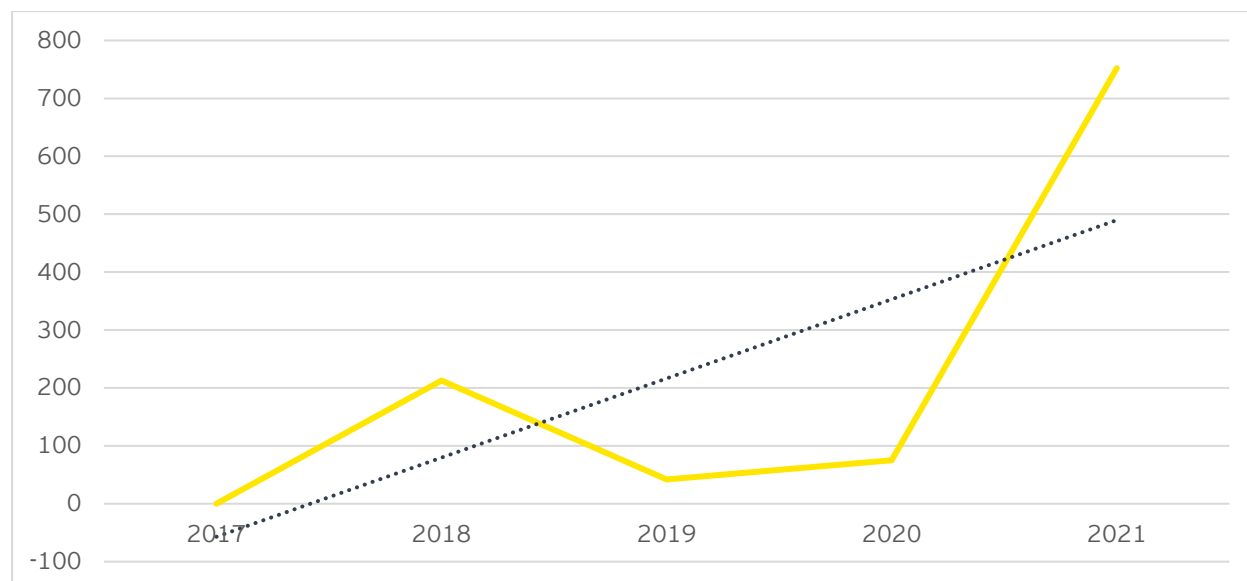


Figure 64: Trend in arrival of Plum in the markets of Himachal Pradesh in the last 5 years

Source: Agmarknet

Over the entire season in 2021 there has been a considerable variation in the modal price of Plum in the markets of Himachal Pradesh. Bhuntar APMC witnessed the highest wholesale price that year of INR69/KG followed by Mandi (Takoli) INR53/KG whilst Bandrol, Kangra and Kullu witnessed around the belt of INR 40 plus/KG. Lowest price of INR29/KG was witnessed in the same year in Chail Chowk and Rampur.

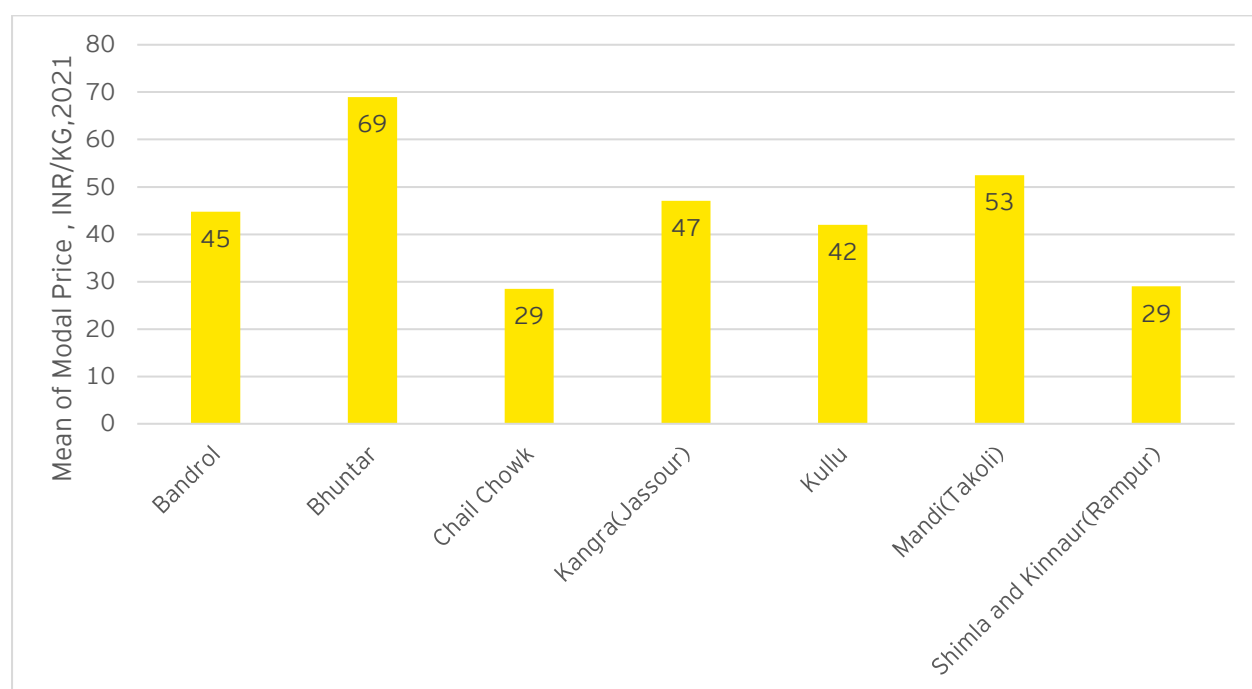


Figure 65: Mean of Modal Price of Plum in Himachal Pradesh Wholesale Markets in INR/KG, 2021

Source: Agmarknet

Analysis of wholesale price data for the past four years show that the trend is flat the mean of modal price dropped from INR50/KG to INR45/KG. The 2020 a price of INR55/KG was witnessed which dropped to INR45/KG. This due to shortage of supply in 2020 and increase in supply in 2021.

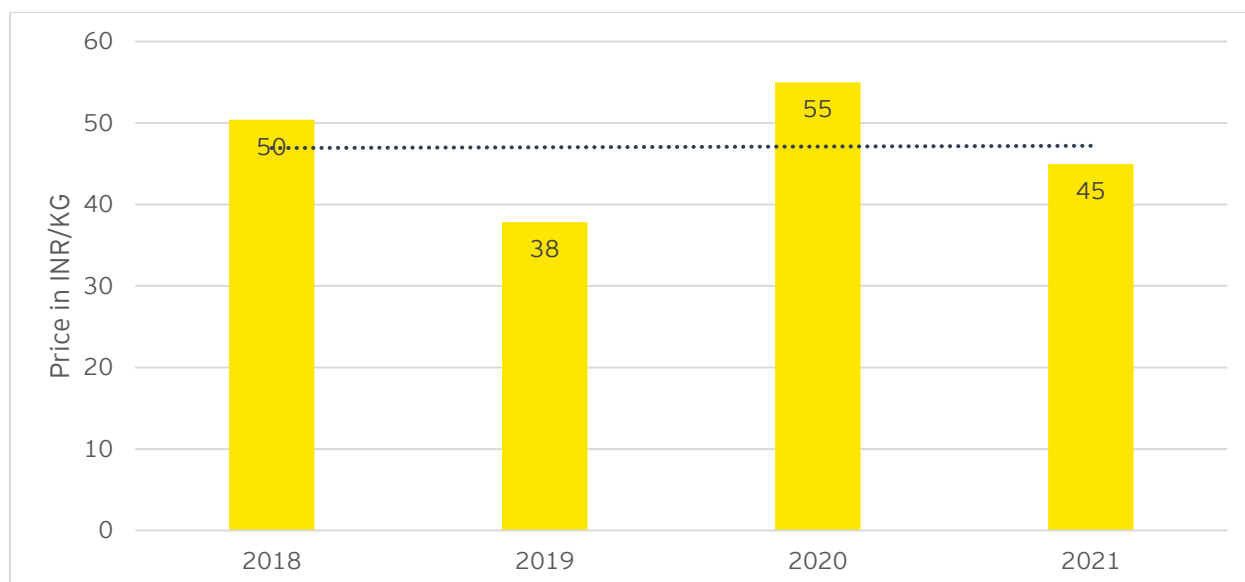


Figure 66: Price trend in the last four years in Himachal Pradesh Markets.

Source: Agmarknet

In the neighbouring J&K markets Plums arrive only in the month of August to the market in Jammu. The arrival volume has increased by 58% from 19MT in 2017 to 30MT in 2021. The trend is positive and is likely to continue with consumer demanding more plum during the month of August. August will be an important month for the producers of Himachal Pradesh to position plum in the J&K markets.

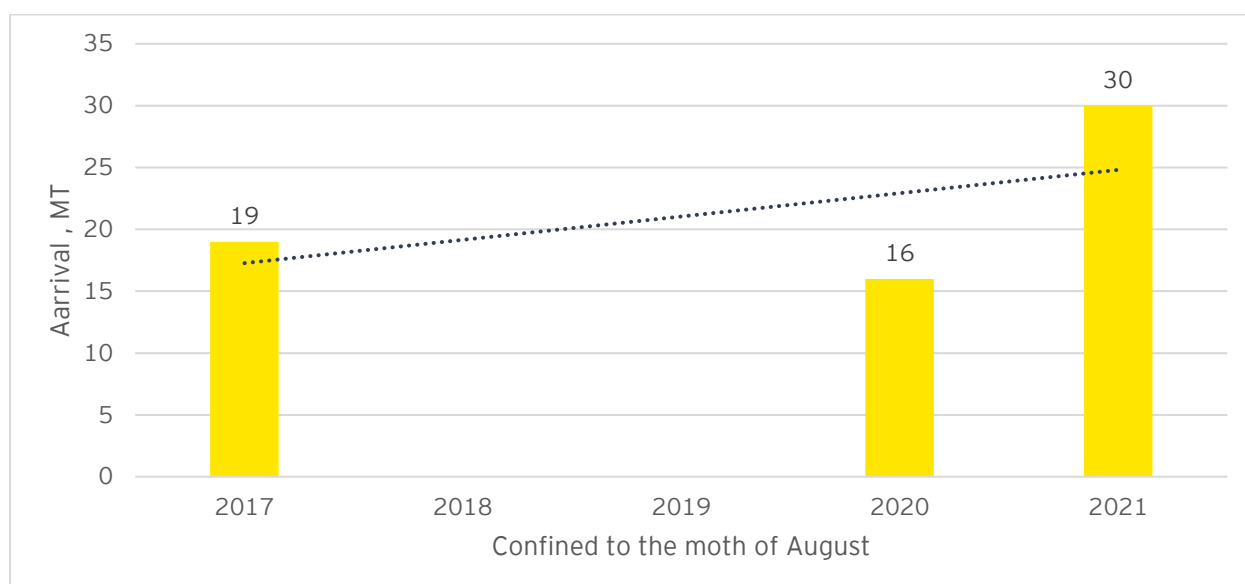


Figure 67: Arrival trend in the past five years in J&K Markets in MT

Source: Agmarknet

ii. Snapshot of International Market Analysis of Plum

Import markets

- ▶ The import market of Plum witnessed a negative annual average growth of -2% which is like B20 group of countries, which witnessed a growth rate of -1% and this trend is likely to continue.
- ▶ Brazil has shown the highest annual average growth rate of 35% followed by Poland (20%), Romania and China with 12% growth rate.
- ▶ In terms of market destination for import of volume of Plum, China, Russian Federation, Romania, and Poland are showing steep growth trends among the B20 at growth rates of 10%, 5%, 12% and 20% these steep trends will continue into future.
- ▶ All the top importers in terms of value of import will continue to grow. Out of these the top four important destination markets for Plum are China, Hong Kong China, Germany, and the Russian Federation. However, tariff and restrictions based on standards of production will play an important role in these markets.
- ▶ The other markets with positive annual average growth rates that will keep growing are Egypt, Poland, and Portugal.
- ▶ The countries paying the highest prices are all importing a large share from one of the hubs of world trade in Plum namely China and Russian Federation. In addition, EM, Kazakhstan, Brazil, Belgium, UK, and Brazil although with lower import volumes are also attractive import destination for Indian Plums.
- ▶ India has a trade deficit of and average 2,785 MT and USD 3.64 million.
- ▶ In India export volume, value, and price development of Plum experienced average volume of 3,034MT, 2,76,000 USD, and an average export price of USD 436 per MT, but with considerable variations between years.
- ▶ In addition, the average import prices are far higher than the export prices. The average import price is of USD 1,497 per MT, which is more than USD 1,061 than the export price in 2020.
- ▶ Plum export price over the over the period 2012 to 2020 is USD 552 per MT which has a growth rate of 24% so there is a high possibility of better export prices, the average import price is around USD 1,497 per MT during the same period but declining at the rate of -2.2%.
- ▶ There was a cumulative trade balance deficit of USD 6.4 million in 2020. India is trade balance deficit in value with a cumulative of USD5.5 million. Indian export must increase far more and with higher prices to overcome the trade deficit. This also an opportunity to increase exports of Indian Plums.

Suggested Export Destinations

The potential export destinations for Indian Plums are Romania, China, Poland, and Russian Federation. Brazil and Kazakhstan offer the highest price, and Netherlands. In the EM group the following are the potential countries: China, Brazil, Poland, and Egypt.

Market criteria	Priority country destination (By Growth rate and Trend)	Growth Rate and Import Price	
Higher volume	▶ Romania ▶ Poland ▶ China ▶ Russian Federation	Volume	▶ 12% ▶ 12% ▶ 10% ▶ 5%
Higher value	▶ Hong Kong China ▶ China ▶ Germany ▶ Russian Federation	Value	▶ 11% ▶ 8% ▶ 2% ▶ 4%
Higher Prices	▶ Russian Federation ▶ China ▶ Brazil ▶ Kazakhstan ▶ Netherlands	Import Price	▶ Russian Fed:USD2388/MT ▶ China: USD2329/MT ▶ Brazil: USD2096/MT ▶ Kazakhstan: USD1890/MT ▶ Netherlands: USD1704/MT
Emerging markets	▶ China ▶ Poland ▶ Egypt ▶ Brazil	Long term focus	▶ 10% volume & 8% value ▶ 12% volume & 12% value ▶ 1% volume & 7% value ▶ 35% volume & 37% value

Source: ITC Trade Maps

The detailed graphs and analysis are presented in Annexure IV

4.6.8. Proposed Interventions

i. Pre- production

Land Preparation: It is recommended to plant plum saplings raised beds of 30 to 45 cm. Pits are dug at recommended spacings; pits are of 1'x1'x1' dimension. Raised beds are compulsory for heavy soils; the width of the bed is 90 cm; the center to centre distance of the beds will be 4*4 m under high density planting. The canopy is maintained by pruning every year to eliminate plant to plant competition.

Planting: After the pits are made, sprinkle bleaching powder on to the floor and the surrounding wall of the pit (2-5 g/pit) and wet the inner surface by spraying water. Pits are to be filled at least a week before planting of the saplings. Pit filling is done by a 1:3 mixture of FYM and garden soil plus 250g SSP, 5g Phorate, and 1kg Neem cake. Hardened plants come in polybags transported by trucks. These plants should be unloaded and kept under shade for about 24-30 hours before planting. They should not be kept under dark or in an enclosure. Sprinkle water to keep the growing media in the polybags wet. At planting cut the polybag vertically without damaging the root system and disturbing the surrounding medium. Keep the plant along with the growing medium carefully at the centre of the pit (by wading the filled-up material to the sides of the pit) and press the soil mixture gently all around the base of the sapling.

ii. Production

Irrigation: Irrigation to be provided with drip system. Plums are shallow rooted and fast-growing plants hence need sufficient moisture during growing period. Frequent irrigation at weekly interval may be applied during April, May, and June. No irrigation at full bloom stage and the ripening stage be given to avoid flower and fruit drop. During rainy season no irrigation is required. The interval may increase to 20 days in September, October, and November. There should be no irrigation given during December and January months. The average annual water requirement through drip irrigation is 20 cm. Drip irrigation helps to save on irrigation and helps to increase the yield by 30-35%.

Nutrient Management: Since plum trees grow fast, they require nutrition to maintain growth. Apply farmyard manure, super phosphate, and muriate of potash in December. Nitrogenous fertilizer (urea) should be split in to two halves. Apply one half in February and second half in April. In addition, the plum trees may be sprayed with a mixture of Zinc Sulphate plus ferrous Sulphate. Both should be of chemical grade. Spray 1 1/2kg zinc Sulphate plus 1 1/2kg ferrous sulphate plus 1 1/2kg un-slaked lime in 500 litres of water during March just when fruits have become pea sized.

Training and Pruning: Plum trees should be trained according to modified leader system. The top growing shoot is headed back at planting time at a height of 90cm. The scaffolds selected at a height of 40cm and above are also headed back in January to get branching. During the first two years selection of secondary branches on the scaffolds is also carried out. In the third year the top growing leader should be removed from a point of our growing scaffold, during January. Thin out some of the side branches and criss-crossing shoots. The small spurs formed during these years on shoots start flowering. Water shoots sprouting on the main trunk should be removed immediately.

Normally no pruning may be given in the first year of bearing. A little pruning to the out growing branches may be done in fifth year onward. The severity of pruning depends upon the planting distance.

Disease and Pest Management: Stem and shoot borers causing damage to plum can be controlled by inserting 0.5g of PDCB (paradichlorobenzene) into the holes and plugging them with mud.

Powdery mildew disease can be kept under check by pruning and spraying wettable sulphur (0.2-0.3%) during dormancy, bud swell and petal fall stages.

Inter-cropping: In plum orchards, inter crops can be grown for the first 2-3 years. The legumes like peas, grams, moong, or vegetables can be taken up. Water needs of intercrops should be such that also favour plum growth and fruiting.

iii. Harvest and Post- harvest

Maturity Indices: In free-stone cultivars of plum, pit browning up to 5% of the pit area is a good index of maturity. Santa Rosa requires 115-120 days.

Harvesting: The plum fruits are mature when these have attained proper size and developed proper colour depending upon the cultivar. The plum fruits are harvested in HP in June-July. For local marketing fruits should be harvested when ripe and firm. For distant markets, fruits are picked when firm but have developed 50% colour on the skin. Plum should be harvested along with pedicels avoiding any injury to the fruit.

The small baskets should be padded with rice trash or grass at the bottom and sides. Freshly harvested fruits are transferred in these baskets and covered with paper and tied in gunny cloth. The fruits should be graded before packing in basket or wooden boxes. Several pickings are made as the entire fruit on a tree do not ripen at one time. Fruit is borne on spurs also so care should be taken to the save the spurs from breakage, during harvesting.

Harvesting time: Early morning or evening hours is the most suitable time for harvesting to avoid accumulation of field heat.

Sorting: Cracked, split, diseased and infested fruits are removed which is done manually by trained sorter.

Grading: Presently, manual grading is done by the farmers in orchard.

Table 59: Plum Grades

S.No.	Grade	Characters
1	Special	4.2 cm and above (diameter)

2	Grade 1	3.6 to 4.2 cm (diameter)
3	Grade 2	Below 3.6 cm

Packaging: For distant markets wooden boxes are preferred over basket. To save fruits from injury each layer of fruit is covered with paper strips and newspaper sheet. Finally, the lid of the box is nailed.

Marketing and Branding:

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.7. Value chain Analysis of Mango

4.7.1 Overview

i. Global Scenario

In 2019, India contributed about 45.89% of the global production and is the largest producer of mangoes globally. The other major producers of mango include Indonesia, China, Mexico, Pakistan, Malawi, Brazil, Thailand and Egypt. However, in terms of export value of mango, India ranks at 8th position (2020) with a 3.67% share in export value of fresh mangoes, where Thailand is the top exporter in the world with 15.25% export value⁴⁹. The 5 major export destination for Indian Mangoes in 2018-19 were UAE, UK, Oman, Qatar, and USA⁵⁰.

ii. Indian Scenario

In 2019-20, India produced 20.26 million MT of mangoes wherein Uttar Pradesh 23.4% of the total country production followed by Andhra Pradesh (23.1%), Karnataka, Bihar, and Telangana. During the same year mango production in Himachal Pradesh was 0.15% (31,879 MT) of the national production.⁵¹

4.7.2 Mango Production in Himachal Pradesh

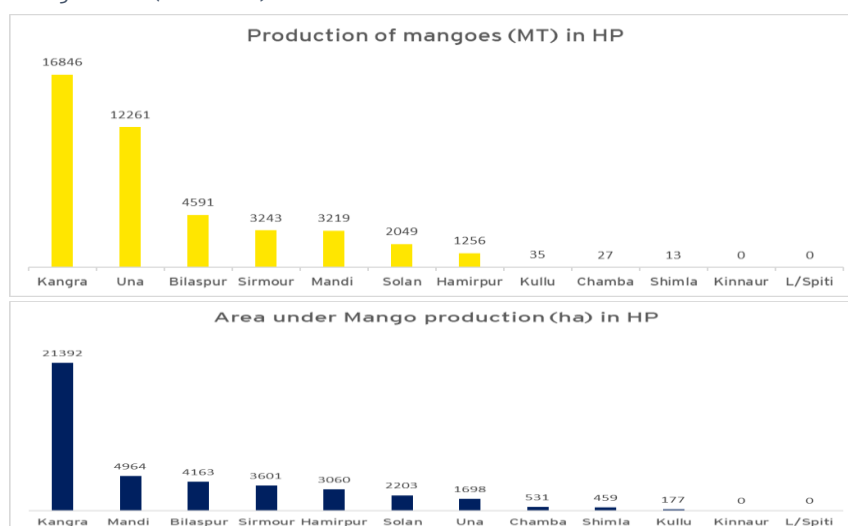
i. Area and Production

Evident from the figure below, that Kangra, Una and Bilaspur are the top 3 mango producing district in Himachal Pradesh. Further, Kangra has the highest area under mango cultivation followed by Mandi and Bilaspur. However, it should be noted that even after having the second largest area under mango cultivation in the state, Mandi lags in production due to low productivity of 0.65 MT / Ha, on the other hand Una benefits from highest productivity and has 2nd largest mango production even after being 7th in terms of area under cultivation.

Table 60: Productivity (MT/ha) of mango in HP (2018-19)

Districts in HP	Productivity (MT/Ha)
Una	7.22
Bilaspur	1.10
Solan	0.93
Sirmour	0.90
Kangra	0.79
Mandi	0.65
Hamirpur	0.41
Kullu	0.20
Chamba	0.05
Shimla	0.03
Kinnaur	0.00
L/Spiti	0.00
Total	1.03

Source: Department of Horticulture



⁴⁹<https://www.tridge.com/intelligences/mango/production>

⁵⁰<https://theprint.in/india/as-indias-mango-exports-to-us-resume-traders-hope-smoother-pre-clearance-measures-will-help/801932/>

⁵¹ Horticulture Statistics Division DAC&FW;

https://www.tnagrisnet.tn.gov.in/dashboard/report/01_23.pdf

ii. Mango varieties

In India about 1,500 varieties of mango are grown which includes 1,000 commercial varieties. Based on the time of ripening, mangoes are classified as -

The major varieties selected for the state include Mallika (hybrid of Neelum and Dashehari) and Pusa Arunima (hybrid of Amrapali and Sensation). The key characteristics of Mallika cultivar are as follows:

- ▶ Smaller trees, hence more trees per acre
- ▶ Mallika cultivar starts bearing fruit after 3 years and bears fruit every year thereafter
- ▶ The fruits are fibreless, sweet and firm with skin and flesh having an attractive colour

The key characteristics of Pusa Arunima cultivar are as follows⁵²:

- ▶ Hybrid derived from the cross between Amrapali and Sensation.
- ▶ The plants are semi-vigorous and are suitable for closer planting (6 m x 6 m).
- ▶ It is a regular bearer and starts bearing after 4 years of planting.
- ▶ It ripens late in the season and its fruits are ready for harvesting by 1st week of August.
- ▶ The fruit size is medium (250 g) having attractive red peel colour.
- ▶ It has medium total soluble solids (19.5oBrix), rich in vitamin 'C' (43.6 mg/ 100 g pulp) and good β carotene content.
- ▶ It has good flavour with very long shelf-life (10-12 days) at room temperature after ripening.

iii. Seasonality

Mallika is harvested from July 3rd week - August 2nd week, and Pusa Arunima is harvested from 3rd week of August till 2nd week of September.

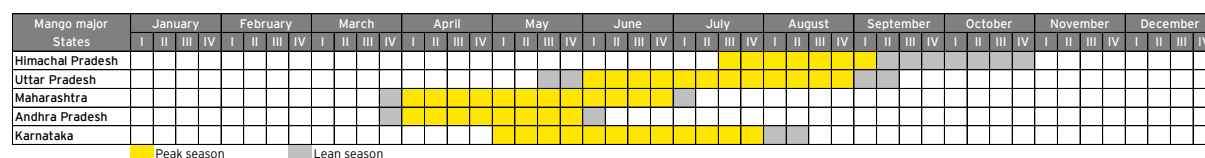


Figure 68: Mango harvesting season in major states

Source: EY Analysis

⁵²[http://agrinovateindia.com/subTechnologyDescription?id=422&Subtitle=Mango%20variety:%20Pusa%20Arunima%20&Techtitle=ICAR-Indian%20Agricultural%20Research%20Institute%20\(IARI\)](http://agrinovateindia.com/subTechnologyDescription?id=422&Subtitle=Mango%20variety:%20Pusa%20Arunima%20&Techtitle=ICAR-Indian%20Agricultural%20Research%20Institute%20(IARI))

4.7.3 SWOT Analysis of Mango Value Chain

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Mango Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 61: SWOT Analysis for Mango Value Chain in Himachal Pradesh

Strengths ▶ Harvesting of mango late in season, last week of July to mid-August, is favorable for better price realization, considering that there is no supply from major growing region.	Weakness ▶ Mango is very sensitive to both harsh summer temperature and winter frosts. ▶ Availability of disease-free quality material in adequate quantity for expansion of area is not there in the region. ▶ High humidity and rains during fruit development may lead to losses due to mould blackening.
Opportunities ▶ Proven cultivation of late varieties like Mallika and Pusa Arunima gives marketing advantage. ▶ There is an ample opportunity for skillful employment in growing, post-harvest handling, value addition and marketing of mango, leading to economic development of the region. ▶ The extended harvesting and less competition in the market may result in better prices	Threats ▶ Mango is highly sensitive to frost occurrence at the time of flowering. Frost may kill vegetative growth and flowering leading to complete loss. ▶ If competitive market advantage of mango is not harnessed, it will affect the development of the region.

4.7.4 Value Chain Analysis

i. Commodity flow analysis

The key players involved in mango value chain include -

- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Wholesalers
- ▶ Traders
- ▶ Processors
- ▶ Retailers

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified 4 main channels in the study area:

- ▶ Channel -A Producer → Consumer
- ▶ Channel -B Producer → Wholesaler → Retailer → Consumer
- ▶ Channel -C Producer → Pre-harvest contractor → Wholesaler/processor → Retailer → Consumer
- ▶ Channel-D Producer → Traders → Processing unit → Retailer → Consumer

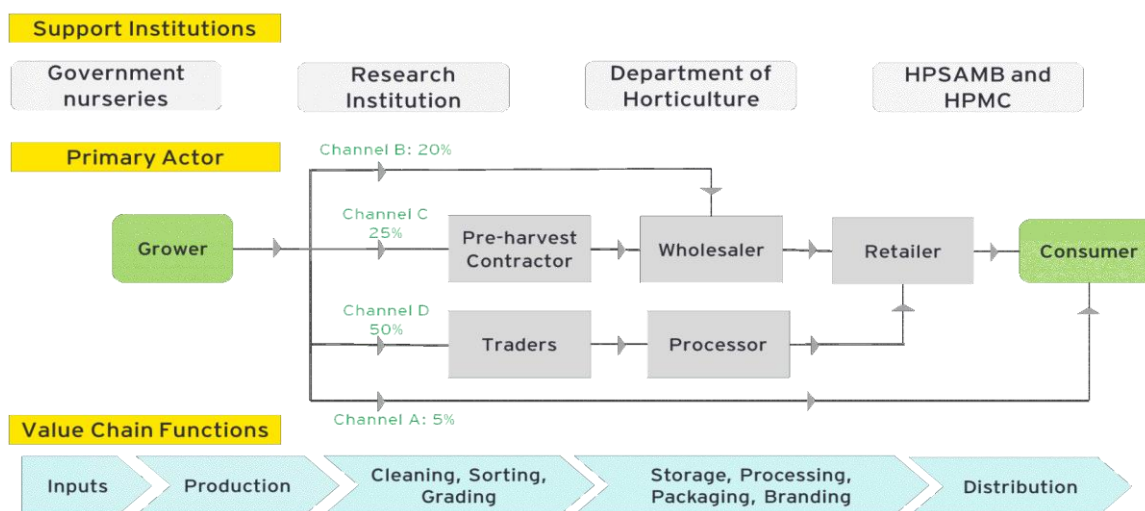


Figure 69: Commodity flow analysis through various channels

Channel A: This channel was used by the farmers/growers at a very limited scale (<5%), mainly to meet the short-term cash requirement at the household. Sometimes, the farmers themselves bring the produce in the nearby markets or put a stall in the market to sell directly to the consumers. Depending on the cash requirement, the farmers harvest the fruits and bring them to the market. In such cases, the transport is arranged by the farmers themselves. In this channel also the farmers have limited bargaining power.

Channel B: In certain cases, the farmers directly sell to distant wholesalers in Delhi, Mumbai and far away distance. This channel is normally opted by bigger farmers who have larger volume of fruit produce, and who have ability to organize and market the fruit produce of fellow farmers. In such cases, the price negotiation is done beforehand, normally over phone. Based on that the harvested fruits produce is brought to the market. The traders sometimes sell the produce to local retailers through which it finally reaches the consumers.

Channel C: In this channel, the pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. They inspect the field, forecast the estimated production, and then negotiate price with the farmers. Thereafter, the contractors become responsible for all risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce.

Channel D: This was another common marketing channel observed during the field assessment. The traders normally visit the farms during the harvesting season and fix a price of the Mango for whole farm. Afterward, they organize harvesting, sorting, loading and transportation.

ii. Value Chain Activities

Pre-Production

Mango can be propagated from seed or propagated vegetatively. Plants are generally propagated vegetatively by using several techniques like veneer grafting, inarching and epicotyl grafting etc. Traditional planting of mango is usually done in the month of June-August at the spacing of 10m * 10 m.

Production

Intercultural operations: Training of plants in the initial stages of growth is very important to give them a proper shape specially in cases where the graft has branched too low. Pruning is generally not adopted due to lack of awareness. No chemicals are used for weed control; de-weeding by hand is the norm.

The frequency and amount of irrigation to be provided depends on the type of soil, prevailing climatic conditions, rainfall and its distribution and lastly the age of the trees.

Pest and diseases: Insect pests mostly observed are mealy bug, hopper, inflorescence midge, fruit fly and scale insects. For controlling these insects, spraying with pesticides is done. The crop is susceptible to diseases like powdery mildew, anthracnose, die back, blight, red rust, sooty mould, etc. Spraying of appropriate chemicals/fungicides is done to control the diseases.

The common pests encountered in mango farms of Uttar Pradesh are mango hopper, mealy bug, fruit fly and tent caterpillar. The common diseases are powdery mildew, anthracnose, stem-end rot and bacterial canker. These pests and diseases affect the quality and price of the commodity. The pre-harvest control methods used for pest and diseases are spraying of pesticides and fungicides. The residues of chemical treatment are highly hazardous especially applications of monocrotophos and chloropyrifos. The spraying of chemicals is done on a random basis and the frequency is based on field conditions.

Harvesting Activities

The fruits are generally harvested early in the season at a pre-mature stage to capture early market. Such fruits are ripened by uniformly dipping in 750 ppm. ethrel (1.8ml./l.) in hot water at 52±20 C for 5 minutes. within 4-8 days under ambient conditions.

Post-Harvesting Activities

Mature fruits are ripened with lower doses of ethrel for uniform colour development. Grading is mainly based on the size, colour and maturity of the fruits. While grading, smaller fruits are separated from the larger ones in order to achieve uniform ripening. Immature, overripe, damaged, and diseased fruits are discarded in the process of grading.

4.7.5 Cost Economics and Price Build up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and discussions with concerned stakeholders. All the values are considered at constant prices without inflation. The initial cost of Mango plantation in 1st year is INR 5.30 lakhs, and in subsequent years range from INR 0.96 lakhs/ha to INR 3.02 lakh/ha. The table on cost of production is given below.

Table 62: Mango Cost of cultivation breakup per hectare

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Input Cost															
Land clearing and development	1,00,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pit augering (@Rs.50/- per pit for 1111 pits)	55,550	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mulching (including labour) (@Rs.32 per running metre for 2.5 metre per plant	88,880	-	-	-	-	88,880	-	-	-	-	88,880	-	-	-	-
Planting material	55,550	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting equipment and tools	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micro-irrigation system and installation	1,20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm yard manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertilizer	15,000	15,000	18,000	21,000	24,000	27,000	30,000	32,000	34,000	35,000	35,000	35,000	35,000	35,000	35,000
IPDM and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,000	3,000	3,000	3,000	3,000
Mango boxes Rs 10 Per 5 Kg	-	-	-	22,220	33,330	44,440	55,550	66,660	77,770	77,770	77,770	77,770	77,770	77,770	77,770
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour Cost	74095	75110	75110	77140	78155	79170	82215	84245	85260	86275	86275	86275	86275	86275	86275
Cost of Mango Production (Rs./ha)	5,30,630	96,665	1,03,026	1,33,193	1,48,568	2,52,823	1,81,348	1,96,738	2,11,113	2,13,378	3,02,258	2,13,378	2,13,378	2,13,378	2,13,378

Table 63: Annual revenue per hectare from mango cultivation (INR)

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (Kg/ha)	-	-	-	11,110	16,665	22,220	27,775	33,330	38,885	38,885	38,885	38,885	38,885	38,885	38,885
Return from Mango Cultivation (Rs./Ha)	-	-	0	444400	666600	888800	1111000	1333200	1555400	1555400	1555400	1555400	1555400	1555400	1555400
Benefit Cost Ratio	-	-	0.00	3.34	4.49	3.52	6.13	6.78	7.37	7.29	5.15	7.29	7.29	7.29	7.29

The labour component is major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers. There is cost spike in 6 and 11 years, basically due to replacement of mulch.

The table below explains different cost of cultivation in percentage.

Table 64: Year wise cost of mango cultivation components in percentage of total cost

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	18.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pit augering	10.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching sheet	16.7%	0.0%	0.0%	0.0%	0.0%	35.2%	0.0%	0.0%	0.0%	0.0%	29.4%	0.0%	0.0%	0.0%	0.0%
Planting Material	10.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting equipment and tools	2.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Micro irrigation system and Installation	22.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FYM	1.0%	5.7%	6.5%	6.3%	5.6%	3.3%	4.6%	4.2%	3.9%	3.9%	2.8%	3.9%	3.9%	3.9%	3.9%
Fertilizer	2.8%	15.5%	17.5%	15.8%	16.2%	10.7%	16.5%	16.3%	16.1%	16.4%	11.6%	16.4%	16.4%	16.4%	16.4%
IPDM and growth hormones	0.2%	1.0%	1.2%	1.1%	1.2%	0.8%	1.2%	1.3%	1.3%	1.4%	1.0%	1.4%	1.4%	1.4%	1.4%
Mango boxes	0.0%	0.0%	0.0%	16.7%	22.4%	17.6%	30.6%	33.9%	36.8%	36.4%	25.7%	36.4%	36.4%	36.4%	36.4%
Irrigation system maintenance	0.0%	0.0%	1.9%	2.3%	2.0%	1.2%	1.7%	1.5%	1.4%	1.4%	1.0%	1.4%	1.4%	1.4%	1.4%
Labour Cost	14.0%	77.7%	72.9%	57.9%	52.6%	31.3%	45.3%	42.8%	40.4%	40.4%	28.5%	40.4%	40.4%	40.4%	40.4%

Mango starts fruiting from 3rd year and achieve optimum yield in 9th year. The annual return for the farmers ranges from INR 4.4 lakhs to INR 15.5 lakhs per hectare per annum.

ii. Price Build-up and market margins of Mango

The price builds up analysis is presented below for the 4 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders and also validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 65: Marketing costs and margins of different functionaries in the various marketing channels of Mango (INR/kg)

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		In Rs.	in %	Price built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price built-up	In Rs.	in %	Price-built-up
(I)	Marketing cost incurred by the producers												
1	Net price received by the farmer	30.00	60.00%	30.00	28.00	37.33%	28.00	25.00	34.72%	25.00	25.00	34.72%	25.00
2	Transportation cost	3.00	6.00%	33.00	3.00	4.00%	31.00						
3	Cost of Packing Materials	0.50	1.00%	33.50	0.50	0.67%	31.50						
4	Cost of basket	0.50	1.00%	34.00	0.50	0.67%	32.00						
5	Loading / unloading	2.00	4.00%	36.00	2.00	2.67%	34.00						
6	Spoilage (approx. 10%-15%)	4.00	8.00%	40.00	4.00	5.33%	38.00						
	Total	10.00			10.00								
	Farmer's selling price	40.00	80.00%	40.00	38.00	50.67%	38.00	25.00	34.72%	25.00	25.00	34.72%	25.00
(II)	Marketing cost incurred by the pre-harvest contractor/Traders												
	Gross price paid by the pre-harvest contractor							25.00	34.72%	25.00	25.00	34.72%	25.00
1	Loading / unloading							0.50	0.69%	25.50	0.50	0.69%	25.50
2	Packing material cost							0.50	0.69%	26.00	0.50	0.69%	26.00
3	Transportation cost							1.00	1.39%	27.00	1.00	1.39%	27.00
4	Mandi Tax							0.25	0.35%	27.25	0.25	0.35%	27.25

[illegible]

S. No.	Particular	Channel A			Channel B			Channel C			Channel D		
		<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price built-up</i>	<i>In Rs.</i>	<i>in %</i>	<i>Price-built-up</i>
A	The gross price paid by retailer				50.00	66.67%	50.00	47.00	65.28%	47.00	47.00	65.28%	47.00
B	Cost components of retailer												
1	Loading / unloading				0.50	0.67%	50.50	0.50	0.69%	47.50	0.50	0.69%	47.50
2	Transportation cost				2.00	2.67%	52.50	2.00	2.78%	49.50	2.00	2.78%	49.50
3	Mandi Tax				0.50	0.67%	53.00	0.47	0.65%	49.97	0.47	0.65%	49.97
4	Commission charge				2.50	3.33%	55.50	2.35	3.26%	52.32	2.35	3.26%	52.32
5	Packaging Charge				2.00	2.67%	57.50	2.00	2.78%	54.32	2.00	2.78%	54.32
6	Spoilage at Retailer level (20%)				10.00	13.33%	67.50	9.40	13.06%	63.72	9.40	13.06%	63.72
C	Total				17.50			16.72			16.72		
D	Retailer Margin (10%-15%)				7.50	10.00%	75.00	8.28	11.50%	72.00	8.28	11.50%	72.00
(V)	Consumer' Purchase Price	40.00	80.00%	40.00	75.00	100.00 %	75.00	72.00	100.00 %	72.00	72.00	100.00 %	72.00

The price spread among different marketing channel is described below. The price spread found to be same in case of channel B, C and D i.e., INR 47, followed by channel A.

Table 66: Price spread of Mango among the different marketing channels (INR/kg)

S. No.	Particular	Channel A	Channel B	Channel C	Channel D
1	Producer price	30.00	28.00	25.00	25.00
2	Consumer's price	40.00	75.00	72.00	72.00
3	Price spread	10.00	47.00	47.00	47.00
4	Producer's Share in consumer rupee (%)	75.00	37.33	34.72	34.72

The producer's share in Channel A is high (75%) as compared to that of in Channel B (37.33%), Channel C (34.72%) and Channel D (34.72%).

The marketing efficiency through different channels are given below. The marketing efficiency was found to be highest in channel-A followed by channels B and C respectively. Though channel A has been found to be most efficient, but the volume transacted was very less (<5.0%).

Table 67: Marketing efficiency of Mango among the different marketing channels

S. No.	Particular	Channel A	Channel B	Channel C	Channel D
1	Farmer's Price	30.00	28.00	25.00	25.00
2	Marketing cost	10.00	35.08	30.32	30.32
3	Marketing Margin	0.00	11.92	16.68	16.68
4	Marketing efficiency	3.00	0.60	0.53	0.53

4.7.6 Gaps in the Value Chain

i. Pre-production

- ▶ Planting materials are available as mono-embryonic seeds and grafts, 1-2-year-old, which are ready for transfer to the field. There is a specific need of planting material of dwarf varieties which will reduce harvesting losses considerably. The principal sources of planting material are nurseries maintained by private owners, government, and universities.
- ▶ The planting material is readily available. The quality of planting material, mostly as grafts was satisfactory. The survival rate of planting material was noted at 80-100 percent.
- ▶ The principal complaint from the farmers regarding planting material -
 - ▶ No credit is available to the farmers for purchase of planting material
 - ▶ Sometimes there is a shortage of supply of planting material at proper time of the year as mentioned by some growers
 - ▶ The saplings have to be moved from nursery to field within 2-3 days at the time of plantation

ii. Production

- ▶ Lack of training for production practises along with attack of pest and diseases, occurrence of frost damages young fruits.
- ▶ The land holdings are small and fragmented. It was observed that farmers are either planting lesser number of plants in their backyard or in the farming fields, thereby having difficulties in reaching to economic threshold.
- ▶ Due to lack of soil testing and knowledge about the soil quality, appropriate quality and quantity of compost/ fertilizers are not being used.
- ▶ Lack of finance, poor quality inputs, inadequate access to market, challenges of findings labourers at fair price.
- ▶ Mango mealy bug was observed in the fields
- ▶ Stem borer is noticed in some of the orchards

iii. Harvesting and post-harvest

- ▶ The harvesting is done manually using the harvester. Sometimes the manual harvesters are used without the netted bag.
- ▶ No de-sapping of mango is practised which leads unpleasant marks on the fruits.
- ▶ Traditional methods of harvesting may lead to bruising and post-harvest losses.
- ▶ Labour cost for harvesting and post-harvest activities very high.

4.7.7 Market Overview

i. Domestic Market for Mango

The arrival of Mango in Himachal Pradesh Markets began in the month of March with and entry of 2.71 MT mangos, which peaked to 1496.66 MT in the month of July finally ending the season in the month of August in 2021 with 122.17 MT. The total arrival in 2021 was 2024 MT.

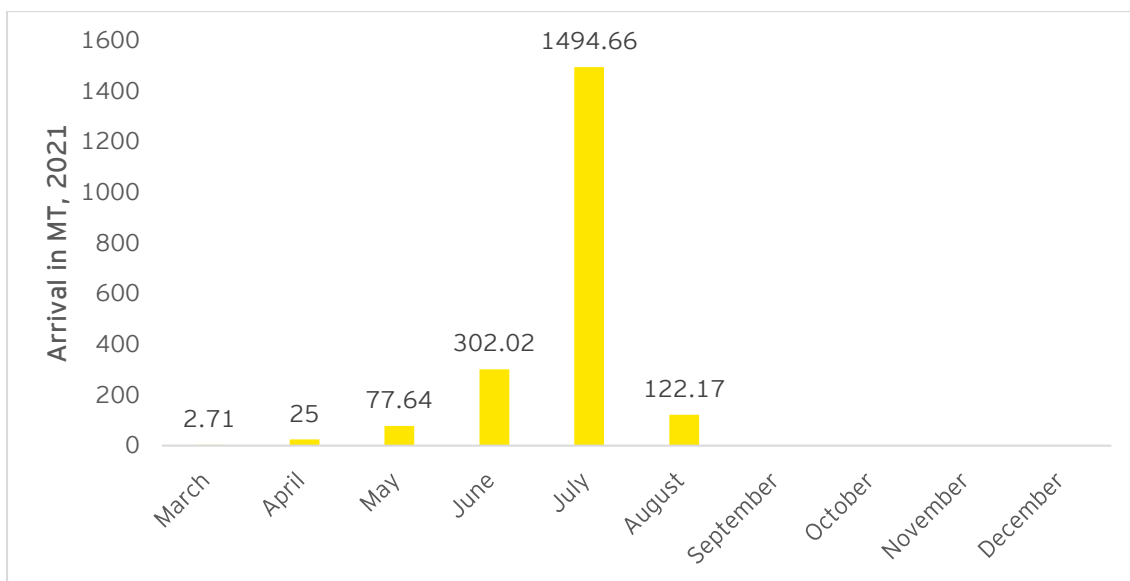


Figure 70: Arrival of Mango in the markets of Himachal Pradesh in 2021 in MT

Source: Agmarknet

During the same year in 2021 the mean of modal prices at the wholesale markets show that Hamirpur (Nadaun) witnessed the highest price of INR 63.99/KG followed by Hamirpur (INR 61.14/KG), Kangra (Balajinath) and Kangra (Jaisinghpur) with INR 54.32/KG and INR 53.19/KG. The lowest price witnessed was in the market of Dhanotu, INR 20.88/KG. These prices are also reflection of the bided prices as per the volume of arrival.

The Mango arrival trend in the last 6 years seems to be in an increasing trend and is likely to continue in the future. In 2017 a very low volume arrived to the markets in Himachal Pradesh compared to the previous year. However, the volume picked up the subsequent year. In 2021 it witnessed an arrival volume of 2024.2 MT.

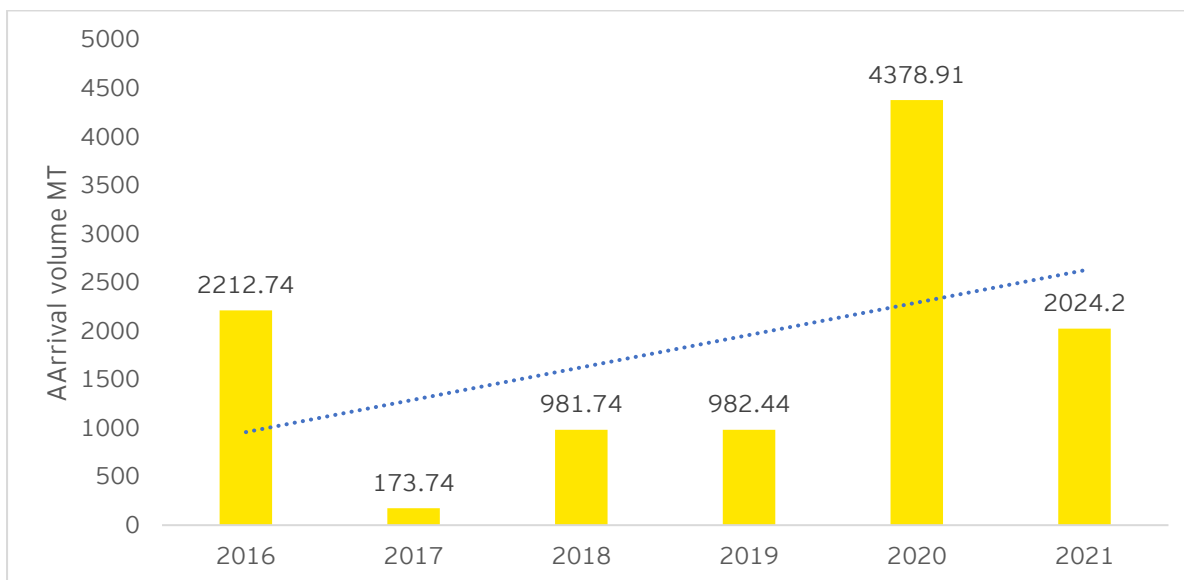


Figure 71: Mango arrival volume in MT (2016-21)

Source: Agmarknet

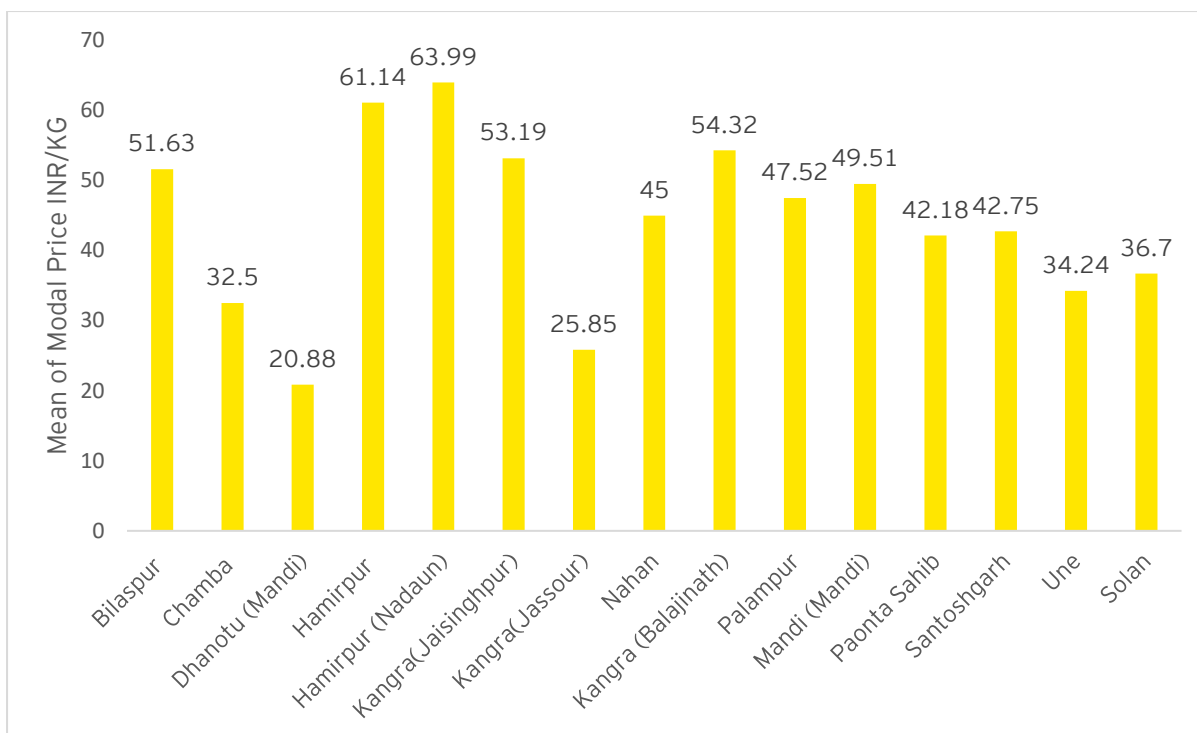


Figure 72: Mean of Modal Price of Mango per KG in the Markets of Himachal Pradesh, 2021

Source: Agmarknet

The mean of the modal price trend since the past five years, or the past ten years seems to be increasing every year and this trend will perhaps continue to grow.

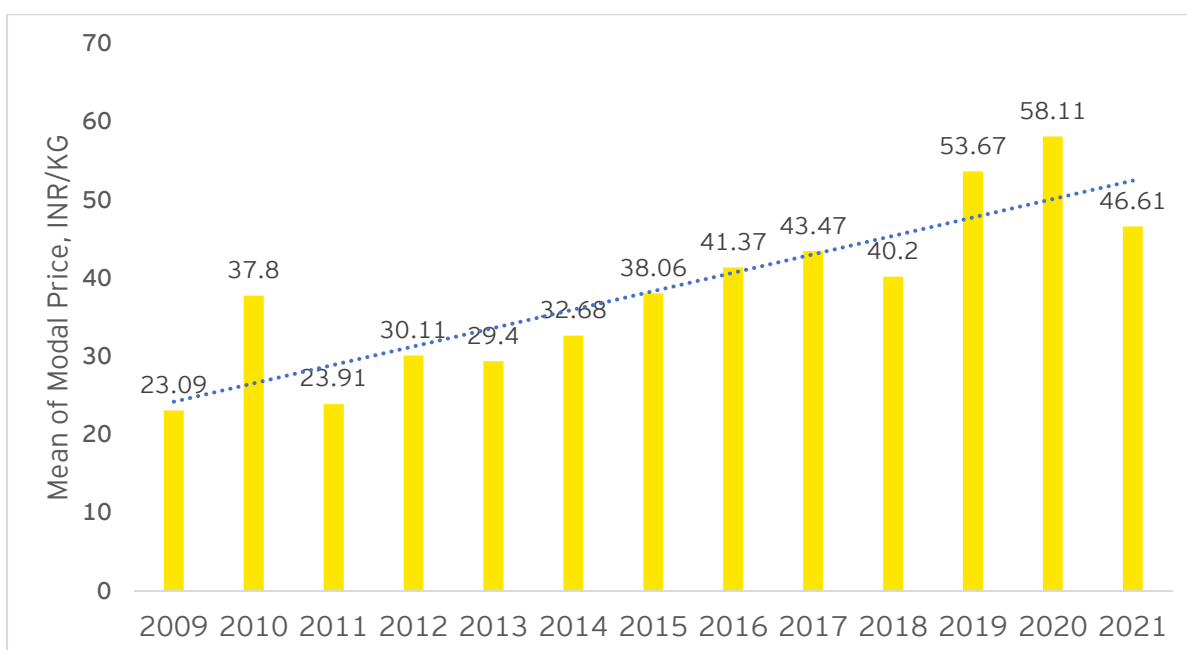


Figure 73: Growth trend in the mean of the modal price in INR/KG of Mango in Himachal Pradesh

Source: Agmarknet

In the neighbouring Azadpur Mandi in Delhi, which is one of the largest wholesale yards in the region the arrival of mango began in January and gradually peaked to 55300 MT in the month of June and then declined to around 7721.6 MT and further as the season ends in December.

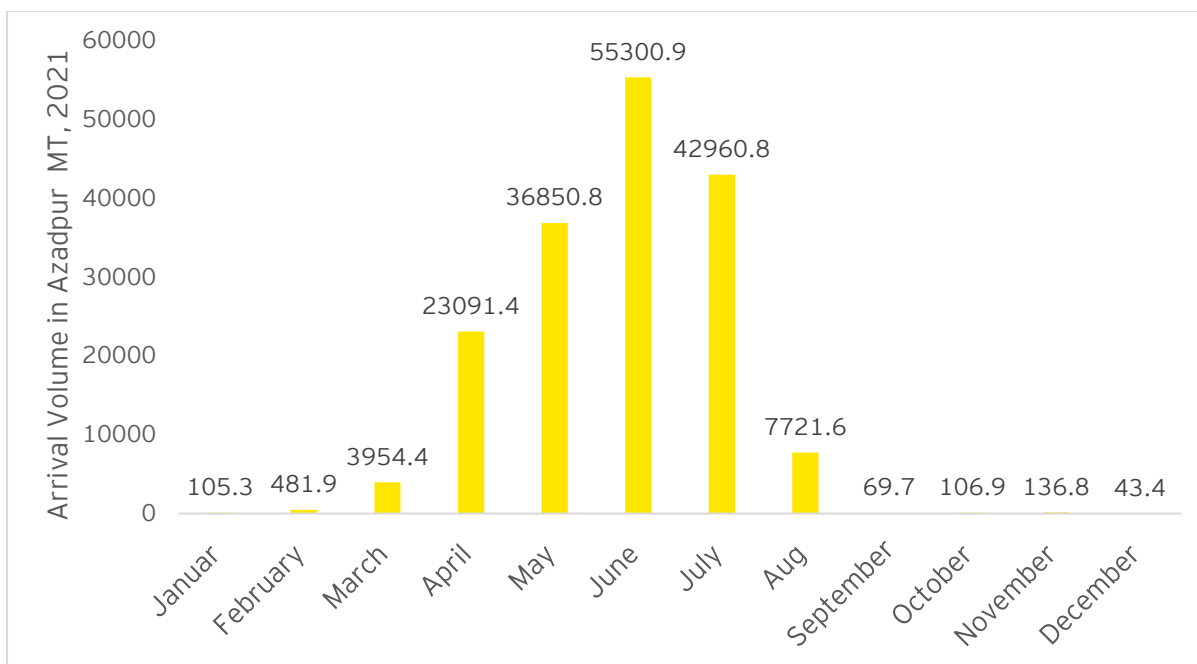


Figure 74: Seasonal variation in arrival volume of Mango in the Azadpur Mandi, 2021

Source: Agmarknet

The other neighbouring domestic market is J&K where the season began in March with a starting arrival of 511.6 MT in 2021, which increased gradually and peaked to 3,165.9 MT in July and then declined to 1,269 MT in August when the season ended.

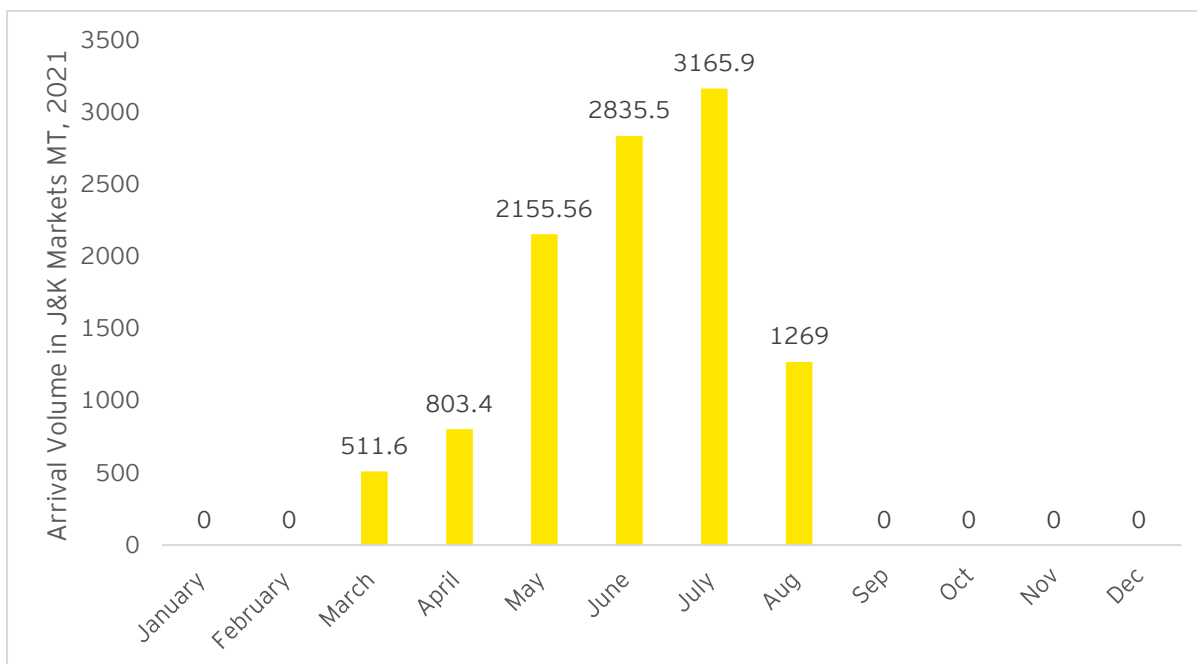


Figure 75: Seasonal variation in arrival volume of Mango in the J&K Markets, 2021

Source: Agmarknet

In J&K the arrival data shows that Nawal Jammu market had the highest arrival of Mango that year in J&K followed by Samba and Kathra markets.

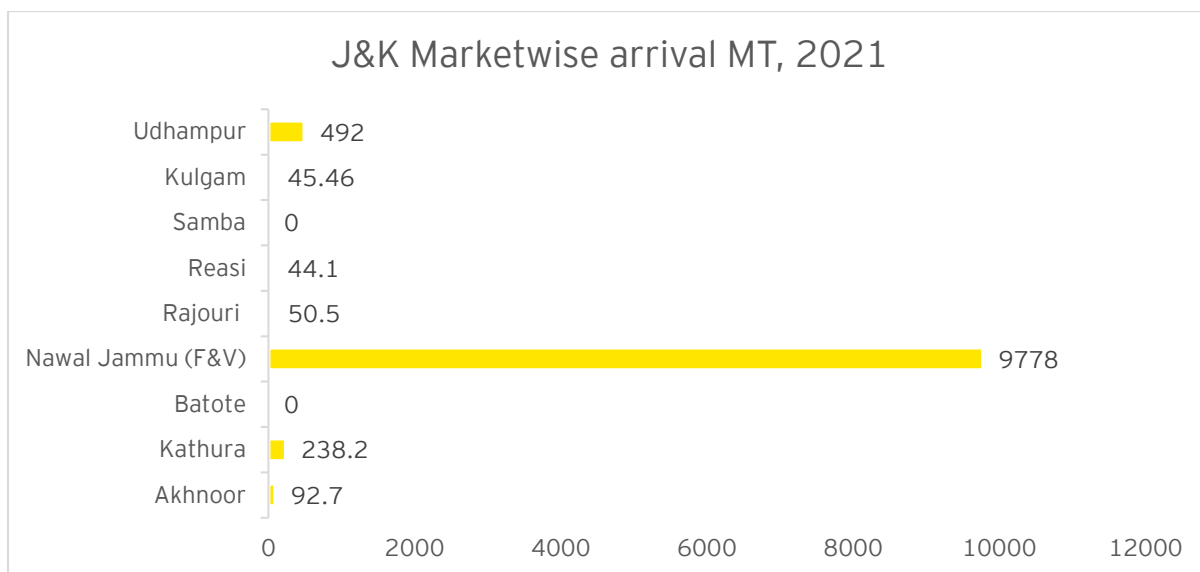


Figure 76: Share of the arrival volume of Mango in various markets of J&K in 2021

Source: Agmarknet

The mean of the modal price started off high in the month of March when volumes were low to around INR 9,544/Qtl and gradually declined as the volumes increased and then shot up to INR 9,888/MT when the season closed in August 2021.

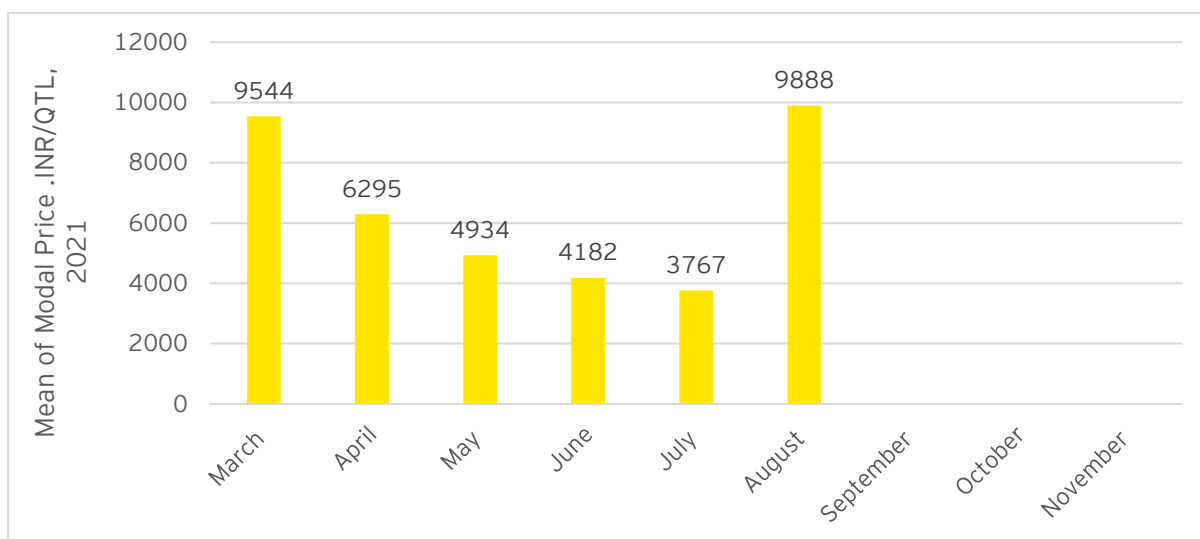


Figure 77: Mean of the modal price movement of Mango in J&K markets in 2021 during the season

Source: Agmarknet

The mean of the modal price of Mango in different markets of J&K shows that Reasi and Akhnoor witnessed the highest price during the season in 2021 of INR 5,642/Qtl and INR 5,457/Qtl respectively. This was followed by Udhampur, which witnessed INR 5,042/Qtl. Kulgam witness the lowest price of INR 4,557/Qtl.

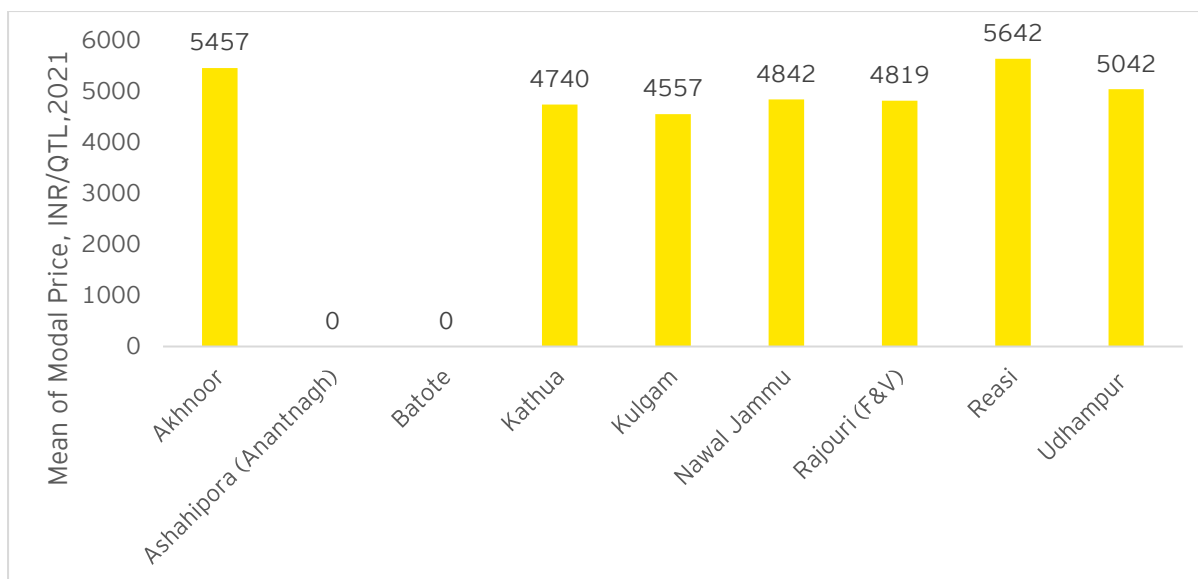


Figure 78: J&K marketwise mean of model price for mango INR / Qtl in 2021

Source: Agmarknet

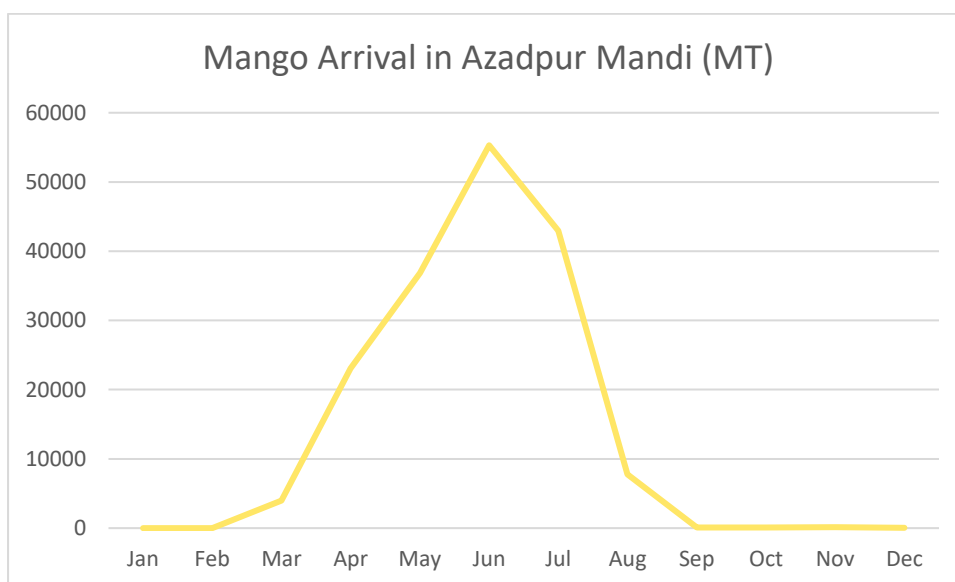


Figure 79 Mango Arrival in Azadpur mandi (MT)

The mango arrivals in the Azadpur mandi shows beginning of arrivals in March which peaks in June and thereafter shows a declining trend. Mango varieties from HP matures in Aug-Sep where there is a dearth of supply which gives an opportunity to capture the market. Similar dearth is observed in Jammu market and in the internal market of Himachal Pradesh.

ii. Snapshot of International Market Analysis for Mango

As International data of Guava and mango is available together, the analysis of Guava and Mango combined is presented in section 4.2.7 (ii) 4.7.8 Proposed Intervention

Pre-production:

Field Preparation: Dig pits of 1 m x 1 m x 1 m. Fill in with topsoil mixed with 10 kg of FYM and 100 g Lindane 1.3% dust per pit. Mango is to be planted in HDP at 3*3 m

Grafts are planted in the centre of pit with ball of earth intact followed by watering and staking. The graft union must be 15 cm above the ground level. Land should be prepared by deep ploughing followed by harrowing and levelling with a gentle slope for good drainage. Pits are filled with original soil mixed with 20-25 kg well rotten FYM, 2.5 kg single super phosphate and 1 kg muriate of potash.

Irrigation Management: Irrigation management is crucial to the production of quality fruit. Water inputs must be geared to tree water requirements, soil factors and fruit physiological requirements.

Production:

New Planting: In a new planting, trees must be irrigated throughout the year, including dry periods which occur during the wet season, to enable rapid establishment of the tree. Water inputs should be appropriate to tree size. In general, up to 100 L/tree/week should be sufficient for the first two years. The radius of the sprinkler should be appropriate to tree size.

Fruiting Trees: In fruiting orchards there are three phases during the annual growing cycle where distinct irrigation management options need to be exercised.

- ▶ Phase One - Pre-flowering, from the end of the wet season to the commencement of flowering (April to June/July).
- ▶ Phase Two - Flowering and fruiting, from visible panicle bud differentiation to harvest (July to November).
- ▶ Phase Three - Post harvest to the end of the wet season (November to April).

a. Phase one: In mature orchards (established fruiting trees) water is normally withheld from the end of the wet season until flowering. This period of low soil moisture is believed to encourage earlier and more synchronous flowering. Experimental evidence is still inconclusive, but it is thought that cool weather (several weeks with night temperatures less than 15°C) is the main flowering trigger. However, irrigation withdrawal is thought to enhance the flowering trigger, particularly in a year where there is an inconsistent run of cool nights.

b. Phase Two: Irrigation is highly recommended from flowering until late fruit maturity. Some growers prefer to start irrigating after 50% of the tree is in flower and at least 50% of the flowers are open. Other growers will start irrigating from the commencement of visible flower panicle development to speed up the flowering and fruit setting process. The present DPIFM recommendation is to start irrigating when at least 60% of the flower buds are visible. The amount of irrigation is dependent on tree size (canopy cover), evaporation rates and evaporation replacement rate. Irrigation frequency is dependent on soil type (water holding capacity) and effective root depth.

Many growers choose to water for 24 or 36 hours at the start of the irrigating season. This may not be necessary particularly if using low radius (2.0-3.0 m) sprinklers because tree water requirement is lower during the first month of flower and fruit development. The use of a hand auger to establish watering depth is recommended, particularly during the first few weeks after irrigation commences. The wetted zone should be at least 40% of the under-tree canopy area and good soil moisture should occur down to 60-80 cm. Saturated soil beyond 80 cm suggests that trees are being over watered.

Phase Three: Irrigation normally ceases a few weeks prior to harvest and is not recommenced until flowering in the following year. In years where the wet season begins late (late January, early February) the new vegetative flush may be delayed. This may influence the following flowering date with the most likely consequence being a later flowering. In situations where trees are grown on light soils and the build-up rains and wet season are late, trees should be irrigated to promote an early flush of growth. This should occur after pruning and fertiliser operations have taken place.

Irrigation Frequency: In simple terms the sandier and gravellier the soil, the more frequent irrigations should be. Two to three times per week will be appropriate for most sandy sites. Long irrigations on

a sandy soil result in water draining beyond the depth of the effective root zone which is a waste of water and leaches away nutrients.

The use of a hand auger to determine irrigation depth can quickly alert you to potential deep watering problems. Moisture monitoring will allow an appropriate irrigation schedule to be established

Water Requirements and Fruit Dry Matter Manipulation: Some growers encourage the earlier development of 14% fruit dry matter (minimum market standard) by manipulation of irrigation inputs and cut off prior to harvest. This practice should be carried out with caution as low water inputs (less than 60% replacement) and early cut off (four weeks prior to harvest) will reduce fruit size and fruit quality and delay the development of fruit peel colour.

Work carried out by the Crops, Forestry and Horticulture Division to establish water requirements of mangoes, shows that fruit size increases with increasing amounts of water up to 100% evaporation replacement. Dry matter development is delayed with increasing water inputs. The current recommendation of 70% evaporation replacement is a compromise in terms of balancing the requirements for adequate fruit size, fruit quality and time to maturity

Table 68: Average mango tree water requirement in a week (per tree)

Canopy cover m ² /ha	Trees per hectare						
	80	100	130	140	160	180	200
1000	490	390	330	280	250	220	200
2000	980	780	650	560	490	440	390
3000	1470	1180	980	840	740	650	590
4000	1960	1570	1310	1120	980	870	780
5000	2450	1960	1630	1400	1230	1090	980
6000	2940	2350	1960	1680	1470	1310	1180
7000	3430	2740	2290	1960	1720	1520	1370
8000	3920	3140	2610	2240	1960	1740	1570

Source: CISH, Lucknow

Intercropping: Short duration crops like legumes, vegetables, groundnut etc. can be raised during pre- bearing age. Inter crops such as vegetables, legumes, short duration.

Nutrient Management

Manures and fertilizers may be applied in September - October. Fertilizers are applied 45 to 90 cm away from the trunk upto the peripheral leaf drip and incorporated. The recommended fertilizer doses are 180 g N, 80 g P and 100 g K.

Training and pruning: Rootstock sprouts and low-lying branches have to be removed. Remove overlapping, inter-crossing, diseased, dried and weak branches in old trees to get good sunlight and aeration. For the internal branches, pruning may be done during August - September, once in three years. Flowering should not be allowed upto three years. Among crowded terminal shoots, weak shoots are trimmed to retain two healthy shoots during August-September annually.

Growth regulators: NAA @ 20 ppm is sprayed at flowering to increase the fruit retention. During February 0.5% Urea (5 g/lit.) or 1% Potassium Nitrate (10g/lit.) may be sprayed to induce flowering if trees do not flower by that time. Spraying of 2% KNO₃ at mustard size will increase the fruit set and retention of fruits.

Application of Paclobutrazol @ 10 g a.i. for non-bearing trees during first fortnight of September will induce flowering and fruit set yield during off years.

a. Pests: Hopper - Wettable sulphur @ 2 g/lit may be sprayed after spraying carbaryl to avoid mite resurgence. Phosphamidon + neem oil 5 ml/lit of water can be mixed with any insecticides for the control of hopper and shoot webber.

b. Leaf galls and Aphids - Application of Dimethoate or Methyl demeton @ 2 ml/lit will control the pests.

c. Flower Webber - Application of Phosalone 35 EC @ 2 ml/lit will control webber.

d. Nut Weevil - Fenthion 100 EC 1ml/lit spray during marble stage and second spray 15 days after the first spray will control nut weevil.

e. Mealy bug -Band the trees with 20 cm wide 400-gauge polythene sheets will prevent the spread of the pest. Similarly, release of Australian ladybird beetle, *Cryptolaemus montrouzieri* @ 10/tree will be a very effective bio-control measure.

f. Stem borer - Monocrotophos (36 WSC) 10 ml is soaked in absorbent cotton and placed on the affected stem by removing the bark of 2.5 cm². Then the portion is wrapped with gunny or plastic papers thereby the chemical gets into the system to kill the stem borer. The trees should not be treated during their bearing stage. Application of carbofuran 3 G @ 5g per bore hole and plugging with mud after mechanically removing or killing the grub by introducing a needle or wire will also control the pest.

g. Fruit fly - Spraying of Fenthion 2 ml/lit or malathion 2 ml/lit will control the pest. Ploughing the inter spaces will expose the pupae. Pheromone trap with methyl eugenol 1 ml in 1 litre of water + 1 ml of malathion solution will attract and kill the female insects. Take 10 ml of this mixture per trap and keep them in 25 different places in one hectare between 6 a.m. and 8 a.m. Collect and destroy the fallen fruits.

Diseases:

a. Powdery mildew - Application of Sulphur dust (350 mesh) in the early morning will protect new flush or spray Wettable sulphur 0.2% or Tridemorph 0.05% will control powdery mildew.

b. Anthracnose and stalk end-rot - Pre-harvest spraying of Mancozeb 2g/lit or Carbendazim 1g/lit or Thiophanate methyl 1g/lit or Chlorothalonil 2 g/lit, 3 times at 15 days interval will control anthracnose and stalk end-rot.

c. Sooty mould - Spraying Phosphamidon 40 SL @ 2 ml/ litre + Maida 5% (1 kg Maida or starch) boiled with 1 lit of water and diluted to 20 litres will control the incidence of sooty mould. Avoid spraying during cloudy weather.

Mango malformation - Use of disease-free planting material.

- ▶ Diseased plants should be destroyed.
- ▶ Incidence reduced by spraying 100-200ppm NAA during October.
- ▶ Pruning of diseased parts with the basal 15-20 cm apparently healthy portions.
- ▶ Followed by the spraying of Carbendazim (0.1%).

Stem end rot

- ▶ Dip mangoes in 6 percent borax solution at 43°C for 3 minutes.
- ▶ Harvest mangoes on clear dry day.
- ▶ Injury should be avoided to fruits at all stages of handling.
- ▶ Spray Carbendazim (0.1%) or Chlorothalonil (0.2%) in the field.

Red rust

- ▶ Bordeaux mixture (1%), or Copper oxychloride 0.25%

Harvest spreads from March to June. Graft plants start bearing at the age of 3 - 4 years (10-20 fruits) to give optimum crop from 10-15th year which continues to increase upto the age of 40 years under good management.

Post-harvest treatment

Dip the fruits in $52 \pm 1^\circ\text{C}$ hot water immediately after harvest for 5 minutes followed by 8% plant wax (Fruitox or Waxol) to reduce anthracnose disease in mango during storage. Two pre harvest sprays of 0.20% Mancozeb (2.0 g/lit) will also reduce the incidence.

Post-harvest handling of mango

Post-harvest losses are 25 -30 per cent of total produce due to improper handling and storage practices. Which amounts to over Rs. 250 crore.

Management steps includes

- ▶ Pre harvest management
- ▶ Assessment of harvest maturity
- ▶ Harvesting
- ▶ Sorting and grading
- ▶ Pest management
- ▶ Uniform ripening of fruits
- ▶ Packaging
- ▶ Storage
- ▶ Transport

Pre-harvest management

- ▶ Bagging of fruits for controlling the post-harvest diseases and bruises with newspaper or brown paper bags one month prior to harvest.
- ▶ Harvested fruits ripe uniformly without any disease and fruit fly infestation.
- ▶ The problem of blackening upon ripening occurs.
- ▶ The shelf life of such fruits is also increased by two to three days.
- ▶ Checks jelly seed formation (softening of pulp near stone).
- ▶ This technique is eco-friendly and job oriented. (Bags are not suited for coloured mango varieties)

Harvest maturity

- ▶ The harvest maturity takes 12 - 15 weeks after fruit set.
- ▶ At the time of maturity, stone becomes hard and pulp colour changes from white to cream.

Sorting and grading

- ▶ Separate mature unripe fruits from immature and ripe fruits.
- ▶ Grade fruits according to size and weight
- ▶ Sort out defected, deformed, bruised and diseased fruits.
- ▶ De-sapping of the fruits is necessary for improving quality.

Pest management

- ▶ Bagging of fruits check development of post-harvest diseases and fruit fly infestation.
- ▶ If bagging has not been done, pre-treatment of fruits is required for controlling post-harvest diseases.
- ▶ Harvested fruits should be dipped in 0.025 per cent Carbendazim in hot water ($52 \pm 10^\circ\text{C}$) for 10 minutes.
- ▶ Fixing of wooden block methyl eugenol traps @ 10 traps per hectare commencing from first week of May to manage fruit fly

Ripening

- ▶ Do not use calcium carbide, a banned chemical, for ripening of fruits.

- ▶ Such fruits do not ripen uniformly and quality of fruits is inferior.
- ▶ Calcium carbide is hazardous to health.
- ▶ Ripe fruits with ethylene gas (100 ppm or 0.1 %) in airtight room by exposing them for 24 -48 hrs under controlled conditions of temperature and humidity

Alternatively, ripe the fruits with dip treatment of ethrel / ethephon solution (250-750 ppm) in hot water (52±20°C) for 5 minutes.

- ▶ The same solution could be used four times.
- ▶ Premature fruits (fruits harvested up to 2 weeks prior to maturity) could be ripened to an acceptance quality by dipping the fruits in 750 ppm ethrel solution.
- ▶ Less mature and mature fruits are ripened by dipping the fruits in 500 and 250 ppm ethrel solution, respectively.

Fruits ripen uniformly with attractive colour.

- ▶ Fruits ripen within 4 - 8 days depending upon the maturity.
- ▶ This technique is also useful for processing industries.
- ▶ Sorting of ripe fruits is not required due to uniform ripening of fruits.

Packaging

- ▶ The filled boxes / packages should be kept under shade.
- ▶ Package should meet the handling and shipping requirements of international standard.
- ▶ The pack should be labelled with name of variety, grade, class and brand, if any.

Storage

Fruits could be stored for 6 - 12 days under ambient conditions, according to variety.

- ▶ For increasing the shelf life, fruits are stored at low temperature and high humidity.
- ▶ Precool the fruits to required temperature before storing at low temperature.
- ▶ The shelf life of fruits at low temperature is 2 -3 weeks.
- ▶ Use rigid containers that can withstand stacking without getting deformed.
- ▶ Do not store other fruits with mango under low temperature conditions.
- ▶ Store fruits until they are marketable and profitable.
- ▶ Transfer cold store fruits gradually to room temperature to minimize sweating.

Transport

- ▶ Do not throw the packages during loading or unloading.
- ▶ Stack 4 - 8 containers, as per their strength, in pallets.
- ▶ Arrange the boxes in the truck to allow proper air circulation
- ▶ Transport the produce during the cooler part of the day, i.e., during night.
- ▶ Cover the truck with tarpoline leaving proper ventilation.
- ▶ Avoid using large containers for packaging and transport of fruits.
- ▶ Transport cold stored fruits in a refer van.

Marketing and Branding:

An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

4.8 Value Chain Analysis of Pecan Nut

4.8.1. Overview:

i. Global Scenario:

Pecan is one of the important nut fruits. It is native to Mexico and was introduced in India in 1930s. Pecan occupies fifth rank among leading tree nuts because of its excellent nutty flavour. The global pecan production peaked at 147,222 metric tons in 2019, which significantly increased with the United States' contribution to the global pecan production. The United States and Mexico together accounted for more than 93% of the overall production in the world while the rest is encompassed by countries like South Africa, and Australia among others⁵³. Moreover, USA has the major consumers of pecan in the world contributing to more than half of the global pecan supply⁵⁴.

ii. Indian Scenario:

Pecan nut is the one of the most important temperate nuts grown in India. It is mainly grown in Jammu and Kashmir, and Himachal Pradesh. The total area under pecan nut production is increasing due its high economic returns and adaptation to intermediate zone of Jammu. Most plantations are of seedling origin in scattered form and produce nuts of variable quality. Overall, pecan nut has remained a low priority crop in otherwise apple dominated regions.

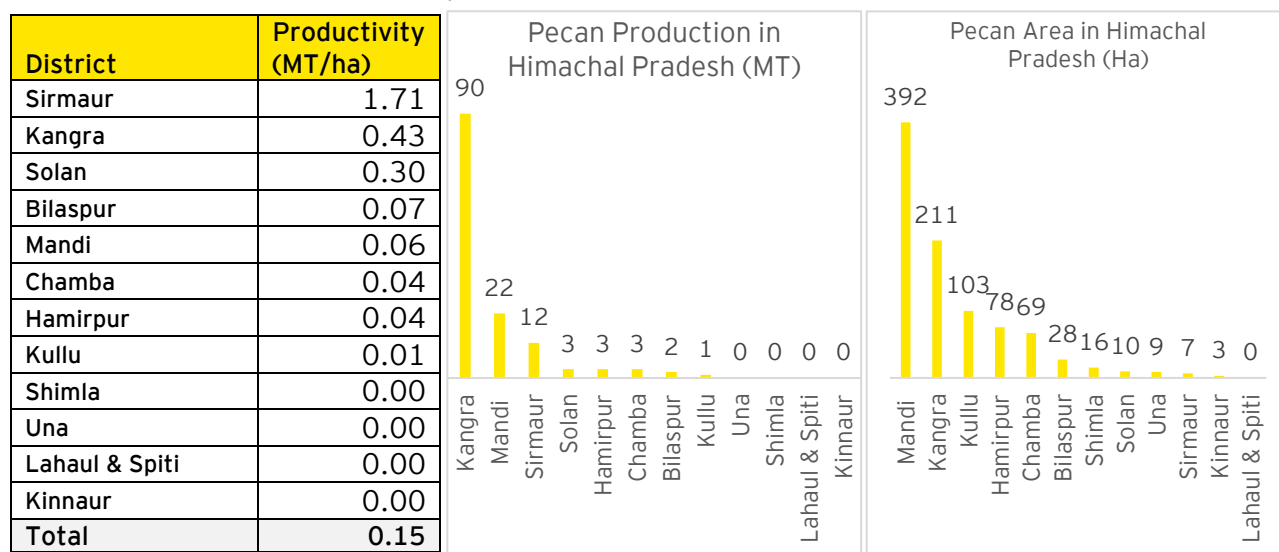
In Himachal Pradesh, its plantation remained confined to the areas of Kangra, Mandi, Kullu and Hamirpur districts, which constitutes approximately 930 ha area.

4.8.2. Pecan nut Production in Himachal Pradesh

i. Area and Production:

The state has recorded production of 136 MT on an area of 926 ha with an average productivity of 0.15 MT/ha during FY 2018-19.

Table 69: District wise Pecan Productivity (MT/ha) in Himachal Pradesh (2018-19)



⁵³National Agricultural Statistics Service (NASS)

⁵⁴<https://www.mordorintelligence.com/industry-reports/pecan-market>

Source: Department of Horticulture

Mandi, Kangra and Kullu accounts for nearly 76% area under production whereas Kangra, Mandi and Sirmaur accounts for nearly 91% production of the state. Though, Mandi district has highest area (42%) under pecan cultivation; it only contributes 16% production of the state due to low productivity (0.06 MT/ha). The state has recorded highest productivity of 1.71 MT/ha (Sirmaur) and lowest productivity of 0.01 MT/ha (Kullu). However, with improved package of practices it is expected to achieve the maximum productivity across state.

ii. Pecan nut Varieties

Very few varieties of pecan nut are commercially grown in India. For profitable farming, it is essential to plant varieties that comply with the high standards concerning adaptability to the region, disease tolerance, kernel percentage, yield, nut size and shape, appearance, and taste of kernels. Some of the commercial cultivars of pecan are Mahan, Burkett, Nellis, WesternSchley, Western, Stuart. The prominent varieties/cultivars that are selected for this project are Himachal Pradesh are Mahan and Nellis.

Mahan: Mahan has one of the largest nuts. Its large nut size and thin shell give it a surprisingly high percent kernel (53%).

Nellis: A regular bearing variety with oblong, cylindrical nut tapering towards the end, shell light brown and has stripes at the base. Amber coloured kernel constitutes 49.4% of nut, moderately filled and easily separated.

iii. Seasonality:

Pecan is expected to be harvested in last week of September - November in Himachal Pradesh.

Figure 81: Pecan nut harvesting season in major states

Pecan Nut	January				February				March				April				May				June				July				August				September				October				November				December			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Himachal Pradesh																																																

Peak season
 Lean season
 Round the year

Source: EY analysis

4.8.3. SWOT Analysis of Pecan Value Chain

The Strength, Weaknesses, Opportunities and Threats (SWOT) Analysis of the Pecan nut Value Chain in Himachal Pradesh identifies the unique features of the State. The table below highlights SWOT.

Table 70: SWOT Analysis of the Pecan Nut Value Chain in Himachal Pradesh

Strengths	Weaknesses
▶ Pecan is a hardy plant which tolerates high winters and harsh weather, unlike Apple or other fruits.	▶ There is an Inadequacy of disease free, true to type quality planting material of pecan nut in the region ▶ Knowledge and skill in production, post-harvest management and marketing of pecan nut is lacking among the farmers.
Opportunities	Threats
▶ Pecan nut is presently imported to meet the requirements of consumers, thus its production in HP provides opportunity for import substitution and save foreign exchange. ▶ Both production and processing provide opportunity for skilful employment. ▶ Availability of low-chilling varieties are conducive to grow in sub-tropical regions	▶ Non -availability of true to type, disease free. and quality plant on suitable rootstock is a threat in expansion of area.

4.8.4. Value Chain Analysis:

i. Commodity Flow Analysis

The key players involved in the Pecan Nut value chain are:

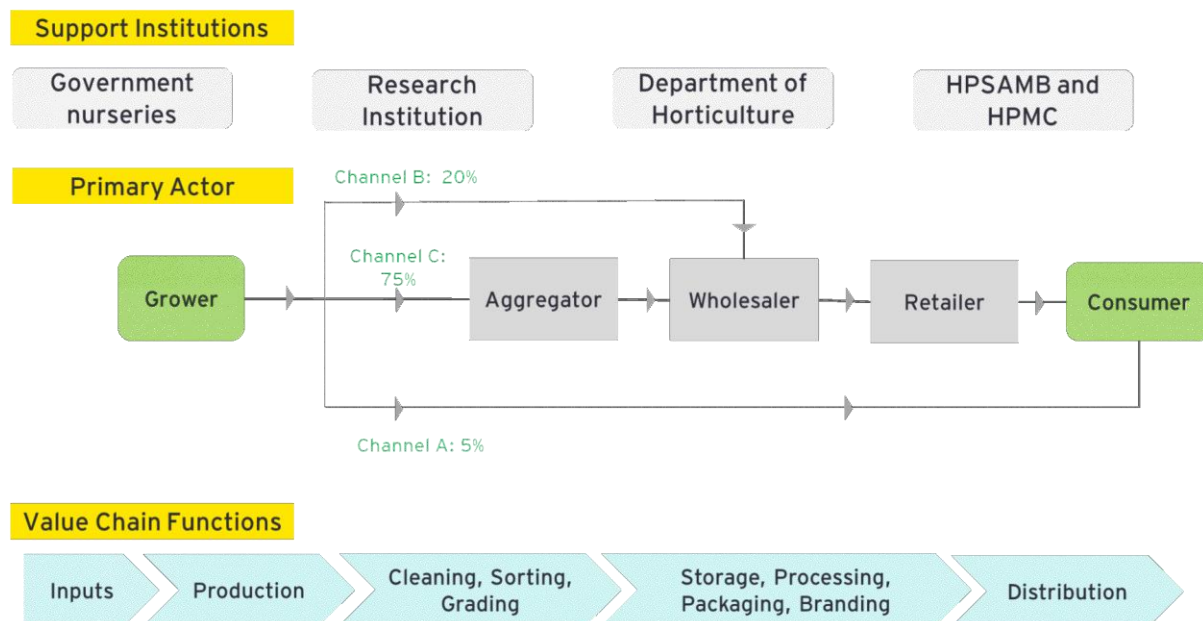
- ▶ Growers
- ▶ Pre-harvest contractors
- ▶ Wholesalers
- ▶ Traders
- ▶ Processor
- ▶ Retailers

The details of all stakeholders are discussed in detail in Section 4 (iv).

The following are the identified three main channels in the study area:

- ▶ Channel -A Producer → Consumer
- ▶ Channel -B Producer → Wholesaler → Retailer → Consumer
- ▶ Channel -C Producer → Pre-harvest contractor → Wholesaler → Retailer → Consumer

The existing marketing channel of Pecan Nut is as below



Most of the farmers sold their produce through traders i.e., Channel-B, followed by pre-harvest contractors, i.e., Channel C.

Channel A: This channel was used by the farmers/growers at a very limited scale (<5%), mainly to meet the short-term cash requirement at the household. Sometimes, the farmers themselves bring the produce in the nearby markets or put a stall in the market to sell directly to the consumers. Depending on the cash requirement, the farmers harvest the fruits and bring them to the market. In such cases, the transport is arranged by the farmers themselves. In this channel also the farmers have limited bargaining power.

Channel B: In certain cases, the farmers directly sell to distant wholesalers in Delhi, Mumbai and far away distance. This channel is normally opted by bigger farmers who have larger volume of fruit produce, and who have ability to organize and market the fruit produce of fellow farmers. In such cases, the price negotiation is done beforehand, normally over phone. Based on that the harvested fruits produce is brought to the market. They sometimes sell the produce to local retailers through which it finally reaches the consumers.

Channel C: In this channel, the pre-harvest contractors contact the farmers and fix a price during the time of flowering/fruiting. They inspect the field, forecast the estimated production, and then negotiate price with the farmers. Thereafter, the contractors become responsible for all the risks and expenses related to undertaking the remaining farm operations as plant protection, harvesting, sorting, grading, packing, transportation, and marketing of produce.

The detailed price- build up analysis for these marketing channels is present in 4.8.5 (ii)

iii. Value Chain Activities

Preharvest Activities

Land preparation: Pecan Nut tree is deciduous in areas of low winter temperature and an evergreen or partially deciduous in tropical and sub-tropical conditions. It can tolerate frost to a considerable extent in dormant stage. Well drained, sandy loan to deep loamy or alluvial soils is suitable for cultivation.

Land is prepared by ploughing, harrowing, levelling, and removing weeds. High density planting is adopted in project areas, with a spacing of 6m x 6m. The average annual water requirement through drip irrigation is 20 cm. Drip irrigation helps to save on irrigation and helps to increase the yield by 30-35%.

Planting: Generally, Central leader system is followed in Pecan. The lowest branch should be kept at 1 m height from the ground level, whereas other branches should be placed spirally at distance of 30 cm from one above another. Light pruning should be carried out on mature trees. Heavy pruning is not recommended in Pecan as it results in vegetative growth which cause low production. Inter-cropping with low growing vegetables, pulses or green manure crops is beneficial.

Disease management: The infestation of the Black margined aphid causes major losses in pecan commercial orchards followed by phylloxera (*Phylloxera notabilis*), a small insect that parasitizes the leaves of the pecan trees. The scab caused by the fungus *Fusicladium effusum* (G. Winter) is the most common disease and the one with the highest incidence in pecan crops worldwide. The main damage caused by this disease is the suppression of leaf development, reducing the photosynthetic area. Scab occurrence is enhanced by rainfall, high humidity, and temperatures above 21°C.

Harvesting and Postharvest Activities

Mature nuts do not fall, all at once, so mechanical shakers are used to bring them down. Harvested nuts are shelled, cleaned, sorted and packed as per their grades.

4.8.5. Cost Economics and Price build-up analysis

i. Cost of Production and Revenue Estimation

The data for analysis is collected from DoH and discussions with concerned stakeholders. All the values are considered at constant prices without inflation. The lump sum cost of 0.80 lakh is considered for land preparation. The spacing of the plant is considered as per the suggested spacing in nursery report, i.e., 6X6 in Pecan Nut. The table below present the annual cost and component wise breakup in 1 hectare land and corresponding revenue from the expected yield.

Table 71: Pecan Nut cost of cultivation breakup per hectare

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	80,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pitting and Plantation (@Rs.50/- per pit for 278 pits)	13,900	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting material (6 x 6 m spacing) = 278 trees/ha @Rs.100/plant	27,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mulching (including labour) (@Rs.32 per running metre for 6 metre per plant	53,376	-	-	-	-	53,376	-	-	-	-	53,376	-	-	-	-
Planting equipment and tools	15,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micro irrigation development (as per PMKSY rate)	1,20,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm yard Manure	5,555	5,555	6,666	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333	8,333
Fertiliser	2,650	2,850	3,050	3,250	3,450	3,650	3,850	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050
IPDM and growth hormones	1,000	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000	3,000	3,000	3,000	3,000	3,000
Pecan packing boxes (Rs 10 per 5 Kg)	-	-	-	-	2,780	5,560	8,340	11,120	13,900	13,900	13,900	13,900	13,900	13,900	13,900
Irrigation system maintenance	-	-	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Labour (MNREGA rate of Rs.203/- day labour)	34,916	28,826	28,826	28,826	43,036	43,036	43,036	43,036	43,036	43,036	43,036	43,036	43,036	43,036	43,036
Total Cost	3,54,197	38,231	41,792	44,909	62,349	1,18,955	68,809	72,039	75,069	75,319	1,28,695	75,319	75,319	75,319	75,319

Table 72: Annual revenue per hectare from Pecan Nut cultivation (INR)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Yield (kg/hectare)	-	-	-	-	1,390	2,780	4,170	5,560	6,950	6,950	6950	6950	6950	6950	6950
Return (@Rs.50/kg)			-	-	69,500	1,39,000	2,08,500	2,78,000	3,47,500	3,47,500	3,47,500	3,47,500	3,47,500	3,47,500	3,47,500
BC Ratio			-	-	1.11	1.17	3.03	3.86	4.63	4.61	2.70	4.61	4.61	4.61	4.61

The establishment cost of Pecan nut cultivation is approximately INR 3.54 lakhs, and annual cost is from INR 0.38 lakhs to INR 1.29 lakhs in the later years. It is observed that the labour component is major component in the cultivation, and it is also the main issue for the farmers to find skilled and un-skilled labourers.

The table below explains different cost of cultivation in percentage of total cost every year.

Table 73: Year wise cost of pecan nut cultivation components in percentage of total cost

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Land clearing and development	22.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pitting and Plantation	3.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Planting Materials	7.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mulching	15.1%	0.0%	0.0%	0.0%	0.0%	44.9%	0.0%	0.0%	0.0%	0.0%	41.5%	0.0%	0.0%	0.0%	0.0%
Planting Equipment	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Micro-irrigation	33.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
FYM	1.6%	14.5%	16.0%	18.6%	13.4%	7.0%	12.1%	11.6%	11.1%	11.1%	6.5%	11.1%	11.1%	11.1%	11.1%
Fertilizer	0.7%	7.5%	7.3%	7.2%	5.5%	3.1%	5.6%	5.6%	5.4%	5.4%	3.1%	5.4%	5.4%	5.4%	5.4%
IPDM & Growth hormones	0.3%	2.6%	3.0%	3.3%	2.8%	1.7%	3.3%	3.5%	3.7%	4.0%	2.3%	4.0%	4.0%	4.0%	4.0%
Packin boxes	0.0%	0.0%	0.0%	0.0%	4.5%	4.7%	12.1%	15.4%	18.5%	18.5%	10.8%	18.5%	18.5%	18.5%	18.5%
Irrigation system manitenance	0.0%	0.0%	4.8%	6.7%	4.8%	2.5%	4.4%	4.2%	4.0%	4.0%	2.3%	4.0%	4.0%	4.0%	4.0%
Labour	9.9%	75.4%	69.0%	64.2%	69.0%	36.2%	62.5%	59.7%	57.3%	57.1%	33.4%	57.1%	57.1%	57.1%	57.1%

Pecan nut starts fruiting from 5th year and achieve optimum yield in 9th year. The annual return for the farmers ranges from Rs.0.695 lakhs to Rs. 3.47 lakhs per hectare per annum.

ii. Price Build-up and Market Margins of Pecan Nut

The price builds up analysis is presented below for the 3 channels discussed in Value chain analysis sub section. The data is gathered from the stakeholders met during field visits and validated through secondary research. The details of stakeholders met are presented in Annexure II.

Table 74: Marketing costs and margins of different functionaries in the various marketing channels of Pecan Nut (Rs/kg)

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
(I)	Marketing cost incurred by the producers									
1	Net price received by the farmer	60	70.59%	60	55	42.31%	55	50	38.46%	50
2	Picking and sorting	3	3.53%	63	3	2.31%	58			
3	Transportation cost	4	4.71%	67	2	1.54%	60			
4	Cost of basket/crate	1	1.18%	68	1	0.77%	61			
5	Loading / unloading	4	4.71%	72	1.25	0.96%	62.25			
6	Spoilage (approx. 5%)	3	3.53%	75	2.75	2.12%	65			
A	<i>Total</i>	15			10					
B	Farmer's selling price	75	88.24%	75	65	50.00%	65	50	38.46%	50
(II)	Marketing cost incurred by the Traders									
A	The gross price paid by Traders							s	38.46%	
B	Cost components of Traders									
1	Labour cost for picking & sorting							0.5	0.38%	50.5
2	Transportation cost							2	1.54%	52.5
3	Cost of basket/crate							0.5	0.38%	53
4	Loading / unloading							0.4	0.31%	53.4
5	Spoilage (approx. 5%)							2.5	1.92%	55.9
C	<i>Total</i>							5.9		
D	Trader's Margin (15%-20%)							8.1	6.23%	64

S. No.	Particular	Channel A			Channel B			Channel C		
		In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up	In Rs.	in %	Price-built-up
(III)	Marketing cost incurred by the wholesaler									
A	The gross price paid by wholesaler				65	50.00%	65	64	49.23%	64
B	Cost components of wholesaler									
1	Loading / unloading				0.5	0.38%	65.5	0.5	0.38%	64.5
4	Transportation cost				0.5	0.38%	66	0.5	0.38%	65
5	Mandi Tax				0.65	0.50%	66.65	0.64	0.49%	65.64
6	Commission charge				3.25	2.50%	69.9	3.2	2.46%	68.84
7	Spoilage at Wholesaler level (approx. 5%)				3.25	2.50%	73.15	3.2	2.46%	72.04
C	<i>Total</i>				8.15			8.04		
D	Wholesalers Margin (5%-6%)				3.85	2.96%	3.85	3.96	3.05%	76
E	Wholesaler Selling price				77	59.23%	77	76	58.46%	76
(IV)	Marketing cost incurred by the retailer									
A	The gross price paid by retailer				77	59.23%	77	76	58.46%	76
B	Cost components of retailer									
1	Loading / unloading				0.4	0.31%	77.4	0.4	0.31%	76.4
3	Transportation cost				0.5	0.38%	77.9	0.5	0.38%	76.9
4	Mandi Tax				0.77	0.59%	78.67	0.76	0.58%	77.66
5	Commission charge				3.85	2.96%	82.52	3.8	2.92%	81.46
6	Storage/rent				0.5	0.38%	83.02	0.5	0.38%	81.96
7	Spoilage at Retailer Level (5%)				3.85	2.96%	86.87	3.8	2.92%	85.76
C	<i>Total</i>				9.87			9.76		
D	Retailer Margin (15%-25%)				13.13	10.10%	13.13	14.24	10.95%	100
E	Retailer Selling price				100	76.92%	100	100	76.92%	100
(V)	Consumer' Purchase Price	75	0.8824	75	100	0.7692	100	100	1	100

The price spread among different marketing channel is described below. The price spread found to be maximum in channel C Rs.50/-, followed by channels B and A.

Table 75: Price spread of Pecan Nut among the different marketing channels (Rs/kg)

S. No.	Particular	Channel A	Channel B	Channel C
1	Producer price	60.00	55.00	50.00
2	Consumer's price	75.00	100.00	100.00
3	Price spread	15.00	45.00	50.00
4	Producer's Share in consumer rupee (%)	80.00	55.00	50.00

The producer's share in Channel A is high (80.00%) as compared to that of in Channel B (55%), Channel C (50%).

The marketing efficiency through different channels are given below. The marketing efficiency was found to be highest in channel-A followed by channels B and C respectively. Though channel A has been found to be most efficient, but the volume transacted was very less (<5.0%).

Table 76: Marketing efficiency of Pecan Nut among the different marketing channels

S. No.	Particular	Channel A	Channel B	Channel C
1	Farmer's Price	40.00	55.00	50.00
2	Marketing cost	10.00	28.02	23.70
3	Marketing Margin	0.00	16.98	26.30
4	Marketing efficiency	4.00	1.22	1.00

The more the intermediaries, the less is the marketing efficiency. This is because of higher marketing costs and margins as the number of intermediaries increases.

4.8.6. Gaps in the Value Chain

The gaps observed at different stages are:

i. Pre-production

- ▶ Pecan nut cultivation suffers from lack of suitable methods of propagation, inadequate vegetatively propagated plants, lack of standard rootstocks and cultivars,
- ▶ Problems of re-establishment of nursery plants in the orchard were also reported by the farmers.

ii. Production

- ▶ The major gaps observed in the production phase are lack of knowledge of scientific cultivation practices, training and pruning, disease and pests,
- ▶ Lack of suitable pollinizers and poor pollination behaviour of existing pollinizers also affect fruit setting and fruit quality.
- ▶ Labour availability is also a major challenge for the farmer. Most of the labours come from outside the locality. Absence of sufficient number of skilled labourers and exorbitant labour prices are hurting the farmers very much.
- ▶ Plants are not trained on central leader system. Water stress has been observed. About 30 to 40 % damage by birds has been reported by site incharge. Pecan tree basin is not mulched with either dry grasses or plastic sheet.

iii. Harvesting and post-harvest

- ▶ Long juvenile period and lack of appropriate harvesting techniques were reported.
- ▶ Lack of proper bagging and packaging were other issues reported by the farmers in post-harvesting difficulties.

4.8.7 Market Overview

Currently, the cultivation of pecan nut tree is limited in India and imports Pecan nut predominantly from USA. The market overview is not provided because of lack of data.

4.8.8. Proposed Interventions

i. Pre- production

The quality planting material should be procured from reputed nurseries.

Land Preparation: Pecan tree can be grown on varied soil conditions ranging from the sandy loam to clay loam and alluvial soil of river and small streams, but they all have certain common characteristics. The soil should be deep, loose, well drained, and well aerated to a great depth. Pecan can be grown satisfactory where pH ranges from 5 to 8.

The climate is probably the main constraint in the expansion of pecan cultivation. It needs warm temperate climate meaning thereby that the extreme of both temperate and sub-tropical climates is undesirable. The pecan requires a long frost-free period from the time when growth starts in the spring until the nut matures in the fall. It is influenced by minimum temperature and number of chilling hours during winter.

An ideal climatic environment for pecan cultivation consists of growing season of 240-280 days, mean temperature above 26.70°C, with at least 400 h of chilling. High humidity affects adversely the growth, fruiting, and regularity of bearing in plant by preventing pollination, increasing the incidence of diseases on leaves and nuts. Hailstorms and winds of high velocity are harmful to the trees.

ii. Production

Pecans do not root easily from cuttings, so seedling pecans are used as rootstocks. With recent improvement in clonal propagation, pecan selections are being made for dwarfing & semi dwarfing rootstocks. Pecans develop into a large tree, growing to 20-40 m in height, rarely to 44 m, with massive root systems. So, trees should be planted at distance of 6 x 6 metre

The pecan is largely self-fertile but dichogamous, and with some varieties there is no overlap of pollen shedding & stigma receptivity. Most varieties require at least 180 days & up to 220 days, for nuts to mature. It takes about 90 days after pollination for the fruit to grow to its full size, slowly at first and then more rapidly.

Irrigation and Fertilization: Pecan trees require more water as compared to other nut trees. Proper irrigation helps in production of better-quality nuts and improves kernel yield, net weight, size, and oil content. Pecan trees come into bearing late, so intercrops like cow pea, soybean, tomato, peas, pulses, beans, and any low growing fruit crops can be grown. The cover crops improve the soil nitrogen level and prevent soil erosion. Mulching in the basin of the tree with dry grass should be done to control the weeds and to conserve the soil moisture.

Training and Pruning: Training and pruning are essential to get proper shape and size. Generally, Central leader system is followed in Pecan. The lowest branch should be kept at 1 m height from the ground level, whereas other branches should be placed spirally at distance of 30 cm from one above another. Light pruning should be carried out on mature trees. Heavy pruning is not recommended in Pecan as it results in vegetative growth which cause low production.

iii. Harvest and Post- harvest

Harvesting starts in 1st week of November when husk split to open & separated from nuts. On an average, a matured tree yields 25-30 kgs nuts. Mature nuts do not fall, all at once, so mechanical shakers are used to bring them down. In-shell nuts are alive, their respiration and metabolic activity is much lower at low moisture content of the dried nuts. For safe harvesting bamboo poles when the pods split open and separated from the nuts.

Storage: Pecan nuts must be stored in clean facilities free from biological, chemical, and physical contaminants. Because of its high lipidic content, pecan nuts favour the absorption of odours from external sources, consequently they should not be stored along with produce with strong aromas and other odorous material. Pecans should be stored at a moisture content of about 4%.

Shelled pecans stored at non-freezing temperatures should be maintained in an atmosphere of about 65-70% relative humidity to hold the 3-4% moisture content. Humidity above these values can cause kernel moulding and pecan texture deterioration (pecans become soft and rubber-like), whereas lower humidity's will cause excessive drying. In-shell pecan kernels will darken under high humidity because of the tannic acid being dissolved from the shell lining.

Sorting: After everything has been collected into our trailers, a conveyor at the top of our large sorting tower sifts through all the content as it cascades down and separates the pecans from the remaining debris. Once properly sorted with the expert eyes of our team, the pecans are transported to our on-site shelling plant for the cleaning process.

Cleaning: Once our precious cargo has arrived, our team thoroughly washes and cleans all the pecans, ensuring that they maintain optimal moisture levels for peak cracking in the shelling process. If too much moisture has been removed in the cleaning process, pecans may run through a soaking process to regain peak moisture levels.

Shelling: Shelling is done meticulously through filters and cracks the shell from the inner pecan, creating 2 perfect pecan halves. The machinery then separates the shells from their inner pieces, and our team double-checks that all outer shells have been removed by hand. Throughout this entire process, moisture levels are continually checked to uphold peak freshness, crunch, and flavour.

Packaging: Now is the time to prepare our pecans for our beloved customers. Pecans are generally packaged into 40-50 kg bulk cases for wholesale customers while retail packaging is done in laminated pouches of 250g, 500g, 1kg and 5 kg.

Marketing and Branding: An umbrella brand is required to be created under the aegis of the state apex body proposed at the topmost level which will undertake the activity for promotion, road shows and also monitor the quality of the produce. The brand should highlight the USP of all the commodity so that it clearly represents the specific advantage and uniqueness of the state.

5. Climate Change Implications and Mitigation Measures in HP

Climate change has emerged as a real concern for the horticulture sector in HP with visible changes in productivity, quality of yields, and acreage. The two major parameters of climate change that has far reaching implications on horticulture are (i) more erratic rainfall patterns, and (ii) unpredictable high temperature spells.

As per study findings, published in International Journal of Science, Environment and Technology⁵⁵, it is revealed that the established commercial varieties of fruits, vegetables and flowers perform poorly in an unpredictable manner due to aberration of climate. Melting of ice cap in the Himalayan regions reduces chilling effect required for the flowering of many of the horticultural crops.

It is predicted that due to rise in temperature, fruit crops will develop more rapidly and mature earlier. For example, Citrus, grapes, melons etc. will mature earlier by about 15 days⁵⁶. Strawberries will produce more runners at the expense of fruits. Specific chilling requirements of apple and stone fruits will be affected hence dormancy breaking will be earlier⁵⁷. Delay in monsoon, dry spells of rains, and untimely rains during water stress period, erratic temperatures during flowering and fruit growth, hailstorms are some of the most encountered climatic conditions experienced by the fruit growers.

The climate change increases the atmospheric temperature and change of rainfall pattern, as a result, fruit cultivation may suffer from high temperature, soil moisture stress or flooding / water logging. High temperature and moisture stress also increase sunburn and cracking in apples, apricot and cherries and increase in temperature at maturity will lead to fruit cracking and burning in litchi⁵⁸. Air pollution also significantly reduce the yield of several horticultural crops and increase the intensity of certain physiological disorders like black tip of mango, which is induced by coal fume gases, sulphur dioxide, ethylene, carbon mono-oxide and fluoride.

Due to high temperature, physiological disorder of horticultural crops will be more pronounced. Climate change is predicted to have a direct impact on the occurrence and severity of diseases in horticultural crops. Climate variations resulting in more winters allow larger populations of flea beetles to survive which increases the frequency of growing seasons with severe wilting in the fruit plants⁵⁹.

As per the estimates from Himachal Pradesh State Action Plan on Climate Change⁶⁰, annual temperatures are expected to rise for all seasons with significant decline in snowfall in mid-hills temperate wet agro-ecological zones. The frequency of rains is expected to increase but with diminished average intensity creating drought conditions in some pockets and accelerated summer flows in the north-western part of the State.

⁵⁵S. Dutta (2013), *"Impact of Climate Change in Indian Horticulture: A Review"*, published in International Journal of Science, Environment and Technology, Vol. 2, No 4, 2013, pp.661- 671

⁵⁶S. Dutta (2013), *"Impact of Climate Change in Indian Horticulture: A Review"*, published in International Journal of Science, Environment and Technology, Vol. 2, No 4, 2013, pp.661- 671

⁵⁷ State Centre on Climate Change, Shimla, Himachal Pradesh

⁵⁸Kumar R and Kumar KK (2007) *"Managing Physiological Disorders in Litchi"*, published in Indian Horticulture Vol.52 (1), pp.22-24.

⁵⁹Rana & Randava, (), *"Impact of Climate Variations on Plant Diseases"*, published by State Centre of Climate Change, Shimla, pp.10-16

⁶⁰<http://www.hpccc.gov.in/nationalActionPlan.aspx>

5.1. Effect of Climate Change on Different Stages of Fruit Production

A status report on Impact of Climate Change in Himachal Pradesh by State Centre on Climate Change at Shimla highlighted the impact of variations in temperature and precipitation condition with their impacts during the three phenological stages as below.

Table 77: Effect of Climate Changes in Different Stages of Plants Growth in Himachal Pradesh

Phenological Stage	Climate Change Impact
Pre-flowering	▶ Flower bud initiation is extremely sensitive to temperature variations from extreme high to low-growing season temperatures ▶ High temperatures lead to under-development of plant reproductive organs
Flowering	▶ Soil moisture variations driven by changing temperatures also decide the flowering time and seed germination ▶ Temperature rise leads to early bud sprouting and increases susceptibility to frost damage ▶ Moderate winds during flowering stage enables better fruit setting; however harsh winds accompanied with heavy rains at low temperatures hinders appropriate flowering ▶ Hailstorms anytime during the flowering stage are catastrophic for fruit crops
Fruit-setting	▶ Orchards deep seated in valley have better fruit setting as compared to plantations in windward sides ▶ Spring frost can either destroy flower sexual organ or completely damage blossom with impacts on fruit-set ▶ Frequent incidents of pests and diseases under high temperature conditions
Fruit Development	▶ Hailstorms anytime during fruit development stage are catastrophic for fruit crops ▶ Excessive rains and fog near maturity leads to poor fruit quality with improper colour development and fungal spots ▶ Extreme and sudden hailstorms lead to spotting and fruit drop, especially for temperate fruits. ▶ High temperature decreases anthocyanin accumulation in fruit trees resulting fruit discolouration ▶ High temperatures are known to alter fruit taste and flavour, sugar content, firmness, and antioxidant activity

Source: State Centre on Climate Change, Shimla, Himachal Pradesh

5.2. Effect of Climate Change on Sub-tropical Fruits

The effect of climate change on selected sub-tropical fruit crops is presented below

Table 78: Effect of Climate Change on Selected Crop in Himachal Pradesh

Fruit Crops	Effect of Climate Change	Measures to be adopted
Citrus	▶ An increase in temperature at critical phenological stages of citrus results in reduced tree fruit set, altered fruit growth and size. Increase in temperature may affect quality with low tree yield, reduced fruit peel thickness, and pre-harvest fruit drop. ▶ Stomatal conductance and net carbon dioxide assimilation in citrus leaves can be reduced by super optimal leaf temperature. ▶ Water deficit reduces the transpiration rate, stomatal conductance by stomatal closure associated with ABA content and causes an abrupt decrease in photosynthesis and CO₂ assimilation in citrus which reduce trees overall growth and production. ▶ Untimely winter rains promote vegetative flushes in citrus instead of flowering flushes. Dry spell during flower emergence and fruit set affects flower initiation and aggravates incidence of pest (<i>Psylla</i>). ▶ High humidity leads to increase in attack of powdery mildew, phytophthora and mold.	▶ Plants have capacity to adjust the canopy temperature through evaporative cooling. To enhance evaporative cooling, water may be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Use of drought tolerant root stock safeguards against water stress and also root diseases. Rangpur lime rootstock is most appropriate ▶ Mulching with polythene reduces losses of water due to evaporation. ▶ Adopt integrated system of disease and pest management
Guava	▶ High humidity leads to attack of fruit borer. ▶ High temperature inhibits growth and affect fruit development, and fruit has less flavor and sweetness. ▶ Extreme of low temperature during winter results in burning of leaves and anthracnose ▶ Increase in temperature would reduce the incidence of frost. Thus, better productivity and no risk of losing crop yield ▶ Untimely rain may affect the quality of fruits by reducing sweetness and flavour of the fruit ▶ High temperature during flowering affect pollination and reduces fruit set and alter fruit size and quality which leads to poor marketability of fruits	▶ Guava is drought and salinity tolerant and adjust to high temperature. It has capacity to adjust the canopy temperature through evaporative cooling. ▶ To enhance evaporative cooling, water must be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Adoption of mulching is essential to reduce losses of water through evaporation and reduction in weed growth.
Litchi	▶ Litchi is very sensitive to variations in temperature, rainfall, and humidity, as weather at the time of flower bud differentiation, flowering, fruit set and growth.	▶ To enhance evaporative cooling, water must be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation.

	▶ Litchi's size is reduced, and its sweetness has also decreased due to variations in temperatures. High temperature with poor humidity leads to fruit burn and poor aril formation. ▶ Low temperatures delay the maturity period. Fruit sizes is also reduced due to low temperature. ▶ Increased infestation of litchi mite and fruit borer due to low temperature and high humidity. ▶ Repeated thunderstorms resulted in unripe litchi falling from the trees and losing crop. ▶ Increase in temperature at fruit maturity leads to fruit cracking and burning in litchi. ▶ Increase in temperature reduces the risk of frost damages	▶ Adoption of mulching is essential to reduce losses of water through evaporation and reduction in weed growth. ▶ Mulching coupled with sprinkling of water above canopy enhances humidity during fruit maturity, checks cracking and enhances fruit colour, and quality ▶ Effective measures to control pest and diseases become essential. Integrated insect, pest and disease control system should be adopted.
Pomegranate	▶ In pomegranate, the hot and dry spell during fruit development reduces size of fruit and colour development is hampered. ▶ The fruit's unique red colour is conferred by anthocyanin which is affected by increased temperature resulting in poor internal colour of fruits. ▶ High temperature during flowering affect pollination and reduces fruit set and alter fruit size and quality which leads to poor marketability of fruits ▶ High temperature during flowering alters female male ratio. High temperature leads to more male flower. ▶ Untimely rains increase the incidence of bacterial leaf spot disease which influence production and productivity ▶ Pomegranate is highly vulnerable to change in temperature, humidity, and wind speed. Moderate night temperature and warm days are essential for better colour and juice quality.	▶ Pomegranate has capacity to adjust the canopy temperature through evaporative cooling. ▶ To enhance evaporative cooling, water may be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Mulching with polythene reduces losses of water due to evaporation and checks weed growth. ▶ Adopt integrated insect, pest disease management system to protect plantation. ▶ Avoid rainy season cropping.
Mango	▶ High temperature at the of flowering leads to poor dehiscence and drying of pollen resulting in poor fruit set and reduced yield. ▶ High reflected temperature enhances spongy tissues and high humidity leads to high incidence of Powdery mildew which causes drop of flowers and fruits resulting in complete loss of mango ▶ Prolong exposure to high temperature, above 40 Degree Celsius results in sunburn making fruits unmarketable	▶ Mango plants have capacity to adjust the canopy temperature through evaporative cooling. ▶ To enhance evaporative cooling, water may be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Use of drought tolerant root stock to safeguards against water stress and also oil borne diseases.

	▶ Rate of transpiration increases from young leaves and fruits during high temperature, resulting in high rate of fruit drops and poor yield and quality of fruits ▶ Repeated thunderstorms resulted in unripe mango falling from the trees resulting in loss of mango fruits ▶ Low fruit set is observed due to sudden rise in day temperature (35°C) during peak flowering in mango. ▶ Low temperature (4 to 11.5°C) in the month of January, accompanied by high humidity (>80%) and cloudy weather delay panicle emergence. ▶ Climate Change with high temperature and c concentration will reduce risk of damage due to frost.	▶ Mulching with polythene reduces loss of water due to evaporation and checks weed growth. ▶ Adopt integrated system of disease and pest management to safeguard against losses
Plum	▶ Higher temperatures during the flowering stages of plum fruit are observed to fasten the flowering process that impacts the overall productivity ▶ Double fruit formation is caused by water stress and high temperatures which reduces fruit quality. ▶ High temperature during flowering affect pollination and reduces fruit set and alter fruit size and quality which leads to poor marketability of fruits ▶ Since plum need cross pollination increased temperature affect pollination resulting in poor fruit set. ▶ Rate of transpiration increases from young leaves and fruits during high temperature, resulting in high rate of fruit drops and poor yield and quality of fruits ▶ Increased temperature may lead to no flowering for want of chilling needs flowering and fruiting.	▶ Plum has capacity to adjust the canopy temperature through evaporative cooling. ▶ To enhance evaporative cooling, water may be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Use of drought tolerant root stock safeguards against water stress and also root diseases. ▶ Mulching with polythene reduces loss of water due to evaporation. Mulching checks weed growth ▶ Integrated system of disease and pest management require to be adopted.
Pecan nut	▶ Extreme deviations in climate greatly influence Pecan crop productivity. ▶ Climatic variations, like prolonged cloudy condition and excessive rainfall induce irregular fruit bearing, and immature nut formation. ▶ Severe short-term droughts can cause premature defoliation. ▶ Rate of transpiration increases from young leaves and fruits during high temperature, resulting in high rate of fruit drops and poor yield and quality of fruits	▶ Pecan nut Plants have capacity to adjust the canopy temperature through evaporative cooling. ▶ To enhance evaporative cooling, water may be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Use of drought tolerant root stock to safeguard. against water stress and also root diseases.

	▶ Increase in temperature and humidity favours infection of bacterial and fungal diseases ▶ Increased temperature influences flowering and fruit set	▶ Mulching with polythene reduces loss of water due to evaporation and checks weed. ▶ Since plants are vulnerable to insect, pests and diseases, integrated system of disease and pest management should be adopted.
Persimmon	▶ Persimmon is less affected variable of climate change as evidenced In 2021 that despite hostile climatic conditions yield was very good. ▶ Heavy frost defoliates leading to defoliation of more than 70% of the leaves, but with little damage on the fruits. ▶ High temperature during flowering affect pollination and reduces fruit set and alter fruit size and quality which leads to poor marketability of fruits. ▶ Erratic temperature and rainfall lead to abnormal precipitation which affect fruit yield and quality. ▶ High temperature, inhibits growth and affect fruit development, and fruit has less flavour and sweetness. ▶ High temperature affects colour development and quality of fruits. ▶ Rate of transpiration increases from young leaves and fruits during high temperature, resulting in high rate of fruit drops and poor yield and quality of fruits	▶ Since plants are vulnerable to insect, pests and diseases, integrated system of disease and pest management should be adopted ▶ Persimmon Plants have capacity to adjust the canopy temperature through evaporative cooling. ▶ To enhance evaporative cooling, water may be applied based on soil water potential and oxygen content of water, referred as pulse Irrigation. ▶ Use of drought tolerant root stock safeguards against water stress and also root diseases. ▶ Mulching with polythene sheet must be adopted to conserve water and check weed growth.

In addition, some of mitigation measures for the effects of climate are presented below:

- ▶ The most effective way is to adopt conservation agriculture, using renewable energy, water conservation, reforestation etc. to sustain the productivity modification of present horticultural practices and greater use of greenhouse technology.
- ▶ Development of new cultivars of horticultural crops tolerant to high temperature, resistant to pests and diseases, short duration and producing good yield under stress conditions need to be promoted.
- ▶ Adoption of hi-tech horticulture and judicious management of land and water use should be the main strategies to meet the challenges due to climate change.

6. Business Environment

We live in a dynamic environment that changes all the time. The value chain actors in sub-tropical fruit produce need to understand the changes in the business environment as well as the way these changes affect their performance. The value chain actors normally exhibit a great deal of control over the internal environment which covers day-to-day operations. They choose the inputs they purchase, production & post-production processes they apply, the products they sell, and the locations where they sell those products. However, the external environmental conditions that affect fruit value chain changes constantly and are generally beyond the control of value chain actors. The value chain actors need to continuously understand the business environment and adapt their operations accordingly.

The quality of the business environment serves a gate-keeping function. Increase in productivity is achieved at the farm and value chain levels by improving the quality of operations that provide better access to markets, technology, finance, and technical know-how. The business environment in sub-tropical fruit value chain in HP is discussed below:

6.1. Quality Inputs Supply

The major issue the small farmers in HP face is the availability of true to type, quality planting materials. Inadequate availability of quality planting material is an important deterrent in the development of robust fruit value chain in the State. It is of special significance, especially in fruit crops which have a long gestation period and effects are known only in later stages. The growers/farmers have very limited option of good quality elite planting materials. They mostly depend on small scale private nurseries which lack modern infrastructure for nursery management, sell plant material of unknown pedigree and often encounter unavailability of standardized root stocks and non-maintenance of healthy stocks of required fruit crop varieties.

6.2. Farmers' Right

The supply of quality planting material to the farmers is regulated by the enforcement of provisions of the H.P. Fruit Nurseries Registration and Regulation Amendment Act 2015. The HP government has recently adopted a series of important measures that not only enable the establishment of a network of quality nurseries, but also promotes stricter enforcement of quality standards. The Intellectual Property Right (IPR) protection related issues of propagation of new varieties is included in the H.P Fruit plant Nurseries Regulation and Amendment Act 2015. the project has also promoted procuring and multiplication of elite planting materials for high density plantation of sub-tropical fruit crops from other states.

India government has ratified the Agreement on Trade Related Aspects of the Intellectual Property Rights to provide an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new plant varieties. The Protection of Plant Varieties and Farmers' Rights Act, 2001 has been enacted in India.

6.3. Finance

The small farmers are often considered non-bankable due to lack of collateral and poor/no credit history. Due to high cost of high-density plantation of fruit crops, the small farmers normally approach private moneylenders who charge abnormally high interest rate. The commercial banks generally provide crop loans to the farmers. The current rate of interest on agriculture loan is around 10%-12.5%. The banks also offer Kisan Credit Cards (KCC) to the farmers to meet their short-term credit requirements for crop cultivation, including post-harvest expenses, if any. The short-

term component of the KCC limit is revolving Cash Credit facility, with an interest rate of 7% up to Rs. 3.00 lakh, if account is regular⁶¹.

6.4. Processing and Value Addition

Himachal Pradesh was predominantly an agrarian economy in earlier days of its statehood. During the nineties, the average annual growth rate of the industrial development was merely 5.7 percent. The pace of industrial development picked up after the Grant of special package of incentive by GoI in 2003 for setting up of industries in the HP, together with the package of incentives provided by the GoHP in the industrial policy and incentive.

This has resulted in high investment in MSME in the State. The maximum number of units registered with the state industries department after the special package of incentives are in the unclassified product group (others) followed by food processing industries. Out of 16,910 units registered, 1926 were in food processing (11.4%)⁶².

The major challenges faced by the processing industries are:

Lack of surplus production of sub-tropical fruits poses big challenge for the processing industry. As the majority of the growers are small farmers, procurement of raw materials is challenging for processors especially if it has to be done in large volumes.

Lack of optimally distributed post-harvest infrastructure (grading, sorting, CA & cold stores, etc) poses huge challenges in maintaining an even supply of raw materials for the processing industry. In addition, lack of on-farm primary processing facilities, such as grading, and sorting hamper the quality of raw material and limit the growth of processing industry.

Packaging and other downstream subsidiary industries are lacking in the state. For example, majority of the packaging material is currently being brought into HP from neighbouring places like Delhi and Chandigarh. This increases the cost of packing material and builds up the cost of product.

Transportation within the state suffers from monopoly by unions. Even in its judgement in 2021 the Himachal Pradesh High Court noted that the practice of blackmailing industrialists and the public and the collection of 'goonda tax' has not stopped⁶³. Given the hilly terrain and limited competition, there is hardly a level playing field in the transportation segment which make the freight charges uncompetitive.

6.5. Supply Chain

The horticulture supply chain in HP is fragmented, involving multiple layers of intermediaries, thus resulting in high spoilage and wastage. The supply chain of most sub-tropical horticulture produce is almost similar in nature with slight variation in terms of the way of handling. Fruits and vegetables marketing is characterized by the dominance of middlemen at different levels, involving pre-harvest contractors, forwarding agents, commission agents, wholesalers, mashakhoras (Sub-wholesalers), retailers, and, in case of the remote terminal markets, there is a repetition once or twice, of the

61 Agriculture Loan by Himachal Pradesh Gramin bank at <https://www.hpgb.in/page/agriculture-loan>

62 MSME Development Institute, Himachal Pradesh, "*Growth of Micro and Small-Scale Enterprises*", at <https://msmedihimachal.nic.in/pages/view/98-smallscaleenterprises>

63 The Tribune (25 Nov 2021) at <https://www.tribuneindia.com/news/himachal/himachal-pradesh-high-court-allows-bbn-industry-body-to-hire-vehicles-to-transport-goods-176037>

wholesale process. The existence of so many intermediaries cause prices to snowball with each transaction.

The growers/farmers are at present normally carry out all the on-farm pre-harvest and post-harvest activities. Some fruit growers prefer to sell to the pre-harvest contractors which saves them from the investments and risks after the contract. Direct links between the growers and the terminal markets are very limited, principally because:

- ▶ marketing centres are very remote from the producing areas.
- ▶ production is largely in the hands of small farmers whose individual output is too small to warrant their own marketing.
- ▶ many of the growers borrow money for production and other cash needs from the traders, resulting in distressed sale of the produce.

Though, Himachal Pradesh has opened the marketing sector for private investment, development of alternative marketing arrangements outside the regulated wholesale markets have been limited. There are a few private players like Adani Agrifresh Limited, Devbhumi Cold Chain Limited, and others have established controlled atmosphere storage facilities at different locations in Himachal Pradesh, specifically for apples. At present these CA store operators, are buying directly from farmers and the fruit is sold through a nationwide network of dealers. By taking control of the produce early in the chain and then storing the same till the off-season, the CA store operator can make the highest margin in the chain.

6.6. International Trade⁶⁴

International trade in fruits and vegetables has expanded more rapidly than trade in other agricultural commodities especially since the 1980s. The global fruit and vegetable trade has increased from \$ 3.4 billion in 1961 to \$100 billion in 2020⁶⁵. There is enormous diversity in fruits and vegetable trade, because of increase in variety of offerings. Advanced technology and trade agreements have played a major role in allowing access to markets and in promoting trade.

The requirements of international trade are classified into two groups, viz. legislative and non-legislative, which are discussed below.

Legislative requirements

- ▶ Tariffs
- ▶ Non- tariffs, like quality standards, marking, labelling, better packaging, contamination etc.

Non- legislative requirements

Good Agricultural Practices etc.,

Legislation for tariff barriers has been mainly enacted by the countries with a view to protect the farmers, whereas legislation for non- tariff barriers like quality standards etc. have been framed in the interest of consumers.

⁶⁴ Source: APEDA at

<http://apeda.in/agriexchange/Market%20Profile/one/INTERNATIONAL%20TRADE%20REQUIREMENTS.aspx>

⁶⁵ Source: Freshfel at <https://freshfel.org/covid-19-accelerates-global-fresh-produce-trade-trends-towards-a-deceleration-of-volumes-previously-growing-values/>

The requirements of tariffs and non-tariffs for different countries are different. These requirements are based on Volume - IV (B & C) of International Market Research covering Trade Scenario and Specifications.

The EU is the leading destination of global trade of fruits and vegetables. In the EU, all member countries have not only a common tariff, but also a common market organization with policy mechanism and trade agreements to stabilize the market for fruit and vegetables sector. Details of both legislative and non-legislative requirements are given below.

6.6.1. Legislative Requirements for EU

Tariffs

Tariff exceptions have been made for developing and least developing countries under Generalized System of Preferences (GSP) Scheme. The GSP is a preferential tariff system which provides tariff reduction on various products. The countries under GSP have duty free access to EU round the year for fruits and vegetables except for banana.

Non-Tariffs

Many other aspects, comprising quality standards, labelling, and marking, Minimum Residue Level (MRL), hygiene of food stuff, contamination, packaging standards, etc. are considered while exporting to EU markets. The quality standards of India which are being adopted by exporters meet the EU requirements.

6.6.2. Non legislative requirements for EU

Non legislative requirements include environmental, ethical, and social policies. There are a number of non-legislative standards that have to be adopted on a voluntary basis. Many buyers may ask suppliers to comply on environmental, health, safety, traceability, good agricultural practices and social responsibility issues, details of which are given below:

Food quality:

Complete traceability from the field to final consumers is required. A set of standards have been established through the production chain and in audit system for verification.

Social impact:

Social impact comprises occupational health, child labour, forced labour, minimum wages, etc. This aspect aims to ensure that reasonable conditions for workers are provided based on ILO conventions and ISO management system.

Environment friendly production:

It requires that food is produced with a minimum damage to the environment using sustainable farming system.

Good Agricultural Practices:

EUREPGAP which is now known as GLOBALGAP is quite popular among Indian farmers and most of them are covered under registration.

Trade and Consumer Preferences:

New and Exotic products: Exotic items are becoming common and popular like mango, papaya, pomegranates. Similarly, there is lot of demand for small products like cherry tomatoes, etc.

Uninterrupted Supply:

Because of new health trends, consumers prefer the supply of the fruits and vegetables, which are made available by African countries and South Asia throughout the year.

Changing Lifestyle:

There is increased demand for processed items such as pre-cut-washed and scraped-peeled-prepared items.

Food Safety:

Because of food safety concerns, there is demand for organic fruits and vegetables mainly in Germany, Sweden, Denmark, France, and UK. Social awareness has also led to increased demand for "Fair trade" certified products.

6.6.3. Non-financial Barriers to Trade (NBT)

A non-financial barrier to trade (NBT) is any regulation, standard or procedure that could make exporting goods to another country more difficult. The TBTs are often greater obstacles to fruit produce exporters than tariffs (import fees). The technical regulations and standards set out specific characteristics of a product – such as its size, shape, design, functions and performance, or the way it is labelled or packaged before it is put on sale.

In certain cases, the way a product is produced can affect these characteristics, and it may then prove more appropriate to draft technical regulations and standards in terms of a product's process and production methods rather than its characteristics per se.

The World Trade Organization (WTO) deals with the rules for international trade; its Sanitary and Phytosanitary Measures (SPS) Agreement and on Technical Barriers to Trade (TBT) Agreement set out the framework in which international standards are applied by governments to ensure the safety and quality of internationally traded food products.

7. Government Regulations

Food quality standards give confidence to consumers in the safety, quality, and authenticity of what they eat. By setting down a common understanding on different aspects of food for consumers, producers and governments, standards enable trade to take place. The following section describes the food quality standards for the production and export of sub-tropical fruits.

7.1. Good Agricultural Practices (GAP)

The concept of Good Agricultural Practices (GAP) is getting prominence due to the rapid changes and increased globalization in food supply, as well as the trust and confidence of stakeholders to safety control and quality assurance of food production and environmental sustainability. *The GAP can be described as understanding practices that are followed to produce and eat safe crop which is compatible with environmental sustainability*⁶⁶.

The GAP principles at farm level in general cover 10 components including (i) soil management; (ii) water management; (iii) inter-crop production; (iv) crop protection; (v) animal production; (vi) animal health and welfare; (vii) harvest and on-farm processing and storage; (viii) energy and waste management; (ix) human welfare, health, and safety; and (x) wildlife and landscape conservation.

The main GAP technologies are integrated pest management; integrated crop management; conservation agriculture; and hazard analysis critical control point in order to control pesticides that seriously threaten human health and the environment. The adoption of GAP standards emphasizes the elimination of pest with minimum impact on environment, and human health, with sustainable agricultural development which contribute to achieve environmental, economic, and social sustainability, as well as attention to the sustainability of on-farm activities to certain safety and quality of food crops.

7.2. Codex⁶⁷

The term "Codex Alimentarius" is Latin and means "food code". Codex standards are international food texts, i.e., standards, codes of practice, codes of hygienic practice, guidelines, and other recommendations, established to protect the health of the consumers and to ensure fair practices in the food trade. The collection of food standards and related texts adopted by the Codex Alimentarius Commission is known as the Codex Alimentarius.

The Codex Alimentarius⁶⁸ includes standards for all the principal foods, whether processed, semi-processed or raw, for distribution to the consumer. Materials for further processing into foods should be included to the extent necessary to achieve the purposes of the Codex Alimentarius as defined. The Codex Alimentarius includes provisions in respect of food hygiene, food additives, residues of pesticides and veterinary drugs, contaminants, labelling and presentation, methods of analysis and sampling, and import and export inspection and certification.

The Codex Alimentarius Commission (CAC) was established in 1962 by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) to implement the joint FAO/WHO Food Standards Programme. The CAC is an intergovernmental body, with 189 Codex Members made up of 188 Member Countries and 1 Member Organization (The European Union). India became the member of Codex Alimentarius in 1964. Codex standards and related texts are not a substitute for, or alternative to national legislation. Every country's law and administrative procedures contain provisions with which it is essential to comply.

66 TNAU Agritech Portal "Good Agricultural Practices", at https://agritech.tnau.ac.in/gap_gmp_glp/gap_pdn_%20fruits.html

67 FAO and WTO (2017), "Trade and Food Standards", <https://www.fao.org/3/i7407e/i7407e.pdf>

68 <https://www.fao.org/fao-who-codexalimentarius/about-codex/en/>

Codex standards and related texts contain requirements for food aimed at ensuring for the consumer a safe, wholesome food product free from adulteration, correctly labelled and presented. A Codex standard for any food or foods should be drawn up in accordance with the Format for Codex Commodity Standards and contain, as appropriate, the sections listed therein. Codex standards can be general or specific.

General Standards, Guidelines and Codes of Practice: These are the core Codex texts and apply to all products and product categories. These texts typically deal with hygienic practice, labelling, additives, inspection & certification, nutrition and residues of veterinary drugs and pesticides.

Commodity standards: Codex commodity standards refer to a specific product although increasingly Codex now develops standards for food groups i.e., one general standard for fruit juices and nectars as opposed to one per fruit.

7.3. Food Safety and Standards Authority of India (FSSAI)⁶⁹

FSSAI is a statutory body established under the Ministry of Health & Family Welfare, Government of India. The FSSAI has been established under the Food Safety and Standards Act, 2006, which is a consolidating statute related to food safety and regulation in India. FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safety. The FSSAI functions under the administrative control of the Ministry of Health and Family Welfare.

The main aim of FSSAI is to lay down science-based standards for articles on food; regulate the manufacture, storage, distribution, import, and sale of food; and facilitate the safety of food. The standards framed by FSSAI are prescribed under Food Safety and Standards (Food Product Standards and Food Additives) Regulation, 2011, Food Safety and Standards (Packaging and Labelling) Regulation, 2011 and Food Safety and Standards (Contaminants, Toxins, and Residues) Regulations, 2011.

The development of standards is a dynamic process based on the latest developments in food science, food consumption pattern, new food products, and additives, changes in the processing technology leading to changed specifications, advancements in food analytical methods, and identification of new risks or other regulatory options. The FSSAI issues three types of licenses based on the nature of the food business and turnover:

Registration: For Turnover less than ₹12 Lakh

State License: For Turnover between ₹12 Lakh to ₹20 Crore

Central License: For Turnover above ₹20 Crore

Other criteria like the location of the business, number of retail stores, etc. are needed while evaluating the nature of the license application.

7.4. FLRS and FoSCoS⁷⁰

FSSAI had earlier implemented a Food Licensing and Registration System (FLRS) - an online application to provide licensing and registration functionality. FLRS application enabled the process for Food Business Operators (FBOs) to submit registration/ license applications related to all food businesses and further supported the processing of these applications by the Central/ State licensing authorities. Over years users complained of slow speed of FLRS and software experts resisted new changes on FLRS thus impeding any further improvement, expansion, and innovation in the licensing system. Thus, the migration from FLRS to FoSCoS was imperative.

⁶⁹<https://www.fssai.gov.in/>

⁷⁰<https://foscoss.fssai.gov.in/about-foscoss>

Food Safety Compliance System (FoSCoS) is an enhanced version of Food Licensing and Registration System (FLRS) which was launched in 2012 for issuance of pan-India FSSAI Licenses and Registration. It had evolved incrementally and organically with changing regulatory needs. FoSCoS is built using latest technology with a vision to have modern on stop pan-India IT platform for food safety regulatory needs.

FoSCoS is conceptualized as the umbrella system which is integrated with FSSAI's other existing IT platforms such as Food Safety Compliance through Regular Inspection and Sampling (FoSCoRIS), Food Safety Connect-Complaints Management System, Online Annual Return platform, Food Import Clearing System (FICS), Indian Food Laboratory Network (InFoLNet), Audit Management System (AMS), adjudications and penalties, Food Safety Training and Certification (FoSTaC), Food Safety Mitra (FSM) etc. These integrations will be done one by one in future until FoSCoS evolves from a licensing platform to a unified compliance platform. FosCoS has a robust architecture capable of future extensions and enhancements.

FoSCoS is being integrated with other platforms of Government of India such as GST, PAN, MCA etc. further ease out the processes for businesses and also ensure a 360-degree profiling of businesses.

7.5. ISO 9000⁷¹

The ISO 9000 standards focus on the best management practices for quality assurance. It sets out the criteria for a quality management system and is the only standard in the family that can be certified. It can be used by any organization, large or small, regardless of its field of activity. This standard is based on a number of quality management principles including a strong customer focus, the motivation and implication of top management, the process approach and continual improvement.

Using ISO 9001 helps ensure that customers get consistent, good-quality products and services, which in turn brings many business benefits. The ISO 9000 helps to create a more effective and efficient operation; increase the level of customer satisfaction and relation; enhance the motivation of employees as well as awareness and morale; and reduction of wastage and increase productivity.

7.6. ISO14000⁷²

The ISO 14000 is a series of environmental management standards developed and published by the International Organization for Standardization (ISO) for organizations. The ISO 14000 standards provide a guideline or framework for organizations that need to systematize and improve their environmental management efforts. The purpose is to help companies manage processes while minimizing environmental effects.

ISO 14000 includes several standards that cover aspects of the managing practices inside facilities, the immediate environment around the facilities, and the life cycle of the actual product. This includes understanding the impact of the raw materials used within the product, as well as the impact of product disposal. This certification can be achieved by having an accredited auditor verify that all the requirements are met.

Obtaining the ISO 14000 certification can be considered a sign of a commitment to the environment, which can be used as a marketing tool for companies. It may also help companies meet certain environmental regulations. The other benefits include being able to sell products to companies that use ISO 14000-certified suppliers. Companies and customers may also pay more for products that are considered environmentally friendly. Meeting the ISO 14000 standards can

71<https://www.iso.org/iso-9001-quality-management.html>

72<https://www.iso.org/iso-14001-environmental-management.html>

help reduce costs, as it encourages the efficient use of resources and limiting waste. This may lead to finding ways to recycle products or new uses for previously disposed of by-products.

The most notable standard is ISO 14001, which lays out the guidelines for putting an environmental management system (EMS) in place. The ISO 14001 should be used by any organization that wishes to set up, improve, or maintain an environmental management system to conform with its established environmental policy and requirements. The requirements of the standard can be incorporated into any environmental management system, the extent to which is determined by several factors including the organization's industry, environmental policy, products and service offerings, and location. It is relevant to all organizations, regardless of size, location, sector, or industry.

7.7. Government Initiatives to Promote Horticulture Value Chain

The strategy of GoHP for the rapid and sustainable development of the horticulture sector includes a variety of initiatives. This focus on growth through diversification into high value horticulture production by creating an environment that enables the farming community to acquire the necessary technical knowledge and capacity to capitalize on emerging market opportunities. The state's strategic shift to and emphasis on high value horticulture opens the financial viability of providing irrigation, which in turn provides improved resilience against rainfall uncertainties.

Weather Based Crop Insurance Scheme⁷³:

The GoHP actively supports the implementation of Weather Based Crop Insurance Scheme (WBCIS). The WBCIS was initially launched in Himachal Pradesh in 6 Blocks for Apple crop and in 4 Blocks for Mango crop during rabi season 2009-10 on pilot basis. In view of the popularity of this scheme, the coverage under this scheme has been extended during the consecutive years. During 2017-18, the scheme is being implemented in 36 Blocks for Apple, 41 Blocks for Mango, 15 Blocks for citrus, 13 Blocks for Plum and 5 Blocks for Peach crops. From the year 2016- 17 name of the scheme has changed to Restructured Weather Based Crop Insurance Scheme (R-WBCIS) and sum insured has been revised and bidding system has been introduced. During Rabi season 2019-20, 84,623 farmers have been covered under R-WBCIS for apple, peach, plum, mango and citrus fruit crops, who have insured their 63,61,540 trees for which the state government has borne 25 per cent premium subsidy of ₹20.31 crore. The sum insured is equivalent to the 'cost of cultivation' and shall be the product of the cultivator's declared 'area/tree under cultivation.

Mission for Integrated Development of Horticulture (MIDH)⁷⁴:

This is a Centrally Sponsored Scheme for the holistic growth of the horticulture sector. It is being implemented in the State under which assistance is provided as back ended subsidy @ 50% to farmers for carrying out various horticultural activities. It includes activities such as: Plantation Infrastructure Development (Open pollinated crops, Hybrid seeds); Horticulture Mechanization (Tractor, Power tiller, Land Development, tillage and seed bed preparation equipment's; Sowing, planting reaping and digging equipment); Integrated Post-Harvest Management (Integrated pack house with facilities for conveyer belt, sorting, grading units, washing, drying and weighing; Pre-cooling unit; Cold room (staging,); Mobile pre- cooling unit.; Cold Storage (Construction, Expansion and Modernization); Establishment of marketing infrastructure for horticulture produce in government/private and cooperative (Wholesale markets Rural markets/ mandies/direct markets) Gravity Operated ropeway in hilly areas).

73http://www.hpagriculture.com/Revamped_RWBCIS_from_Kharif_2020_to_Rabi_2022-23.pdf

74<https://midh.gov.in/>

Rashtriya Krishi Vikas Yojna (RKVY):

Rashtriya Krishi Vikas Yojana was initiated in 2007 as an umbrella scheme for ensuring holistic development of agriculture and allied sectors by allowing states to choose their own agriculture and allied sector development activities as per the district/state agriculture plan. The programme focuses on enhancement of soil health and mechanization; development of rain fed farming systems in and outside watershed areas; strengthening of market infrastructure and marketing development, and enhancement of horticultural production and popularization of micro irrigation systems.

Mukhya Mantri Greenhouse Renovation Scheme (MMGRS):

Keeping in view the damage caused to the polyhouse structure due to natural calamities and losses incurred by the farmers, the Govt. of Himachal Pradesh has launched MMGRS in 2017-18 in order to provide support to such farmers. Under this scheme, assistance was being provided to the polyhouse farmers @ 50% maximum subject to Rs. 32/- per sq. metre for replacement of Polysheet after at least five years of polyhouse construction or damaged due to natural calamities. The scheme was implemented by the Department of Agriculture only. However, with the vision to provide additional benefit to the farmers under the scheme and to cover the large number of greenhouse growers, the state Government has recently announced to raise the rate of assistance to 70% and has also allocated funds to the Department of Horticulture for the year 2018-19.

Solar Irrigation Scheme:

Saur Sinchai Yojana 2021 in Himachal Pradesh is a new scheme which is aimed at increasing the income of farmers in the state by providing them the facility of irrigation through the use of solar power. Under this scheme, govt. will provide 90% financial assistance to small and marginal farmers for purchase of pump-sets. Govt. provides 80% subsidy to all individual medium and big farmers.

8. Key Recommendations

This chapter deals with crop specific recommendations across the value chain covering preproduction, production, harvest, post-harvest levels. This is followed by recommendations on value chain ecosystem covering pre harvest and post-harvest infrastructure interventions and capacity building of the requisite stakeholders for achieving the envisaged development.

8.1. Specific Recommendations for Different Fruits Value Chain

A compiled recommendation of each crop is presented in the table below at each value chain node from pre-harvest and production, harvest, post-harvest, supply chain and logistics and collective action and branding.

Sweet Orange

Table 79: Recommendations for Sweet Orange

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Pre- production and Production Level	▶ To provide quality planting materials ▶ Best quality fruits	▶ Lack of quality planting materials resulting in low productivity	▶ Provision of quality planting materials ▶ Scientific cultivation practices to be followed	▶ Nursery for multiplication of citrus planting materials with virus indexing facility. ▶ R& D centre at university for standardization of quality plating material
Harvest level	▶ To train and demonstrate the farmers on proper harvesting methods	▶ Harvesting with fruit stem leading to puncturing of other fruits in the bag/crates	▶ Training and IEC materials	▶ Conduct training and demonstration on proper harvesting technique. Provision for A shaped ladder, clippers, harvesting bags
Post-Harvest Infrastructure Level	▶ To provide grading and packing facilities to	▶ Lack of proper sorting and grading leading to low price in the market	▶ Mini pack-houses at common points	▶ Construct mini pack houses near to collection points. ▶ Renovate existing pack-houses

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
	farmers near to their farms			▶ Establishment of training cell in University/research centre for both pre and post-harvest training
Supply Chain/ Cold Chain Logistics	▶ To provide transport facilities for transportation to the market	▶ Lack of transportation leading to high spoilage	▶ Pick-up vans. Ropeways in inaccessible areas	▶ Provide pick-up van and build system for its proper utilization and maintenance
Processing	▶ To build capacities in primary and secondary processing ▶ To establish micro-processing units ▶ To strengthen existing processing units, operated by government and private sector	▶ Farmers are selling the fruits without any processing, resulting in lower shelf life and low return	▶ Training and capacity building in processing ▶ Capital grant for strengthening existing processing units and establishing micro-processing unit	▶ To conduct training on processing and provide basic equipment for household level processing
Collective Action and Branding	▶ To establish and promote a common brand for the project products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trademark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

Guava

Table 80 Recommendations for Guava

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Production Level	▶ Quality fruit production with properly managed orchard	▶ Canopy can become very dense and uncontrolled. ▶ High incidence of fruit fly in rainy season crop. ▶ Guava wilt can become a serious problem	▶ Training and pruning must be done to get better plant structure. ▶ Adoption of bagging technique by farmers to avoid the infestation of Fruit fly ▶ Installation of solar traps and pheromone traps ▶ Bio-control agents, <i>Aspergillus niger</i> (AN 17) for guava wilt*. ▶ Intercropping with turmeric ▶ Boundary plantation of Marigold	▶ Providing growers with Anti-fog* Polybags (13" 9" dimension) with proper cuts at its base (1" length) – 1 piece per fruit ▶ Paper – Half newspaper size page per fruit ▶ Foam Net (Bottle neck) – 1 per fruit ▶ 1 pheromone trap/acre ▶ Co-cultivation with <i>Curcuma domestica</i>, <i>Allium sativum</i> and <i>Tagetes erecta</i> were found effective in reducing the incidence of wilt in guava
Harvest level	▶ Minimize damage while harvesting	▶ Soft skin leads to early damage	▶ Training for gentle handling of fruits and harvesting with secateurs not pulling by hand	▶ 4 Secateurs per acre. 2 buckets. 5 crates ▶ Smooth crates/buckets/harvesting bags
Post-Harvest Infrastructure Level	▶ Sorted, graded and packaged fruits	▶ Lack of aggregation points and Pack house	▶ Establishment of collection centers and pack house	▶ Construction of packhouses at cluster level

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Supply Chain/ Cold Chain Logistics	▶ Taking the fruits to newer markets. Arranging the transportation in advance	▶ Lack of connectivity leads to localized marketing and increased overhead in transportation ▶ Also sometimes overhead transportation leading to higher labour cost	▶ Establishment of transportation and logistics facilities	▶ Aggregating the districts produce and prearranging the transportation at aggregation point. Covered trolleys for local market, reefer vans for long distance transportation.
Processing	▶ To convert produce into value added products and enhance income of the entrepreneurs	▶ No direct linkage with existing processing units.	▶ Linkage with food processing units. ▶ Guava Pulp Plant ▶ Entrepreneurs can also be attracted for small processing units for guava leather, nectar, candies, RTS, jelly	▶ Upgrading the existing processing units and linking the CHPMA with processing units
Collective Action and Branding	▶ To establish and promote a common brand for the project products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trade mark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

Pomegranate

Table 81 Recommendations for Pomegranate

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Pre production and Production Level	▶ To arrange for Tissue Culture quality planting material. ▶ Production of best quality fruits	▶ Lack of information for scientific cultivation	▶ To provide facilities for mulching, drip irrigation, bagging and composite	▶ Timely provision of these facilities. ▶ Establishment of Tissue culture facility ▶ Technological knowledge transfer
Harvest level	▶ Gentle and safe harvesting of the produce free from disease and pest incidence	▶ Poor awareness on proper harvesting method	▶ Training and awareness	▶ To conduct training in Package of Practice and maturity indices for proper harvesting.
Post-Harvest Infrastructure Level	▶ Primary processing and packaging of produce	▶ Non availability of infrastructure facility	▶ Establishment of the pack houses at cluster level	▶ Training on practices to be followed at pack house
Supply Chain/ Cold Chain Logistics	▶ To improve supply chain logistic in transportation and reach of the produce to distant markets for better price like Jammu and Azadpur	▶ Reefer transport not available	▶ Provision of temperature-controlled vehicle for transportation	▶ To procure and provide the temperature-controlled vehicle with established system for utilization and management
Processing	▶ To promote processing of pomegranate arils into diverse products	▶ Presently, there is no organized processing unit. ▶ High potential for dried Aril (Anardana) and anardana powder not being tapped	▶ Processing units ▶ Training & capacity building	▶ Provision of processing facilities together with training on processing and quality control

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Collective Action and Branding	▶ To establish and promote a common brand for the project products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trademark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

Litchi

Table 82 Recommendations for Litchi

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Production Level	▶ To train farmers on proper Package of Practice	▶ Litchi is sensitive to production techniques and timings.	▶ Awareness and training to the farmers with technical handholding during production cycle	▶ Conduct training at cluster level, and provide handholding support through technical facilitation
Harvest level	▶ Safe and gentle harvesting, collection in harvest bags with no fruit cracking	▶ Fruit cracking is evident in some fruits which can spoil other fruits also	▶ Litchi net harvester and training on its usage. A type self-standing ladder for facilitation	▶ Facilitation of equipment like harvester, refractometer, ladder, clippers
Post-Harvest Infrastructure Level	▶ To provide pre-cooling chamber facilities to harvested fruits	▶ Due to short shelf life, spoilage is very high	▶ Pre-cooling is required to prolong the shelf life	▶ Promote mini packhouse with pre-cooling chamber
Supply Chain/ Cold Chain Logistics	▶ To organize temperature-controlled vehicle for transportation	▶ Considering the high degree of perishability of the crop it is essential that temperature-controlled vehicles are used.	▶ Provision of temperature-controlled vehicle for transportation	▶ To procure and provide the temperature-controlled vehicle with established system for utilization and management
Processing	▶ To promote proper fumigation by Sulphur di-oxide to reduce fruit loss	▶ Improper fumigation by Sulphur dioxide leads browning of pericarp besides health hazards.	▶ Awareness and training to farmers. ▶ Establishment/Equipping pack-houses with proper fumigation technology	▶ To conduct proper training on fumigation practices and ensure quality control
Collective Action and Branding	▶ To establish and promote a common	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trademark	▶ Get expert service for branding and market promotion,

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
	brand for the project products		▶ capacity building about branding, awareness activities etc.,	▶ Promotion material in form of materials in form of brochure, digital media

Persimmon

Table 83: Recommendations for Persimmon

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Pre production and Production Level	▶ Provide quality planting materials ▶ Train farmers in modern cultivation practices in Persimmon cultivation	▶ Farmers still follow conventional production practices with very low productivity ▶ ▶	▶ Provision of quality planting materials ▶ Training and demonstration in cultivation practices	▶ To multiply and provide quality planting materials by promoting nursery for Persimmon ▶ Organize training programmes for cultivation technology ▶ ▶ Research and development at university level for selection of dwarfing rootstocks
Harvest level	▶ Careful harvesting with no damage to calyx and skin	▶ Rough harvesting leads to damages	▶ Technological capacity development	▶ Organizing training program for farmers to cut the fruits not pull them from stem
Post-Harvest Infrastructure Level	▶ Pre cooling, cold storage and packaging facility	▶ No infrastructure facility available	▶ Pre conditioning at 23oC, Waxing of the fruits	▶ Facilities for washing, drying, polishing, waxing, pre cooling, storage and packaging
Supply Chain/ Cold Chain Logistics	▶ Safe longdistance transportation without chilling injury	▶ Open trolley transport leading to damages	▶ Arrangement of facilities	▶ Pre cooled reefer trucks at 10-12oC with RH 80-85%
Processing	▶ Production of many value added products like jam, slices and preserves	▶ Non-availability of processing units	▶ Establishment of units	▶ Technology transfer for development of processed products

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Collective Action and Branding	▶ To establish and promote a common brand for the project products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trade mark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

Plum

Table 84 Recommendations for Plum

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Production Level	▶ To promote varietal diversification with genetically improved cultivars.	▶ Santa Rosa is the predominant plum cultivar grown over 90 percent of the total area under plum cultivation in Himachal Pradesh and the predominance of single cultivar leads to monoculture like situation and create gluts in the market and the farmers do not get remunerative prices for their produce	▶ R & D with new cultivars ▶ Promoting demonstration of new cultivars like 'Black Amber' and 'Duarte'	▶ To support horticultural research station in R & D of new cultivars. ▶ Promote demonstration of new cultivars at farmers' field.
Harvest level	▶ To promote safe harvesting without damage to skin and pedicel. ▶ Determination of maturity as per distance from the market	▶ Early harvesting can result in immature fruits. Late harvested fruits have a short shelf life	▶ Training & demonstration for safe harvesting methods	▶ Conduct training to farmers for safe and timely harvesting of plum fruits and minimizing damage to the skin
Post-Harvest Infrastructure Level	▶ To provide pre-cooling chamber facilities to harvested fruits	▶ Due to short shelf life, spoilage is very high	▶ Pre-cooling is required to prolong the shelf life	▶ Promote mini packhouse with facilities for washing, sorting, grading, pre-cooling chamber and storage
Supply Chain/ Cold Chain Logistics	▶ To organize temperature-	▶ Considering the high degree of perishability of the crop it is essential that	▶ Provision of temperature-controlled vehicle for transportation	▶ To procure and provide the temperature-controlled vehicle with established

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
	controlled vehicle for transportation	temperature-controlled vehicles are used.		system for utilization and management
Processing	▶ Plum can be converted into many value added products like syrup, spread, jam	▶ Limited processing facilities available in the state	▶ Support for establishment of units and technical training for the same	▶ Encouraging entrepreneur's fir establishment of processing units
Collective Action and Branding	▶ To establish and promote a common brand for the project products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trademark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

Mango

Table 85 Recommendations for Mango

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Production Level	▶ To promote cultivation of frost resistance varieties	▶ Mango is highly susceptible to the frost	▶ Improved cultivars of Mango ▶ Selection of frost-free locations for cultivation	▶ Promote cultivation of drought resistance varieties like Chausa ▶ Promote cultivation in lower elevation where frost incidences are very low/negligible
Harvest level	▶ To promote bagging practices in mango fruits		▶ Bagging prevents pests, especially fruit flies, from reaching and damaging the mangoes and prevents latex burns and fungal spots on the fruits	▶ Provide training to farmers in bagging technology ▶ Establish demonstration sites ▶ Procure and provide bags to the farmers at subsidized rate.
Post-Harvest Infrastructure Level	▶ Preparing and marketing the fruits as per demand	▶ Lack of infrastructures facilities at post-harvest level	▶ Establishment of pack houses	▶ Packhouse with facilities for precooling, de-sapping, washing, ethereal ripening, packaging, and storage
Supply Chain/ Cold Chain Logistics	▶ To organize temperature-controlled vehicle for transportation	▶ Considering the high degree of perishability of the crop it is essential that temperature-controlled vehicles are used.	▶ Provision of temperature-controlled vehicle for transportation	▶ To procure and provide the temperature-controlled vehicle with established system for utilization and management
Processing	▶ Processing facilities at household level	▶ Organized processing facilities suggested	▶ Improve farmers' accessibility to existing processing units	▶ No fresh establishment of mango pulp unit as cost economics will not work out.

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Collective Action and Branding	▶ To establish and promote a common brand for HPSHIVA products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trademark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

Pecan nut

Table 86 Recommendations for Pecan nut

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Production Level	▶ To produce best quality pecan nuts free from any pest and diseases	▶ Pecan nut cultivation suffers from lack of suitable methods of propagation, inadequate vegetatively propagated plants, and lack of standard rootstocks and cultivars	▶ Arranging the quality planting material, root stocks, inputs	▶ Establishment of nursery. Timely supply of irrigation, fertilization and plant protection measures. ▶ Training on production practices particularly canopy management.
Harvest level	▶ Safe harvesting when husk split open and separated from the nuts	▶ Non availability of mechanical shakers	▶ Training on harvesting and usage of mechanical shakers	▶ Arrangement of mechanical shakers before harvesting season
Post-Harvest Infrastructure Level	▶ Shelling, drying and packaging	▶ Non availability of units	▶ Shelling units near the production area	▶ Encouraging the entrepreneurs for establishment of shelling, drying and packaging unit
Supply Chain/ Cold Chain Logistics	▶ Linking production area and processing unit and then safe transportation to the wholesale and retail markets	▶ Currently no linkage available	▶ Non reefer transport with humidity between 65-70% so there is no development of moulds	▶ Arrangement of transportation facility with dehumidifier
Processing	▶ To promote processing of Pecan at in developing different value-added products like pecan nut butter	▶ No units for processing/ Shelling	▶ Training on development of value-added products	▶ To conduct training to micro-entrepreneurs and provide processing equipment

Components	Objectives	Constraints	Required Interventions	Recommended Action Points
Collective Action and Branding	▶ To establish and promote a common brand for HPSHIVA products	▶ Lack of branding and collective action in marketing leads to low price realization	▶ Promotion of branding and trademark ▶ capacity building about branding, awareness activities etc.,	▶ Get expert service for branding and market promotion, ▶ Promotion material in form of materials in form of brochure, digital media

8.2. Value Chain Development Framework

In the view of scale and complexity involved in implementation of project, EY team proposes three-tiered structure for development of HPSHIVA Value chain. This structure is segmented at 3 levels namely Group of Cluster (GoC level), District level and State level as follows:

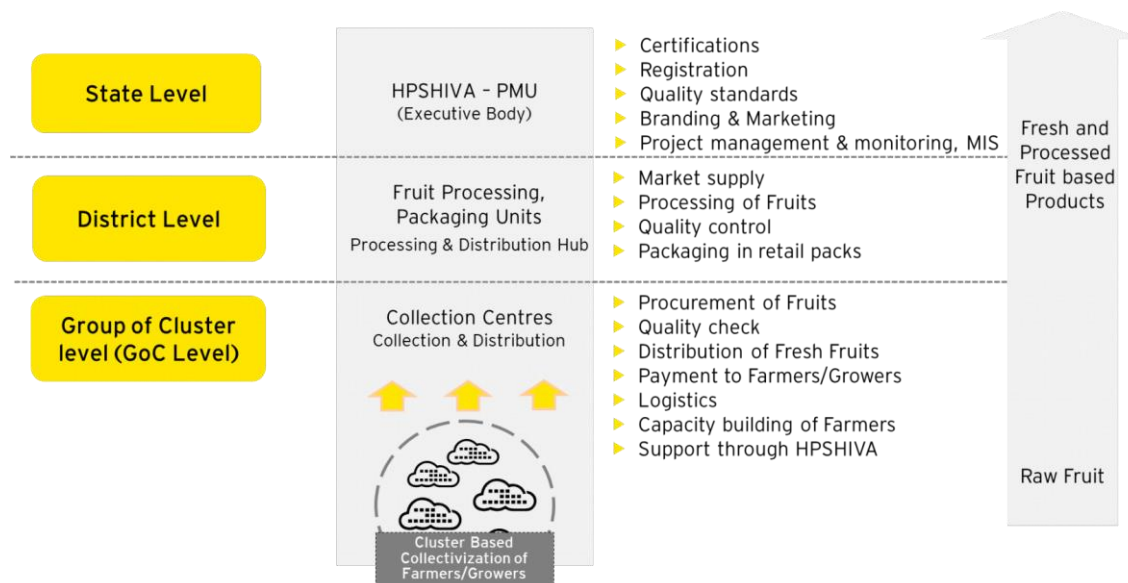


Figure 82: Three-Tiered structure for development of HPSHIVA Value Chain

The overall monitoring and management of the project is done at the state/ Apex level, which is responsible for quality control, certification, branding, market promotion, monitoring and data management. It will support the fruit value chain management by ensuring optimization of the flow of material, information, and fund. It closely works with district level packhouses and processing units which acts as Processing and Distribution hubs. They will be responsible for overall quality control, processing, packaging, and establishing market linkages. These will be connected to Group of cluster level namely Collection and Aggregation Centers (CACs) where majority of ground level aggregation and actual project implementation takes place.

The major responsibility of each of the bodies at various levels of value chain is detailed in the info graph presented below:

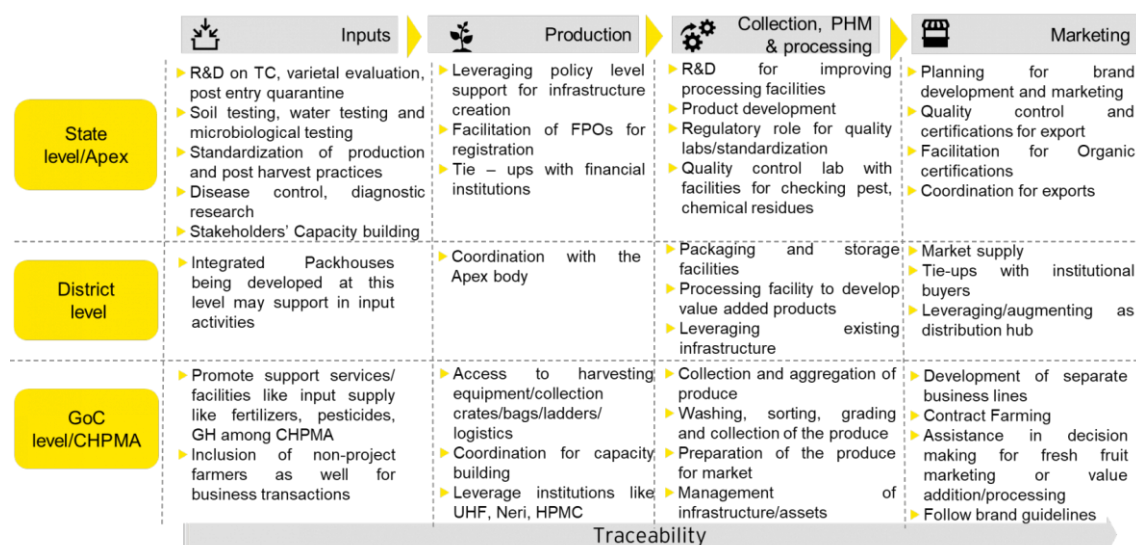


Figure 83: Ecosystem development framework

The details of the interventions required at the infrastructure and capacity building is explained in the following sections:

8.2.1. Proposed interventions in Infrastructure development

Infrastructure is the basic requirement for increasing the value of the produce. The quality of the produce can't be improved after harvesting but it can be preserved. Infrastructure at pre harvest level will help to improve the quality and productivity of fruits whereas infrastructure at post-harvest level will help to retain the quality, increase the post-harvest life and make accessible distant markets.

Summary of existing infrastructure and gap analysis

For quality planting material production there are few nurseries in the state and also a plan has been proposed to develop the nurseries for quality planting material production. At the production level DOH in the PRF cluster is providing facilities for water harvesting, mulching, composite fencing. At post harvest level the state has three types of infrastructure facilities, cold storages for Potato and Apple and processing plants. There are processing units run by the government under the HPMC, there are ones are run by the private sector companies mainly owned by entrepreneurs. The government processing units have centralised plans and budgets. These budgets are then allocated for respective processing units to implement the plan. There are 27 private processing and packing units and 7 government food processing units in project area.

The major government processing unit is HPMC which was established with the objective of marketing fresh fruits and processing all types of surplus fruits however, it mainly deals with apple. It also provides inputs, tools and implements besides apple grading. Packaging and storage facility. Now the units under HPMC have also ventured into processing of sub- tropical fruits. The Fruit Canning Units under HPMC are manufacturing various kind of processed foods and selling their products under the name "himcu". The government processing units have centralised plans and budgets. These budgets are then allocated for respective processing units to implement the plan. Majority of the private processing units backed by the Department of Horticulture, Himachal Pradesh are in defunct state. Some of them working on Spices and aromatic plants and few are preparing juices, pickles and ready to eat products.

The summary of gaps identified during the field visits and as discussed with stakeholders are as follows:

- ▶ Shortage of water harvesting structure and drip irrigation facilities
- ▶ Danger from animals without fencing
- ▶ Even if cold storages are present, they are mostly used for Apple and Potato
- ▶ Some processing units are old and dysfunctional. Operational capacity of the units not fully utilized
- ▶ Lack of market information system and access to markets
- ▶ The procurement of raw materials, and MRP rates of the products are fixed by Department of Horticulture and it is constant across the units. As production and operation costs are different across units, keeping fixed rates may sometimes be not profitable.
- ▶ The factories have been operating within lesser capacity about 60% utilization, however, there is potential for increasing the capacity utilization to around 90%. Most of the facilities are used for 1-2 seasonal crops reducing the number of working days and availability of raw materials are the reasons for under utilization.
- ▶ Though there is potential and scope to improve production and build the brand nationally and also enter export markets, the marketing activities performed are very limited within state and very few neighbouring states.

- ▶ The current condition of infrastructure is dilapidated and needs immediate action on renovation, especially in government processing units.
- ▶ Limited availability of number of trained and skilled manpower in the units.

i. Interventions in Pre harvest infrastructure

The major infra facilities required at pre harvest level are facilities for soil and water testing which can be established at College of Horticulture and Forestry, Neri for proper identification of gap and nutrient management planning. In addition, R & D centre for standardization of Tissue Culture protocol, development of new varieties and standardization of package of practices are required. The details of these infrastructure will be part of Horticulture Sector Development Strategy and Investment Plan Report 2023-2030.

In the orchard level, major facilities needed are mulching for weed management and moisture conservation, water storage and drip irrigation facility for irrigation and composite fencing for protection of orchards from wild animals, monkeys etc. The approximate cost of installation of drip irrigation is about INR 65,000 per hectare and cost of establishment of water storage facility is about INR 50,000 for 10,000 lt. Composite fencing for protection of fruits in orchards costs about INR 5 lakhs per hectare.

Input shop:

The input shop will serve the group of clusters and will have storage area and shelves for storage of chemical fertilizer, organic fertilizers, pesticides (from reputed companies), biofertilizers, CFB packages, plastic crates, plant growth regulators, gloves, head gear, chlorine for water, stickers for label, pet bottles, jars, jar closures, separators etc.

It is proposed to have 13 input shops in packhouse premises to cater to the additional requirements as mentioned above. They will be maintained by producer groups. Total cost of the project for the establishment of the shops will be INR 10 lakhs per unit.

Composite Fencing:

It is a barbed wire fencing with multiple strands of plain wires and metal/cement/ wooden posts to hold the strands in position. The wires carry high voltage current. The Solar Power Fence gives a sharp, short but a non-lethal shock to the intruder and creates psychological fear, against any tampering. The alarm incorporated in the system gets activated and alert the inmates of the protected area. These are tailor made fences and can be designed according to customer needs and site condition.

A solar panel is made up of several photovoltaic cells connected in series. Electricity is generated by these cells. Combined into a solar panel, these cells can produce enough voltage to charge a regular 12 volt battery. The solar panel ensures that the battery remains always charged. The battery stores the energy generated by the panel and powers the energizer 24 hours a day. This way the fence is electrified and animals touching the fence receive the shock. Due to high voltage shock to the animals touching the fence, animals keep away from the fence and field is protected.

ii. Interventions in Post- harvest infrastructure

The major infrastructure facilities to be developed include packhouses, collection centres and upgradation/ of existing processing units/establishment of units.

The infrastructure support is proposed to be provided at three levels state level, district level and group of cluster level by integrating the existing facilities and creating new facilities. It is suggested to also integrate the existing processing unit rather than creating completely new infrastructure, the project should support in upgradation and strengthening of existing government and private processing units, and integrate them with HPSHIVA production system (CHPMA, FPOs/SME and FPCs).

Futuristic Value chain

It is supposed that with interventions and support from the government, the futuristic value chain of the commodities will be different than existing value chain and following product flow is envisaged as presented in the diagram below:

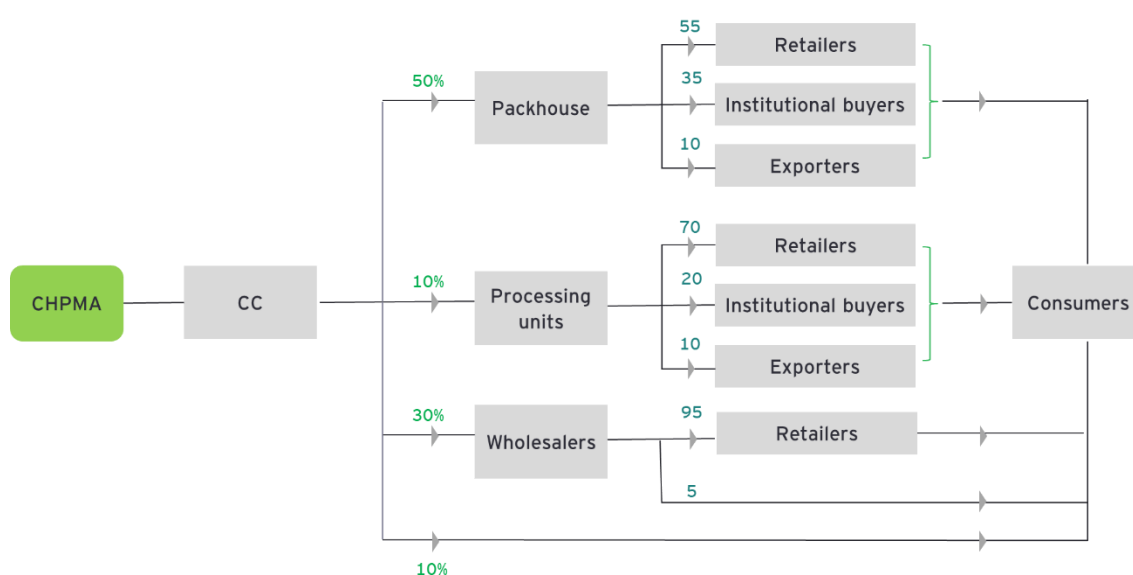


Figure 84 Futuristic Value Chain

Out of the total harvested produce from CHPMAs, it is expected that the produce likely to go through Collection Centres. Thereafter, 50% produce may go to district level packhouses, 10% to district level processing units, 30% to wholesalers, and 10% may directly to marketing. These are the estimated projections which may vary depending on the the actual situation.

The details of the infrastructure have been worked out based on the value chain, marketable volume and seasonality of the produce.

Through collection centres, four marketing channels are proposed in which 80% of the produce will be Grade A and Grade B that may go through packhouses and wholesalers, 10% of produce which is usually Grade C through processing industry and remaining 10% produce to direct marketing.

Among packhouse and wholesalers, distribution of Grade A and Grade B produce is assumed as 50% and 30% respectively.

Pomegranate as an example:

Assume, the value of pomegranate through direct marketing is INR 30 per kg, to processing unit is INR 8 per kg, and INR 40 per kg both to wholesalers and packhouse. Considering, packhouse charges of 3 rs gets add on to the value and with an assumption of 8% margin, the final value of pomegranate

is 46.44 per kg, whereas value of pomegranate will be INR 42.84 after addition of 2% of market fee and 5% margin. The total value of pomegranate if 1000 MT is flown through these two channels for variable distribution percentage is as follows:

Table 87: Case 1- 50% packhouse, 30% wholesalers

Case 1: 50%, 30% Total Produce= 1 MT	Packhouse (50%)	Wholesalers (30%)
Volume	500 kg	300 kg
Total Value	23220	12852
Difference (Packhouse - wholesalers)	10368	

Table 88: Case 2- 40% packhouse, 40% wholesalers

Case 2: 40%, 40% Total Produce= 1 MT	Packhouse (40%)	Wholesalers (40%)
Volume	400 kg	400 kg
Total Value	18576	17136
Difference (Packhouse - wholesalers)	1440	

Table 89: Case 3- 30% packhouse, 50% wholesalers

Case 3: 30%, 50% Total Produce= 1 MT	Packhouse (30%)	Wholesalers (50%)
Volume	300 kg	500 kg
Total Value	13932	21420
Difference (Packhouse - wholesalers)	-7488	

From above scenario, it is understood that 50%, 30% case has attained maximum difference of INR 10,360. This is after consideration of not drastically disturbing the existing supply chain and impact on stakeholders.

Marketable volume

The marketable volume is calculated based on yield estimated from the proposed plantation schedule. Spoilage in each crop is considered till aggregation level. The summary of calculated Marketable volume from plantation is presented below. The detailed calculations are provided in Annexure VII for reference.

Table 90 Marketable volume of fruits (MT)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sweet Orange	-	-	4,783	11,160	20,726	35,074	53,409	75,729	87,686	95,657	95,657	95,657	95,657	95,657	95,657	95,657	92,469	87,686	82,903	74,931
Guava	-	-	4,325	10,091	18,740	31,713	48,291	68,472	79,284	86,491	86,491	86,491	86,491	86,491	86,491	86,491	83,608	79,284	74,959	67,752
Pomegranate	-	-	1,483	3,461	6,427	10,877	16,562	23,484	27,192	29,664	29,664	29,664	29,664	29,664	29,664	29,664	28,675	27,192	26,203	25,214
Litchi	-	-	-	-	359	1,434	3,227	6,096	10,579	17,571	25,102	31,915	38,728	44,824	49,307	50,203	50,203	50,203	50,203	50,203
Persimmon	-	-	179	418	777	1,315	2,002	2,839	3,287	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,466	3,287	3,108	2,809
Plum	-	-	-	68	203	473	946	1,656	2,669	3,852	5,204	6,488	7,636	8,650	9,461	9,968	10,137	10,137	10,137	10,137
Mango	-	-	-	242	604	1,087	1,933	3,141	4,652	5,739	6,706	7,551	8,155	8,457	8,457	8,457	8,457	8,457	8,457	8,457
Pecan nut	-	-	-	-	31	93	186	340	572	851	1,098	1,314	1,469	1,546	1,546	1,546	1,546	1,546	1,546	1,546
Total	-	-	10,770	25,439	47,866	82,067	1,26,556	1,81,757	2,15,920	2,43,411	2,53,507	2,62,666	2,71,387	2,78,876	2,84,170	2,85,573	2,78,562	2,67,792	2,57,516	2,41,050

Yearly availability of fruits

On pursuing the data of availability of all crops it's clear that one or the other produce is available in all the seasons except March-April which can be utilized as maintenance season and facilities can be utilized for primary processing of other crops too. The facilities are proposed for Collection centre at Group of cluster level, Pack houses and Processing units at district levels and general infrastructure at state level apex body for monitoring of the activities.

S. No	Name of Plant (Crop)	Name of Variety	Jan				Feb				Mar				Apr				May				Jun				Jul				Aug				Sep				Oct				Nov				Dec			
			I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV								
1	Sweet Orange	All varieties																																																
2	Guava	Lalit, Shweta, VNR Bihi																																																
3	Litchi	Dehradun, Calcattia																																																
4	Pomegranate	Bhagwa																																																
5	Persimmon	Fuyu/ Jiro																																																
6	Plum	Angelino																																																
		Friar																																																
7	Pecan nut	Mahan																																																
		Nellis/ Berket																																																
8	Mango	Mallika (Late season Variety)																																																
		Pusa Arunima																																																

Figure 85: Summary variety-wise harvesting seasons in HP

It can be noted from above tables, that there is no fruit production in year 1 and year 2 after plantation. In year 3, there will be production from Sweet orange, Guava, Pomegranate and Persimmon. Therefore, number of days that are considered as per the harvesting season for these crops is 154 days. Similarly, number of harvesting days in year 4 is 210, with addition of Plum and Mango and in year 5 onwards, number of days is 273.

A. Group of Cluster level infrastructure:

a. Collection Centre:

Collection centre will be established at Group of cluster (GoC) level and each centre will cater to many clusters for proper utilization of facilities and the proposed centre will cater to the requirement of each identified crop. At each cluster, around two to five (2-5) micro-entrepreneurs will be identified and trained in primary processing. The CHPMA will select/nominate such persons based on their interest and earlier experience in similar work. These micro-entrepreneurs will be associated with the CHPMAs after the training, and will assist CHPMA in the collection and aggregation of the fruit production. They will also carry the collected fruits to Collection Centres for cleaning, sorting, grading, pre- cooling and packaging.

As discussed above, 50% of produce will be aggregated and forwarded through the Collection Centers. Also, for calculation of number of Collection centers required, pecan nut is not considered as it will need a separate facility. Considering the capacity of sorting and grading line at 2MT/hr with 1 shift of 8 hrs in a day, the throughput will be 16 MT/day. Based on the harvesting seasons of the respective fruit crops, there will be total 154 days of working in Year 3, 210 days in Year 4, and 262 days in Year 5 and subsequent years. The total requirement of collection centre comes to 70; 3 each in Year 3 and Year 4, 6 in Year 5, 8 in Year 6, 11 in Year 7, 14 in Year 8, 8 in Year 9, 7 in Year 10, 2 in Year 11, 3 in Year 12, 2 in Year 13, 1 in Year 14, 2 in Year 15. As the production of fruits grows subsequently the establishment of collection center also grows up and will continue even after the project period.

Table 91: Average MT and working days for Collection center every year

1 Collection Center	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average
Throughput in MT/ day	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
Number of functional days as calculated from Harvesting season	0	0	154	210	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	240
Effective MT per year	0	0	2464	3360	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368	3786

Table 92: Requirement of collection centres

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Total Volume (in 1000 MT)	0	0	11	25	48	82	126	181	215	243	252	261	270	277	283	284	277	266	256	240	
Total collection center required	0	0	3	6	12	20	31	45	53	60	62	65	67	68	70	70	68	66	63	59	
Cumulative till previous year	0	0	0	3	6	12	20	31	45	53	60	62	65	67	68	70	70	68	66	63	
Number of new collection centers required	0	0	3	3	6	8	11	14	8	7	2	3	2	1	2	0	0	0	0	0	70

The Collection centres are conceived as small-scale aggregation places managed and may be operated by micro-entrepreneurs. These collection centres will be the first level aggregation, common point that will have minimum infrastructure facilities so that not only initial losses are prevented but overall value is enhanced with proper grading, packing, and handling. The brief process flow of produce in the centre is presented below:

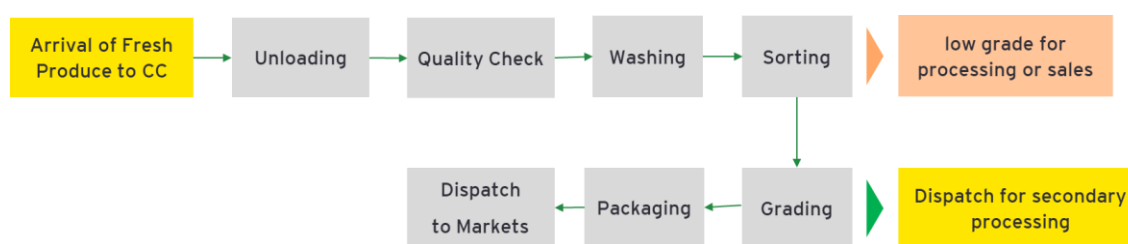


Figure 86: Process flow in Collection centers

These Collection centres will be supported by trained micro-entrepreneurs and used by the farmers. The capital cost of these centers includes land development, civil work, machinery and equipment. It is suggested that land should be contributed by community. Each collection centre will also have one pick-up van which will supply the processed produce to the district level SME and transport the inputs from districts for farmers. For working capital, the centers will charge nominal fee as facilitation charge for sorting, grading and packaging services to manage its operation. As the volume of produce will increase over years, the income of the CC will also increase. The tentative budget of one collection centre is given below.

Table 93 Cost of collection centre

S. No.	Particular	No of Unit	Unit cost	Rs. (in lakh)
1	Land development (500 sq.mt)	1	150	0.75
2	Building and civil structures 350 sq mt	1	800	2.8
3	Machinery and equipment:			
3a	Weighing scale			2.5
3b	SS Preparation table	1	45000	0.45
3c	Pre cooling units of ecozen (5 MT/hr)	1	12,00,000	12
3d	Fruit Washer	1	1,50,000	1.5
3e	Round Fruit Grader 1 MT/hr	1	2,00,000	2
3f	Supporting equipment's like crates, MS trolleys	1	1,00,000	1
3g	Pick up van (5 MT)	1	6,50,000	6.5
3h	Tan 90 boxes for transport	10	4000	0.4
	Total Budget (Rs. In lakh)			29.9

The establishment cost of collection centre comes to INR 29.9 lakhs with facilities for weighing, washing, sorting grading, supporting equipment and collection and distribution of produce. The maximum labour requirement is coming 10 labours @ INR500/day for 240 days with water requirement as 1260 lt/day @Rs. 30/kl and electricity requirement at 3kWh @ INR 4.6/KVA for 365 days . The revenue for collection center is based on service charge for primary processing facilities, packaging charges considered at a minimum of INR 0.5/kg whereas transport charge is INR 1000/trip. There will be 2 security guard @ INR 8000/month, supervisor 2 nos @INR 40000/month each and, manager @INR 60000/month.

For the model, inflation rate is assumed as 5.6%, Discounting factor for calculation of NPV is taken as 12%, depreciation as 5.6%. It is taken that loan will be repaid in 5 years at interest rate of 12%. The NPV is INR 27.22 lakh at 21.4% IRR as with pay back period in year 10.

B. Integrated Facility Centre

It is proposed to establish integrated facility centre at suitable location which will have the facilities for pack house and processing unit as per the locational demand. As per the locational demand and output either integrated units can be developed, or separate units or existing processing units can be upgraded. It will provide secondary and tertiary level processing support to HPSHIVA and other farmers in sub-tropical regions. After primary processing it is suggested that 10 % of the produce

will directly go the market, 30% through wholesalers, 50 % of the produce will move to packhouse and 10 % of the produce will be considered for processing.

A brief description of the facilities along with their business model is given below:

a. Packhouse

After the primary processing at CCs, about 50% of fruits will be brought to the pack house. Considering the throughput of sorting grading line at 5MT/hr and 1 shift working of 8 hrs, seasonality of all the fruit crops and utilization of the pack house the total number of pack houses to be established comes to 13 packhouses in total.

Table 94 Requirement of packhouses

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
50% of Marketable Volume to Packhouse	-	-	5,385	12,719	23,918	40,987	63,185	90,708	1,07,674	1,21,280	1,26,204	1,30,676	1,34,959	1,38,665	1,41,312	1,42,013	1,38,508	1,33,123	1,27,985	1,19,752
MV after adding back Mango which was not considered in processing (10% of Mango MV)	-	-	5,493	12,971	24,390	41,796	64,430	92,491	1,09,781	1,23,648	1,28,661	1,33,214	1,37,577	1,41,354	1,44,053	1,44,769	1,41,193	1,35,701	1,30,460	1,22,062
Number of Packhouses required to handle capacity	-	-	1	2	2	4	6	8	10	11	12	12	13	13	13	13	13	12	12	11
Cummulative till previous year	-	-	-	1	2	2	4	6	8	10	11	12	12	13	13	13	13	13	13	13
Number of new packhouses units	-	-	1	1	-	2	2	2	2	1	1	-	1	-	-	-	-	-	-	-

Facilities for Pack House:

The small-scale pack house with storage, packing and cool room facilities will be an enterprise that will cater to sorting, grading, washing, waxing, packing and cool storage of fruits. This enterprise will be managed by the respective Cluster Association/Farmers' producer organisation. The pack houses will have facilities for weighing, washing, sorting grading, pre-cooling, cold storage, post-harvest unit. One pack house in Mango cluster should also have facilities for ripening of Mango.

Table 95 Packhouse model

Investment Inputs	Unit area	Cost (INR lakhs)	Total cost (INR lakhs_
Land development (sq.m)	2500	250	6.25
Boundary wall (RM)	200	500	1.00
Pack house building of 1500 sqm @3000/ sq.m	1500	3,000	45.00
Post harvest unit -Structure, washing, sorting, drying, waxing, grading, packing -lines, 260 lac for1000sqm	1000	26,000	260.00
Weighing Scale/ Weighbridge -60 MT	1	700000	7.00
Weighing scale small	1	250000	2.50
Dock shelter, leveller, motorized overhead door	5	7,00,000	35.00
Material handling equipment Forklifts, etc for 10 men for 10 m	10	17000	1.70
Servo Stabilizer 200 KVA	1	185000	1.85
Genset 100 KVA	1	710000	7.10
SS tables for manual sorting /grading packing, etc. Length 3-5 m width 1-1.5 m	1	150000	1.50
Pre cooling unit (6 MT)	1	2500000	25.00
Cold Room Cum Staging Unit 30 MT	30	18000	5.40
Refrigerated Truck 5MT	1	1500000	15.00
Plastic crates (20 kg capacity) crates	275	2000	5.50
Guard room (sq. m)	10	3,000	0.30
Office inside pack house shed (sq.m)	15	3,000	0.45
Water source/ Tube well	1	2,50,000	2.50

Labour change room with washroom outside /inside packhouse shed (sq.m)	15	3,000	0.45
Laboratory -Inside or outside pack house shed (sq.m)	10	3,000	0.30
Store room inside the pack house shed (sq.m)	10	3,000	0.30
Rainwater harvesting arrangement	1	1,50,000	1.50
Sub-total			425.60

We have assumed that this huge production from 10-hectare orchards and the mega clusters that they will form in a single geographic location will need pack houses for backward and forward linkage with local, high end national markets, and potential export markets in different geographies. Hence for 10-hectare orchard the project will build pack houses in 1500 square meters where 1000 sq. mt will be utilized for equipment and machinery, rest area will be utilized as working and storage area with a cool room for storing around 30 MT of perishable fruits and vegetables. This cool room will be used by the farmers in cooling fruit as well as vegetables produced by the cluster organisations before being taken to the market. They would also be able to store fruits and vegetables produced by non-project small holder farmer within proximity of the clusters.

The pack house will consist of a boundary wall with docking, shelter, and a motorized door. A post-harvest unit for washing, sorting, drying, waxing, grading, and packing, with packing lines. It will comprise of a sorting line with a capacity of 5 MT per hour, electronic weigh grader line 1MT /hour. It will have packing lines, weighing scale, and weighing bridge of 60MT capacity, material handling equipment, and a smaller weighing machine as well. Furthermore, the pack house will have all the necessary electrical fittings that will be required for operating the pack house machines and the cooling room. The investment cost is approximately INR 4.26 Crores. All the cost assumptions are based on Crop cluster development program, secondary research, and insights from the field visits. The overall breakup and complete financial analysis are present in Annexure III (i) in detail.

The pack house will cater to all the crops in the project and hence will have a functioning period of 240 days starting with gradual increase in capacity utilization. As per manpower requirement 2 security guard @ INR 8000/month, maximum 15 labours for 240 days @ INR 500/day, 2 supervisors @INR 40000/month each, 1 assistant manager @ INR 50000/month and 1 manager @ INR 60000/- month have been considered. The water requirement is considered at 3000 lt/day and electricity requirement as 15KWh/day for the whole year. Chemicals and other inputs along with miscellaneous expenses have been considered

As per revenue streams a minimal service charge of Rs. 1/kg has been considered for sorting, grading, packaging and storage. The transport revenue for refrigerated has been kept at INR 3000/trip.

For the model, inflation rate is assumed as 5.6%, Discounting factor for calculation of NPV is taken as 12%, depreciation as 5.6%. It is taken that loan will be repaid in 5 years at interest rate of 12%. The NPV is INR 518 lakh at 24% IRR as with pay back period in year 9.

Mango ripening chamber:

Ripening of Mango will make it softer and sweeter. Overall, ripening procedure helps in improving the quality and taste of fruits. If you prefer Ripening of Mango, you can have sweeter and testier mangoes. To maintain the tastiness and longevity of the fruits.

Mango can be harvested at colour break stage and can be kept in the storage at this stage. As per the market demand they can be ripened for 24 hrs and then sent to market.

- ▶ Fully automatic temperature control system.
- ▶ Ethylene dozing is fully automatic Dozing can be set as per the requirement.
- ▶ Carbon dioxide level is automatically controlled by the system, which prevent softening of fruits.
- ▶ Ethylene concretions can be measured in PPM enabling precise dozing of the gas.
- ▶ Concentration of ethylene and carbon dioxide is continuously measured by precise instrument resulting in optimum good quality of the produce.

- ▶ Ripening cycle can be controlled by this system. ripening chamber for mangoes
- ▶ This system is acceptable by all the food standards.
- ▶ Very safe and hygienic process.
- ▶ With forced draft air circulation system, uniform ripening of Fruits is possible resulting in uniform colour of each Fruit.
- ▶ Our refrigeration system is design to maintain high humidity within the room which results in minimum weight loss after ripening process

An insulated cold room can be converted into ripening chamber by adding a catalytic generator which comes at a cost of INR 85000/- or a ethylene generator which costs INR 3000/cylinder.

Post harvest requirement for different fruit crops:

The post harvest requirements for different fruit crops are presented in the table below. Care has to be taken that climacteric and non-climacteric fruits should not to be stored together in the same season. Similarly, ethylene sensitive and ethylene producing fruits should not be stored together.

Table 96 Post harvest requirement of Fruits

Crop	Storage Temp °C	Type of fruit	RH %	Ethylene producing	Ethylene sensitive	Sensitive to chilling injury below temp (°C)	Waxing beneficial	Wrapping beneficial	Pre cooling	Storage life
Sweet Orange	4 to 7	Non-climacteric	90 to 95	Very Low	No	4	Yes	No	Hydrocooling	12 weeks
Guava	7 to 10	Climacteric	90 to 95	Medium	High	5	No	Yes	Hydrocooling	2-3 weeks
Pomegranate	5 to 10	Non-climacteric	90	No	No	5	No	Yes	Forced air	4-6 weeks
Litchi	4 to 7	Non-climacteric	90 to 95	Very low	Low	4	no	No	Forced air	3 weeks
Mango	10 to 13	Climacteric	85 to 95	Medium	High	7	Yes	yes	Hydrocooling	3-4 weeks
Pecan nut	-18 to 2	Non-climacteric	70	Very low	No	no	no	Yes	No	6 to 12
Persimmon	0 to 1	Climacteric	90 to 95	No	High	5	yes	yes	Hydrocooling	6 weeks
Plum	0 to 2	Climacteric	90 to 95	High	High	0 for long-term	yes	Yes	Hydrocooling	3-4 weeks

b. Processing unit

The processing units are proposed for aseptic processing for pulp, juice, jam, jelly sauces, canned fruits and pulp and a separate processing unit for Pecan nut. As per the requirement three processing units are required to be established. The establishment of new processing unit is more financially viable but upgradation of public processing unit (in Nagrota and Sirmour) can also be considered. The details for establishment are as under:

Land and land development

The land should be free from any encumbrance and shall be mortgageable. The land should be classified as non-agriculture. Permission for non-agriculture use, wherever applicable, shall be obtained for the land. The land may be leased by the government. The cost of land development varies from place to place and should be considered on actual basis.

Electrical and other items:

Various machines must be connected to electrical motors of suitable power ratings for supplying power to them. Accordingly, AC-3 phase motors of different power ratings, varying from 2.50 Hp to 7.50 Hp will be required for powering various unit operations of the unit.

Water Requirement

The total water requirement of such unit will be 5,000 litres per day. Water is mostly required for washing and in various unit operations during processing. The water should be clean and treated

well for hardness before use. It is preferable to carry out water testing from a reputed testing laboratory before setting up a plant.

Waste Disposal:

There will be minimum waste/garbage disposal as possible. The organic wastes will be utilized in the preparation of vermi-compost. There will be separate bins for different kinds of wastes. Non - degradable waste will be collected in separate area and dumped suitably. The effluent will be treated in Effluent Treatment Plant (ETP) before discharge into nearby nallah or municipality pipeline. Other sewage will be connected to municipality.

Building and civil structures:

The processing hall and other utilities would require construction of around 6,000 sq. ft. of building. The breakup of the area for various facilities would be- 2000 Sq.m for raw material storage area, 500 sq.m for washing area, 1000 sq.m for processing hall, 2000 sq.m for finished product storage area, 500 sq.m office, meeting hall, toilet, and guard room.

The processing buildings should be constructed as per the guidelines of FSSAI. The height of the building should be such that sufficient breathing space is available. All windows and doors should be provided with insect proof wire mesh. Slope as per standard guidelines should be provided in floor. Glazed tiled flooring shall be preferable to ensure easy cleaning of floor in evening.

Machinery details

The details for processing unit machinery are suggested below:

- ▶ **Fruit washing machine-** The fruit washing machine is used for different fruits and vegetables. The purpose of machine is to reduce the initial microbial load by washing raw materials with chlorinated water. Water used for washing has to be replaced at an interval of 3 to 4 hours. The proposed capacity of fruit washing machine is 5 MT.
- ▶ **Sorting or inspection conveyer** - This belt conveyor can be used for cutting, inspection and sorting purpose. The est.
- ▶ **Industrial Mixer Systems with Screw Feeder** The screw feeder is used for feeding of sorted and cut fruit to fruit mill. The capacity of feeding can vary from fruit to fruit.
- ▶ **Twin pulper-** The pulping is major activity in this project. The pulper crushes fruit and fine pulp is extracted. Therefore, a pulper of 3 MT per hour for fruits is required to ensure the regular supply of pulp. The fruit pulp passes through a sieve where stone or waste is removed.
- ▶ **Autoclave-Retort** is a pressure vessel used in the food manufacturing industry to commercially sterilize food after it has been placed into its container. An autoclave (also known as a retort) is used to sterilize products, equipment and supplies by subjecting them to high pressure saturated steam at 121 °C for between 15-120 minutes depending on the size of the load and the contents.
- ▶ **Juice Processing Machine:** The machine with a capacity of 500 kg/hour is recommended.
- ▶ **Automatic Natural Fruit Juice Bottle Packaging Machine:** Capacity - 50-60 bottles per minute
- ▶ **Steam jacketed kettle:** Pulp / other products requiring processing are heated in steam jacketed kettle at desirable temperature to reduce microbial load. During this process some ingredients like sugar and citric acid are also added to standardize the product. Capacity: 375 kg
- ▶ A fruit and vegetable processing unit will also require some supporting equipment's like crates, electric hoist, rotary flat can body reformer, body blanks (empty cans), working table, MS trolleys, plastic barrels, knives, weighing scale etc.
- ▶ Aseptic packaging line for safe packaging of juices and pulps

The costing for this unit is estimated as INR 224 lakhs and details are provided in Annexure III (ii).

Table 97 Processing unit cost

Investment Inputs	Unit	Cost (INR)	Total Cost (INR lakhs)
Land Development (2025 sq.m)	2025	250	5.06
Electricity (including 3 phase meter and transformer 100 KVA)	1	1,50,000	1.50
Water provision	1	3,00,000	3.00
Waste Disposal	1	1,00,000	1.00
Building Construction	600	3,000	18.00
Plant and Machinery			-
Fruit washing machine (5 MT)	1	1,50,000	1.50
Sorting or inspection conveyer	1	1,60,000	1.60
Screw Feeder (2MT/ hr)	1	3,33,000	3.33
Industrial Mixer Systems with Screw Feeder, Capacity: 350 Kg/Batch	1	1,70,000	1.70
Twin pulper (3 MT)	1	2,70,000	2.70
Industrial Juice Processing Machine (500 kg/hour)	1	1,10,000	1.10
Autoclave	1	1,50,000	1.50
Automatic Natural Fruit Juice Bottle Packaging Machine (50-60 bottles per minute)	1	60,000	0.60
Steam jacketed kettle (500 kgs)//	1	90,000	0.90
Miscellaneous	1	6,00,000	6.00
Aseptic processing line	1	17500000	175.00
Sub-total			224.49

Miscellaneous items include crates, electric hoist, washer & sterilizer, working table, MS trolleys, plastic barrels, weighing scale etc.

The maximum output of the capacity is considered at 300 MT/year starting with capacity utilization of 30%, 40%, 50%, 60% and gradually increasing to 100% in the 9th year onwards. The proportion of the output product is considered as 40% pulp, 20% juice, 30% jam, jelly squash and 10 % canned fruits

For operational expenses water requirement is considered as 1000 lt/day for 250 days whereas electricity requirement is considered at 15KWH for 365 days @ unit rate of INR 4.6. The other things required will be utensils and testing equipment like refractometer, penetrometer etc. For the optimal running of the processing unit, it is proposed to appoint 2 security guard @ INR 8000/month, maximum 15 labours for 240 days @ INR 500/day, 2 supervisors @INR 40000/month each, 1 assistant manager @ INR 50000/month and 1 manager @ INR 60000/- month have been considered.

The sales of different products have been considered at 62,000/MT for pulp, 70000/MT for juice, 60,000 MT for jam, jelly, squash and 62,000 /MT for canned fruit.

For the model, inflation rate is assumed as 5.6%, Discounting factor for calculation of NPV is taken as 12%, depreciation as 5.6%. It is taken that loan will be repaid in 5 years at interest rate of 12%. The NPV is INR 116 lakh at 16% IRR as with pay back period in year 15.

Pecan nut processing

Pecan nut processing is three step process which involves cracking, shelling, sorting (removal of empty shells), grading and packaging of the produce. In value added products pecan nut butter can be product of major importance. Also, different types of shelled pecan pieces are used in various confectionary industries. The machinery in pecan nut shelling and cracking unit will cost INR 60000/- and pecan nut butter unit will cost INR 4 lac.

There will be significant change in the production scenario with the huge production that is going to emerge with the fruit production in the HPSHIVA clusters coming to full fruition in coming years. It would be a strategic shift for the processing units to link with the CHPMA production system and the micro-entrepreneurs and CACs would become integrator for value addition at that node.

During stakeholder consultation workshop integration/ upgradation of private and government units can be discussed and finalized, although it is difficult to upgrade these units and establishing a new greenfield unit is easier the existing units should be considered.

C. State Level

It is proposed to establish a state level body which can be located at PMU office. The primary responsibility of this unit will be quality control, certification, branding and market promotion. The state level body will support the fruit value chain management by ensuring optimization of the flow of material, information, and fund. It is expected to perform following tasks:

- ▶ Framework: Develop the contractual framework and the processes that will be involved for the Processing Units to integrate with the FPO/CACs system and with the micro-entrepreneurs.
- ▶ Tools: These will include the preparation of manuals for managing an orchard, guidelines for fixing price and negotiating price and preparation of forward contract. It will prepare guidelines for quality assurance, logistic management, pack house management, and inventory management.
- ▶ Templates: Develop templates such as farm records, templates to maintain farm accounts, templates for recording inventory, transport logbook, sales records, etc. These will be both manual and computer templates in Excel and Word templates.
- ▶ Step-by-step training: Develop a training manual to step-by-step train the FPO and the Microprocessors.
- ▶ Exposure visits: Seeing is believing! Exposure visits motivates and expedites learning. The body will need to organise exposure visits for FPOs, microprocessors and for the staff of the processing units.
- ▶ Best Practice: Document best practice in facilities management, infrastructure management and processing and value addition technology and share with all the stakeholders
- ▶ Provide Technical Assistance: Undertake training need assessment and support assessment and accordingly organise technical assistance through by hiring consultants. Also, they may need expertise towards creating world class infrastructure, consultants may be hired for creation of same.

The state level body will be provided with necessary hardware and software to perform its tasks, which will include establishing building construction, provision of necessary furniture, fixture, and IT system, human resources, and operational expenses. It is expected that the state level body, like other new institutions will start generating sufficient resources to sustain itself in 3 years period. Therefore, the funding support is provided for three years, which can be reviewed during midterm evaluation of the project. The state level unit will also have a central monitoring facility as described in section "Performance Monitoring and Traceability".

iii. Other interventions

A. Transportation:

The transport facilities is required at three stages 1) from farm to pack house which can be done in pick up vans costing about INR 10 lakhs each 2) reefer vehicles for transporting fruits each of 5 MT and may cost approximately INR 15 lakhs per vehicle and gravity ropeways for access to difficult areas:

Gravity Ropeways

Due to the difficult terrain, life is difficult for people living in the remote hills/mountainous areas. Transportation of crops/ goods to market and crossing of river without bridge can be exhausting and dangerous. It is generally women and children who carry these heavy loads on their backs, down treacherous, winding mud tracks. When it rains, or there's a landslide, it's completely impossible to take goods to market. An alternative means of transportation like gravity ropeway can provide a sustainable solution to the excluded and isolated people of rural and mountainous regions of Himachal Pradesh.

Gravity ropeway works solely on gravitational force without using electricity and other external power. Gravitational ropeways are simple and inexpensive to operate as well as environmentally friendly. Gravity goods ropeway helps to increase the rural productivity. It works two ways - sending produce down from the top by gravity and at the same time a smaller load (one third) is taken up from below to top by the force of goods coming down. It is suitable only for transportation of goods.

The estimate will include but not necessarily be limited to the following items:

a) Civil component

- ▶ Site clearance
- ▶ Earth work
- ▶ Boulder soling
- ▶ Masonry work in cement mortar
- ▶ Plain cement concrete (PCC)
- ▶ Reinforcement steel
- ▶ Truss post
- ▶ Roofing materials (CGI sheet)

b) Mechanical component

- ▶ Wire ropes
- ▶ Structural steels
- ▶ Machinery parts
- ▶ Bearings
- ▶ Shafts and sheaves
- ▶ Brakes and braking systems
- ▶ Connecting accessories - bulldog grips and thimbles
- ▶ Galvanisation

As per Practical Action, and NGO working on gravity flow ropeways, the approximate cost of one such system is Rs.25.0-Rs.30.0 lakhs, depending on the materials uses, length of ropeways, etc. Once installed it does not require any operation costs besides minor regular maintenance.

In project area, these ropeways can be installed in those areas where transporting goods is difficult. On experimental basis, provision for one such ropeway in each district can be made. The area can be identified, and tenders can be issued subsequently.

The CHPMA can be entrusted to maintain and operate the ropeway. It can charge a service fee for transporting the goods which can be used to pay the salary of operators, and for repair and maintenance of the ropeway.

B. Performance Monitoring and Traceability

The project requires a robust monitoring and evaluation system, and Management Information System (MIS) should be in place which would collect and integrate information. A dedicated IT platform or revamping of the existing portal is necessary to enable effective monitoring of the project status at all levels including financial progress, maintain beneficiaries' database etc.,

In addition, there should be a system in place for traceability, drawing synergies with MIS platform. The horticulture produce traceability system enables capturing of quality and produce or product movement information across the value chain, to provide better visibility and control. Recently, block chain technology is gaining momentum in the global agri- food sector enabling in tracing the entire lifecycle of produce from origin through every point of contact. The certification is created through the notarization of immutable data in the Blockchain. It requires collection of data along the entire value chain including cultivation, processing, handling etc., though a scannable barcode or QR code adhering to GS1 standards. These standards provide implementation guidelines for traceability in the Fresh Fruit and Vegetable industry. These guidelines are applicable for the following⁷⁵:

- ▶ To addresses traceability practices from pre-grower to retail store or foodservice operator (i. e. external traceability) to the point of consumer sale to support Critical Tracking Events (CTEs) such as product creation/(re)packaging, shipping, receiving, processing, and selling
- ▶ Considers traceability practices upstream from the grower, including guidance for seed or crop protection or treatments
- ▶ Applies to all fresh fruit and vegetable products for human consumption
- ▶ Applies to all levels which are uniquely identified including the base product or traded item (e.g. case/carton, consumer item), Logistic Unit (e.g bin, container);
- ▶ Includes all supply chain participants: growers/primary producers, packers/re- packers, suppliers/ distributors/ traders/ exporters or importers, wholesalers, retailers, and foodservice operators.

Currently, APEDA has adopted traceability of various agriculture/ horticulture products to facilitate exports. APEDA is offering internet based electronic services namely **Hortinet** which is facilitating export of fruits including Grapes, Pomegranate, Mango, Vegetables, Betel leaves, Citrus fruits and other fruits; and **Tracenet** for export of organic products. The promotion of export of common fruits can be achieved in convergence with APEDA. In addition, the state level Executive Body, may choose to select third- party vendor to develop pilot Traceability system targeting domestic consumption of envisaged quality produce.

⁷⁵https://gs1go2.azureedge.net/cdn/ff/HcFlvUhEsylenglLelevugUra4Voonv419Dhdh1aVFI/1614099548/public/docs/traceability/Global_Traceability_Implementation_Fresh_Fruit_Veg.pdf

iv. Financing arrangements

This section summarises the arrangements for development of infrastructure including mode of funding, responsibility for operation and maintenance, revenue avenues for the facilities proposed above.

Infrastructure	No.	Estimated Cost per Unit	Mode of Funding	Operation and Maintenance	Revenue Avenues
State Level Apex Body					
Central monitoring facilities	1	INR 2 Cr	Government	Government	NA
District level					
Pack house	13	INR 4.26 Cr	70% Government subsidy and 30% from entrepreneur/ cluster association	A Joint Venture will be formed between FPO & Strategic Partner. The Strategic partner will be responsible for the O&M of the pack house	▶ Sale of Products on behalf of the Orchards ▶ Service charges for supply, packaging and storage
Processing units	3	INR 2.24 Cr	70% Government subsidy and 30% from entrepreneur/ cluster association	O&M of the processing units will be done by the Strategic Private Partner in the PPP.	▶ Sale of Products to domestic distributors and to exporters
Processing unit for pecan nut	1	INR 4.6 Lakhs for cutting and shelling machinery	70% Government subsidy and 30% from entrepreneur/ cluster association	O&M of the processing units will be done by the Strategic Private Partner in the PPP.	▶ Sale of Products to domestic distributors and to exporters
Reefer Vans		INR 15 lakh	100% commercial loans to rural entrepreneurs/youth who would sign Service Agreement with the management of Pack houses	O&M of the Reefer Vans will be the responsibility of the Entrepreneur/s who own the Vans.	▶ From transport charges on goods levied on Pack houses and Farmer Groups based calculated on weight and distance.
Gravity ropeways	7	INR 30 lakh	90% Government subsidy and 10% from Rope Way Company	O&M of the Rope Ways will be the responsibility of the Rope Way company	▶ From separate charges for transporting people and goods. Rate fixed per person and rate per Kg for goods
Input shops	13	INR 10 lakh	Based on a 50% project subsidy and 50% from entrepreneur, and/or 90% subsidy to FPO/farmer cooperatives	FPO/Cooperatives or Entrepreneur will be responsible of O&M of shops	▶ Sale of farm inputs

GoC Level					
Collection	79	INR 30 lakhs	100% grant from the Government (DoH) for building collection sheds before produce is sent to the market or to the pack house.	Management Committees of the Cluster Groups of farmers managing the orchards	► Farm gate sales of the produce
Drip irrigation / ha		INR 1,20,000/-	100% grant from the Government (DoH)	Management Committees of the Cluster Groups of farmers managing the orchards	► From the sale of fruits
Water storage facility		0.5 lakhs per 10000 litres	100% grant from the Government (DoH)	Management Committees of the Cluster Groups of farmers managing the orchards	► From the charges levied on the orchard revenue from sale of fruits and crops
Composite Fencing		INR 5 lakhs/ hectare	100% grant from the Government (DoH)	Management Committees of the Cluster Groups of farmers managing the orchards	► From the sale of fruits

Input Shops

With the development of 10 hectare orchards we have seen that there will be a need for farm inputs by farmers, hence we propose 13 such shops in integrated facility that will be linked to FPOs and Farmer Cluster Groups for procurement of inputs. Total cost of the project for the establishment of the shops will be INR 10 lakhs per unit. As promoters will be mostly from the existing community of entrepreneurs who already having input shops in the state, the project will support with 50% of the project costs as a grant-in-aid, and 50% of the project cost will have to be covered by the promoter/s. The promoters/entrepreneurs could provide this amount from their own equity, or through a commercial loan where they will have to provide a minimum of 5% margin money and the bank will provide the rest as working capital loan (this is as per RBI guidelines). If these shops are opened by FPO/Farmer Cooperative then they will be provided 90% of the total project cost as grand-in-aid, and 10% of the project cost will have to be borne by the FPO/Farmer Cooperative.

Drip Irrigation infrastructure

We have seen drip irrigation systems operating in the filed orchards funded by the Department of Horticulture during the field visits. These systems have been funded and established by the DoH. The drip irrigation systems will cost around INR 1.20 lakh per hectare including the laterals for intercropping. This cost will be a 100% grant-in aid from the DoH. The Management Committee of the Cluster Group managing the orchards will be responsible for operation and maintenance of the Drip Irrigation system.

Water Storage Facility

There are already water storage facilities being operated in the field demonstrations and in the 10 hectare orchards established by the DoH. The estimated investment of the water storage systems is 0.5 lakhs per 10,000 liters. This total cost (100%) will be provided as a grant from the DoH. The Water Storage Facilities will be operated and managed by the Management Committees of the Cluster Group of farmers managing the 1 hectare FLD units and 10 hectare orchards.

Composite Fencing

It has been estimated by us that Composite Fencing will cost INR 5 lakhs/ hectare. The cost of fencing will be 100% grant from the DoH. The fencing will be maintained by the Management Committees of the Cluster Groups of farmers managing the orchards.

Collection and Aggregation center

The collection and aggregation center will be a 100% grant from the Government/DoH for building the collection sheds where the produce will be aggregated before the produce are sent to the wholesale market, pack houses, or to processing units. The Management Committees of the Cluster Groups of farmers managing the orchards and using the collection and aggregating center will be responsible for the O&M of the Centers.

Pack houses and processing units

We have provided the 90% grant-in-aid and 10% cost of the project as promoter's contribution to encourage entrepreneurs to invest in infrastructure. Second, we have undertaken the financial viability analysis and have demonstrated that the projects will be viable for this design stage. When banks provide credit, they will undertake a similar viability analysis based on latest prices, depending on when the entrepreneurs apply for a loan. The analysis undertaken by EY can be also referred, which will give the banks confidence and support their due diligence and viability analysis.

In this case the 10% of the project cost that will be borrowed from the bank wherein the promoter will have to show a minimum of 5% margin money and the bank will provide working capital finance up to 25% of project cost, here we are expecting the banks to provide 10% of the project cost. Margin money varies from 10% to 25% of the project cost. These are as per RBI guidelines. All successful projects have followed these guidelines in India. As per RBI guideline 5 June 2005: "In accordance with these guidelines, the working capital requirement is to be assessed at 25% of the projected turnover to be shared between the borrower and the bank, viz. borrower contributing 5% of the turnover as net working capital (NWC) and bank providing finance at a minimum of 20% of the turnover." One example of this financing modality is the NABARD model project "Medium Fruit and Vegetable Processing Unit" of July 2014. This is an example for such provision of working capital to promoter from 10% to 25% of the total project cost by the bank as per RBI guidelines. Successful projects in India have followed similar financing pattern as per RBI guidelines. A joint venture will be formed between the FPO and a Strategic Partner/Entrepreneur/Promoter for all the 13 packhouses and 3 processing units for pulp and juices, 1 processing unit for pecan nut. The strategic partner, as per a MoU will be responsible for Operations and Maintenance of the pack houses and processing units. The revenue for O&M of pack houses will be generated from the sale of products on behalf of the orchards, and service charge for supply, packaging, and storage. On the other hand, the O&M of the processing units will be financed from the revenue that will be generated from sales of processed products through domestic distributors and exporters.

The upgradation of existing processing units in the public sector may be undertaken. In such cases, the Government (DoH) will meet 100% of the total upgrading cost. The operation and management will be the responsibility of the existing management of the units after being trained on the upgraded machinery and equipment. The revenue for O&M of the upgraded infrastructure will be derived from the sale of products through their existing outlets and distribution channels.

Gravity ropeways

After visiting the field and having consultations with the farmers we propose that there needs to be 7 Gravity ropeways for transfer of people and goods (fruits) from one location to another where the use of roads transport would not be cost effective and would consume longer time to transport perishable goods. Hence the construction of 7 ropeways costing INR 30lakhs each would be a 90% subsidy of the total cost of the project and 10% of the total cost of the project will promoter's contribution. The Promoter/s will be existing rope way operating company/s in Himachal Pradesh, or any other company outside the state having experience in operating ropeways. The O&M of the rope ways will be the responsibility of the Ropeway company operating the ropeways. The PMU will undertake a national competitive bidding procurement process to select such companies, which will be based on cost, quality, and the experience in operating ropeways.

8.2.2. Proposed Interventions in Capacity Building

Currently, the small farmers in sub-tropical regions of HP are using conventional planting materials with outdated production technologies in fruit production. Also, many of the farmers are the first-generation fruit growers, therefore they lack the necessary skills. The High-Density Plantation (HDP), as promoted by in the project needs special care and maintenance.

The high-density plantation must be appropriately managed to give the maximum benefits to the small farmers/growers. Building their capacities through training and exposure is critical for the success of the sub-tropical fruit value chain.

Summary of existing capacities and gap analysis

As the FLDs have been established by the project, the farmers are dependent on the project officials for almost all works. There was no awareness on the production cost and market price. In almost all the clusters, all the cost are borne by the project, and the villagers could not tell the cost of the cultivation. Upon enquiring, the farmers responded that they are observing the results of the FLD and outputs from the fruit trees. Upon success, they will decide whether to scale up these plantations or not.

As such, though capacity building exercises have been conducted for the farmers, and many of them attended exposure visits, due to lack of interest and motivation, majority of farmers haven't learned the production or post-production techniques.

In many of the clusters, the farmers were also not practicing farming on these lands. For example, in Kanga Litchi cluster it was learned that the land was fallow for last 7-8 years due to human-animal conflict. Therefore, not only the interest but the skills and capacities in cultivation and fruit production are lacking.

There is also lack of capacities in marketing and entrepreneurial skills. For example, the farmers in Khedaroo and Bhaleu clusters in Hamirpur informed the team that they don't know where and how to market their produce, and the project personnel are responsible for marketing their produce. No initiatives were shown to organize harvesting and marketing. The training and capacity building exercises have been proposed at three levels as presented below:

i. State Level Training and Capacity Building

The team propose establishment of state level body at Shimla, which could be integrated or given space with the PMU. Its main role will be branding and market promotion as well as quality control of the value chain. We also propose to promote one unique brand for whole region, which can be termed as 'SHIVA' or 'HPSHIVA farm fresh'.

This shall be managed by a team of State Manager and subject matter specialists in branding and market promotion, quality control, standardisation, and export marketing and DoH officials at each district levels. The training and capacity building support will be provided on business development, export promotion, communications, and negotiation skills. In addition, the experts and managers will be trained to obtain and maintain ISO and HACCP certification. In total three 2 days- training shall be organised with 1 training for every 2 years.

Person	Number of persons	Number of trainings	Training topics
State Manager	1	1 training for every 2 years. Total 3 trainings	Business development Quality management Export promotion Communication skills
Experts	2		
DoH officials to coordinate with Apex body	7		
Total	15		

ii. District Level Training and Capacity Building

At district level, training and capacity building support should be provided to 17 Managers (i.e., 13 Packhouses, three (3) Processing units and one (1) Pecan nut processing unit), 34 technicians and support team (accountants, machine operators, driver, and security person). Technical training for staff in pack house and processing units regarding facility management and operations, produce management and processing technology will be required. In addition, the staff and managers will need to be trained to obtain and maintain ISO and HACCP certification for entering markets overseas. These certifications will help in achieving higher value for the processed value-added products. Three (3) days training, total of three (3) trainings- once in every two years for managers and Technicians should be conducted. For skilled workers, one (1) day training on Primary processing, operations, quality management, machinery functions, safety measuring should be conducted at least once in a year for three (3) years.

The training and capacity building activities of the district level unit personnel are proposed as follows

S. No.	Topic	Persons	No.	Duration (No. of Days)	Number of Trainings
1.	Packhouse operations, Supply chain management, Processing of produce, Storage, Certification, Sanitary and phyto sanitary	Managers	17	3	3
2	Food processing, certification, and safety measures	Technicians	34	3	3
3	Primary processing, operations, quality management, machinery functions, safety measures	Skilled workers (excluding managers and Technicians)	170	1	6 (Once in a year)

The DoH staff will be oriented in value chain management practices, together with study tours and exposure visits within and outside the state. It is proposed that DDH, SMS, HDO and HEO from each district should be given trainings. The details are given below

S. No.	Topic	Persons	No.	Duration (No. of Days)
1	Orientation on Value Chain Management, Promotion of linkage with financial and non-financial institutions	DDH, SMS, HDO & HEO	28	1
2	Exposure Visit within the State	DDH, SMS, HDO & HEO	28	1
3	Exposure Visit outside the state (eg: Maharashtra, Karnataka, or to shaydari farms and namdhari fresh)	DDH, SMS, HDO & HEO	28	3
4.	Exposure Visit outside India (eg: Israel, New Zealand, Europe)	DDH and PMU staff	10	5

The private sector plays an important role in value chain promotion, and they should also be involved in the training and capacity building. The key private players in value chain includes **processors, traders, Commission Agents, Wholesalers, retailers, and input providers**. It is proposed that these private players should be taken for exposure visit to HPSHIVA value chain institutions namely CHPMA, CC, and district processing unit. During the exposure visit, they should also be given an orientation on need and advantages of joint value chain promotion. It is estimated

that each exposure visit will include upto 25 private players which will be of 1 day duration. The details are given below

Item	2023	2024	2025	2026	2027	2028	Total
No. of exposure visits		7		7		7	21
No. of stakeholders		175		175		175	525

iii. Training and Capacity Building at Cluster Level

Orientation Training to Farmers on Production Technology and Value Addition:

It is suggested to appoint 1 Horticulture Extension Functionary for every 25 hectares (i.e., 400 Horticulture Extension Functionaries for 10,000 hectares). These Horticulture Extension Functionaries should be trained on the overall operations in clusters including productivity enhancement techniques and technologies for high density plantation, canopy management, nutrition management, crop load management, IPM, INM, post-harvest treatment for extending shelf life of fruits etc., Training for every 50 Horticulture Extension Functionaries can be conducted and hence total of 5 trainings in a year for 3 years.

These Horticulture Extension Functionaries will in turn train all the 25,000 farmers on the above topics which may coincide with the plantation schedule. As 25 farmers are estimated in each cluster, 1000 training events will be needed to be organized. Each training shall be of 1-day duration. The training materials should be pictorial and in audio-visual mode in a language, easily understandable to the farmers in vernacular language. The venue of the training should be kept near to the cluster so as the women farmers can also attend the training.

Table 98: Details of Plantation Schedule and number of training events

Item	2023	2024	2025	2026	2027	2028	Total
Plantation %	10	10	10	20	25	25	100
No. of training events	100	100	100	200	250	250	1,000
No. of farmers to be trained	2500	2500	2500	5000	6250	6250	25,000

iv. Training to Micro-entrepreneurs

It is proposed to identify and train at least two micro-entrepreneurs from each CHPMA in backward and forward linkages, primary and secondary processing, packaging, and marketing. Hand-holding support to these microentrepreneurs should also be provided in business plan preparation, technical follow-up, linkage with financial and non-financial institutions, and marketing of their produce. Each training will be conducted for 1 day. In each training event, 50 micro-entrepreneurs will be trained. The detail of the training is provided below.

Table 99: Details of training to microentrepreneurs

Item	2023	2024	2025	2026	2027	2028	Total
Plantation %	10	10	10	20	25	25	100
No. of micro-entrepreneurs to be Trained	200	200	200	400	500	500	2000
No. of training events	4	4	4	8	10	10	40

The summary of cost for the capacity building activities as discussed above, is as follows:

Category	Number of persons	No. of days per training	No. of training in year	Numb er of Years	Cost / Person/ training	Remarks	Total amount (INR lakhs)
Training to experts at state level	15	2	1	3	5000	1 training for every 2 years.	4.5
Training to district level officials (Facilities-Managers)	17	3	1	3	5000	1 training for every 2 years.	7.65
Training to district level officials (Facilities-Technicians)	34	3	1	3	5000	1 training for every 2 years.	15.3
Skilled workers in facilities	170	1	1	6	2000	2 trainings every year	20.4
DoH officials: Orientation on Value Chain Management, Promotion of linkage with financial and non-financial institutions	28	1	1	1	5000	1 training in a year	1.4
DoH officials: Exposure Visit within the State	28	1	1	1	7000	1 visit in a year	1.96
DoH officials: Exposure Visit outside the state	28	3	1	1	10000	1 visit in a year	8.4
DoH officials: Exposure Visit outside India	10	5	1	1	40000	1 visit in a year	20
Exposure visits for private players	175	1	1	3	7000	1 visit in every district and all 7 districts should be covered in 2 years.	36.75
Training to Horticulture Extension Functionaries	400	In proportion with plantation schedule			3000	NA	12
Training to Farmers	25,000	In proportion with plantation schedule			1000	NA	250
Training to micro entrepreneurs	2000	In proportion with plantation schedule			2500	NA	50
Total							428.36

Conclusion and Way Forward

The value-chain analysis report is a second precursor to the Horticulture strategy report and it includes within its ambit the current scenario of area and production, focussed districts and crops, swot analysis of the value chain, challenges and opportunities, competitive advantage among the states, climate change implications and mitigation measures and key recommendations on different aspects of the upgradation of value chain. The major points from the report are:

- ▶ Due to its cooler climate, Himachal Pradesh has a delayed harvesting period which gives it a remunerative advantage in terms of price
- ▶ Specific climatic conditions and variation in day and night temperature gives the fruits a unique colour, orange colour fruits in sweet orange, red spots on surface of fruits in Guava.
- ▶ Some countries like China, Ireland, Thailand, and Spain distinctly show rising trend in the import of sub-tropical fruits while Japan and Germany show a decline trend
- ▶ Among emerging markets, the noticeable share is seen for Poland, China, and Egypt.
- ▶ Among domestic markets the target markets should be markets of Haryana, Punjab, Delhi, and Chandigarh
- ▶ The key constraints noticed in the Value chain include presence of small and fragmented land holding, wastage of produce at different levels and lack of efficient post-harvest, cold chain, and processing facilities.
- ▶ There are three-four different channels for supply chain depending on the crop. The producer's share in Channel A is highest (ranging above 90%) as compared to other channels. The more the intermediaries the more is price spread and the less is producer's share in consumers' price.
- ▶ In climate change, the major implications can be seen in terms of delay in monsoon, dry spells of rains, and untimely rains during water stress period, erratic temperatures during flowering and fruit growth, hailstorms are some of the most encountered climatic conditions experienced by the fruit growers. Adoption of hi-tech horticulture and judicious management of land and water use should be the main strategies to meet the challenges due to climate change.

Keeping these points in mind and considering the overall scenario the proposed recommendations are as follows:

- ▶ Implementation of technological recommendations for pre-production, production, harvest, post-harvest, transportation, and marketing level at different nodes of value chain.
- ▶ For futuristic value chain, it is proposed that all produce will go to CC. 10 % directly to consumers, out of the remaining 90% produce: 50 % produce to Packhouse, 10% to processing unit and 30 % to wholesaler. From this as per proposed value chain the produce will be marketed to institutional buyers, wholesalers, exporters and finally to consumer.
- ▶ At group of cluster level, there is a need to establish collection centres. These proposed centres are 70 in number and to be constructed in phased manner depending on the production capacity. The business plan has to be supported by subsidiary activities like bee keeping, mushroom cultivation etc.
- ▶ It is proposed to establish a state level body which can be located at PMU office. The primary responsibility of this unit will be quality control, certification, branding and market promotion
- ▶ There is a need for establishment of 13 packhouses at district level, 3 processing units (new/upgradation), one cold room in pack house with mango ripening facilities and one pectin processing unit. Integrated facility center deciding upon the components based on location may be explored.
- ▶ To reach the difficult areas 7 gravity ropeways are proposed to be installed
- ▶ A state level body can be located at PMU office. The primary responsibility of this unit will be quality control, certification, branding and market promotion.
- ▶ To reach the difficult areas 7 gravity ropeways are proposed to be installed.

- ▶ For the capacity building and quality production, at state level 3 trainings are proposed one training for every 2 years for state manager, experts and DoH officials.
- ▶ Training and capacity building support shall be provided for 17 Managers, 34 technicians and 170 skilled workers.
- ▶ It is suggested to appoint 1 Horticulture Extension Functionary for every 25 hectares (i.e., 400 Horticulture Extension Functionaries for 10,000 hectares) in proportion with plantation schedule and training shall be conducted accordingly.
- ▶ These Horticulture Extension Functionaries will in turn train all the 25,000 farmers which may coincide with the plantation schedule. As 25 farmers are estimated in each cluster, 1000 training events will be needed to be organized in proportion with plantation schedule. Each training shall be of 1-day duration.
- ▶ Out of the clusters, for motivated and diligent individuals will be selected and trained to serve as micro entrepreneurs in the state. The capacity of the microentrepreneurs will be enhanced by conducting 4 trainings every year from 2023 to 2025, 8 in 2026 and 10 each in 2027 and 2028 with participation of 50 in each training.
- ▶ DDH, SMS, HDO and HEO from each district should be given one day orientation on Value Chain Management, Promotion of linkage with financial and non-financial institutions, 1 day exposure visit within the State and 1 3- days exposure visit outside the state and 1 outside India.
- ▶ Pack house and processing unit models have been suggested to implement with 70 % grant from Government and 30% equity contribution which may be a SME loan taken from a bank by the promoters, or in this case the Cluster Association, or any entrepreneur.

Along with this, confidence building and enhancement in overall governance will serve as a major booster for the farmers.

Annexures



Annexures

Annexure I: Summary of field visits

PRF/ FLD cluster visits summary

Date	District	PRF/ FLD Cluster location	Resources
09-Nov-21	Bilaspur	FLD Cluster- Kotlu	Shaheel Rafique, Arya Vinayakam
10-Nov-21	Bilaspur	PRF cluster- Lanjhta	Shaheel Rafique, Arya Vinayakam
11-Nov-21	Bilaspur	PRF cluster- Dulhet, Mehri Kathla	Shaheel Rafuque, Jitendra Sinha, Arya Vinayakam
11-Nov-21	Una	FLD Clusters- Sanhal, Thanakhurd, Boul- II	Neeru Dubey, Bhavitha Vighahala
12-Nov-21	Hamirpur	FLD Cluster- Majhot	Shaheel Rafuque, Jitendra Sinha, Arya Vinayakam, Bhavitha Vighahala
13-Nov-21	Hamirpur	PRF Clusters- Bhaleu, Kehdru	Shaheel Rafuque, Jitendra Sinha, Arya Vinayakam, Bhavitha Vighahala
16-Nov-21	Kangra	PRF Clusters- Sehal, Dhanag	Shaheel Rafuque, Jitendra Sinha, Bhavitha Vighahala
17-Nov-21	Kangra	PRF Clusters- Dehan	Shaheel Rafique, Bhavitha Vighahala
18-Nov-21	Kangra	PRF Clusters- Lahat, Trehla	Shaheel Rafuque, Jitendra Sinha, Bhavitha Vighahala
15-Nov-21	Mandi	PRF Clusters - Ghamdhal, Dabrot, Binga, Sandhole	Arun Kumar Johri, HP singh, Ruchir Kant Pareek
16-Nov-21	Mandi	PRF Clusters- Tanda- Matour , Kalahod	Arun Kumar Johri, HP singh, Ruchir Kant Pareek
18-Nov-21	Sirmaur	FLD cluster- Fatehpur	Mohit Kumar
22-Nov-21	Solan	Met farmers fromChunad, bughar and jayalang FLD clusters	Mohit Kumar
23-Nov-21	Solan	FLD cluster-Belikhoh-II	Mohit Kumar

APMC visit

Date	District	APMC	Resources
11-Nov-21	Bilaspur	APMC Bilaspur	Shaheel Rafuque, Jitendra Sinha, Arya Vinayakam
15-Nov-21	Kangra	Kangra APMC and Jachh APMC	Shaheel Rafuque, Jitendra Sinha, Bhavitha Vighahala
18-Nov-21	Mandi	Mandi APMC	Arun Kumar Johri, HP singh, Ruchir Kant Pareek
20 Nov- 21	Chandigarh	Chandigarh APMC	Jitendra Sinha, Shaheel Rafique

Processing units visits

Date	District	Processing units	Public/ Private	Resources
09-Nov-21	Bilaspur	S.N Enterprises	Private	Shaheel Rafique, Arya Vinayakam
11-Nov-21	Una	Cremica Food Park	Private	Neeru Dubey, Bhavitha Vignahala
13-Nov-21	Hamirpur	Hamirpur Supplement Foods	Private	Shaheel Rafique, Jitendra Sinha, Arya Vinayakam, Bhavitha Vignahala
17-Nov-21	Kangra	Fruit Canning unit at Nagrota	Public	Shaheel Rafique, Bhavitha Vignahala
17-Nov-21	Mandi	HPMC unit-Sundarnagar	Public	Arun Kumar Johri, HP singh, Ruchir Kant Pareek
18-Nov-21	Sirmaur	Fruit Canning Unit, Dhaulakuan	Public	Mohit Kumar

Departments/ Research/ Academic institutions visits

Date	District	Name	Resources
20- Oct- 21	Shimla	India Meteorological Department, Metrological center Shimla	Shaheel Rafique, Jitendra Sinha, Neeru Dubey, Bhavitha Vignahala
27-Oct- 21 17- Dec- 21	Shimla	General Manager, HPMC Shimla	Jitendra Sinha, Neeru Dubey
09-Nov-21	Bilaspur	DDH officials	Shaheel Rafique, Arya Vinayakam
11-Nov-21	Una	DDH officials	Neeru Dubey, Bhavitha Vignahala
12-Nov-21	Hamirpur	DDH officials, College of Horticulture & Forestry Neri Hamirpur	Shaheel Rafique, Jitendra Sinha, Arya Vinayakam, Bhavitha Vignahala
15-Nov-21	Kangra	Kangra KVK, Research center at Jachh Nurpur	Shaheel Rafique, Jitendra Sinha, Bhavitha Vignahala
16-Nov-21	Kangra	DDH officials	Shaheel Rafique, Jitendra Sinha, Bhavitha Vignahala
17-Nov-21	Kangra	Palampur university HoD and GIZ climate expert	Shaheel Rafique, Bhavitha Vignahala
18-Nov-21	Mandi	DDH officials	Arun Kumar Johri, HP singh, Ruchir Kant Pareek
18-Nov-21	Sirmaur	DDH Officials, CSKHPKV Hill Agricultural Research & Extension Centre at Dhaulakuan, KVK Dualakuan	Mohit Kumar
20-Nov-21	Solan	Meeting with Solan university officials, KVK, Research center at Kandaghat	Arun Kumar Johri, HP singh

Annexure II: Snapshot of Visits



Figure 87: Visit to Bhaleu PRF Cluster, Hamirpur



Figure 88: Visit to Bhumpal PCDO, Hamirpur



Figure 89: Citrus Fruit Growers



Figure 90: Lahat PRF Cluster



Figure 91: KVK Kangra



Figure 92: Hamirpur Supplement Foods



Figure 93: APMC Kangra



Figure 96: Chandigarh APMC



Figure 97: UHF Hamirpur



Figure 98: DDH Hamirpur



Figure 99: Private Tissue culture



Figure 100: CHPMA at Sehal Cluster, Kangra



Figure 101: Transporter/ aggregator at Kehdru cluster



Figure 102: Research center Jacch



Figure 103: Kehdru Cluster



Figure 104: FLD Manjot



Figure 105: CA and farmer at KangraAPMC



Figure 106: Jacch APMC



Figure 107: Kalahod



Figure 108: Harabagh

List of stakeholders met

Date of Visit	District	Visit Category	Location	Crop	Designation	Stakeholder names
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Rakesh Kumar
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Jogindra Singh
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Prashant Sharma
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Keshawnanda Sharma
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Ramlak Sharma
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Avinash Sharma
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Suresh Kumar
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Rakesh Kumar
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Dalvindra Singh
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Manish Kumar
09-Nov-21	Bilaspur	PRF Cluster	Kotlu	Guava	Farmer	Narendra Singh
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Ganga Ram
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Prakash Singh
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Ramakrishna
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Omkarji
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	yashwant singh
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Arun Singh
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Hemraj Chauhan
10-Nov-21	Bilaspur	PRF Cluster	Lanjhta	Litchi	Farmer	Santohi Devi
NA	Bilaspur	Others	Kuthera	Pomegranate	Farmer	Dhani Ram Sharma
20-Nov-21	Chandigarh	APMC	Chandigarh	NA	Trader	Ganesh
13-Nov-21	Hamirpur	PRF Cluster	Kehdru	Citrus	Farmer	Kamala Devi
13-Nov-21	Hamirpur	PRF Cluster	Kehdru	Citrus	Farmer	Kashmira Devi
13-Nov-21	Hamirpur	PRF Cluster	Kehdru	Citrus	Farmer	Kishan Chand
13-Nov-21	Hamirpur	PRF Cluster	Kehdru	Citrus	Farmer	Pavan Kumar Sharma
13-Nov-21	Hamirpur	PRF Cluster	Kehdru	Citrus	Farmer	Dharampal
13-Nov-21	Hamirpur	PRF Cluster	Bhaleu	Guava	Farmer	Pradeep Kumar
13-Nov-21	Hamirpur	PRF Cluster	Bhaleu	Guava	Farmer	Teelakraj
13-Nov-21	Hamirpur	PRF Cluster	Bhaleu	Guava	Farmer	Kartar chand
15-Nov-21	Kangra	KVK	Kangra	NA	KVK Incharge	Sanjay Sharma
15-Nov-21	Kangra	APMC	Kangra	NA	Commission Agent	Indrajit
15-Nov-21	Kangra	APMC	Kangra	NA	Farmer	Sunil Kumar
15-Nov-21	Kangra	APMC	Kangra	NA	Retailer	Pawan Kumar
15-Nov-21	Kangra	Research institution	Jacch	NA	Head	Atul Gupta

Date of Visit	District	Visit Category	Location	Crop	Designation	Stakeholder names
15-Nov-21	Kangra	APMC	Jacch	NA	Supervisor	Narendra Rana and 5 traders/ CAs
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Rajinder Sharma
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Ganga Ram
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Arjun Singh
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Suresh Kumar
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Madhu Bala
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Sharda Devi
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Babli Devi
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Dhruv Raj
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Mahesh Kumar
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Asha Devi
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Farmer	Kamini Devi
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	Cluster Incharge	Rajesh Rana
16-Nov-21	Kangra	PRF Cluster	Sehal	Guava	HPSHIVA	Gokul
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Farmer	Manju Rana
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Farmer	Rajinder Rana
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Farmer	Anju Rana
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Farmer	Shakti Singh
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Farmer	Bhupinder Singh
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Farmer	Anil Kumar
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	SMS	Rajesh
16-Nov-21	Kangra	PRF Cluster	Dhanag	Litchi	Cluster Incharge	Rajesh Patiyal
17-Nov-21	Kangra	Processing unit	Canning unit Nagrotta	NA	Incharge	Narottam
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	HDO	Sailaja
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	Cluster Incharge	Luvee
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Kishan Datt
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Manju Rana
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Vena Devi
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Babita Devi
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Ranjana
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Rukmini Devi
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Jagadish Prakash
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Naveen Sharma
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Ankush Kavir
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Kuldeep Rana
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Virender Singh
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Pradeep Kumar

Date of Visit	District	Visit Category	Location	Crop	Designation	Stakeholder names
17-Nov-21	Kangra	PRF Cluster	Dehan	Litchi	farmer	Shubham Thakur
17-Nov-21	Kangra	Other departments	Kangra	NA	Lead strategist GIZ	Rajan Kumar Kotru
17-Nov-21	Kangra	Academic	Palampur	NA	HoD	Sanjay Upadhyay
18-Nov-21	Kangra	PRF Cluster	Lahat	Guava	Farmer	Pritham Jain
18-Nov-21	Kangra	PRF Cluster	Lahat	Guava	Farmer	Harinder
18-Nov-21	Kangra	PRF Cluster	Lahat	Guava	Farmer	Vinod Kumar
18-Nov-21	Kangra	PRF Cluster	Lahat	Guava	Farmer	Rekha
18-Nov-21	Kangra	PRF Cluster	Lahat	Guava	HPSHIVA	Vishal Thakur
18-Nov-21	Kangra	PRF Cluster	Trehla	Citrus	Farmer	Subhash Chand
18-Nov-21	Kangra	PRF Cluster	Trehla	Citrus	Farmer	Kasirang
18-Nov-21	Kangra	PRF Cluster	Trehla	Citrus	Farmer	Ranjeet Singh
18-Nov-21	Kangra	PRF Cluster	Trehla	Citrus	SMS	Dharampal
18-Nov-21	Kangra	PRF Cluster	Trehla	Citrus	HEO	Rakesh Rana
15-Nov-21	Mandi	PRF Cluster	Binga	Citrus	Farmer	Lisha Thakur
15-Nov-21	Mandi	PRF Cluster	Binga	Citrus	Farmer	Shanta Devi
15-Nov-21	Mandi	PRF Cluster	Binga	Citrus	Farmer	Asha Devi
15-Nov-21	Mandi	PRF Cluster	Sandhole	Litchi	Farmer	Sapna Devi
15-Nov-21	Mandi	PRF Cluster	Sandhole	Litchi	Farmer	Ramesh Kumar
15-Nov-21	Mandi	PRF Cluster	Sandhole	Litchi	Farmer	Pratap Chand
15-Nov-21	Mandi	PRF Cluster	Sandhole	Litchi	Farmer	Saroj Kumar
15-Nov-21	Mandi	PRF Cluster	Sandhole	Litchi	Farmer	Gopal Singh
15-Nov-21	Mandi	PRF Cluster	Dabrot	Guava	Farmer	Roopal
15-Nov-21	Mandi	PRF Cluster	Ghamdhal	Guava	Farmer	Om Chand Thakur
16-Nov-21	Mandi	FLD Cluster	Matour tanda	Pomegranate	Farmer	Vijay Kumar
16-Nov-21	Mandi	FLD Cluster	Matour tanda	Pomegranate	Cluster Incharge	Anchal
16-Nov-21	Mandi	FLD Cluster	Matour tanda	Pomegranate	Joint Director	Sushil Awasthi
16-Nov-21	Mandi	PRF Cluster	Kalhoud	Guava	farmer	Bhajla Ram
16-Nov-21	Mandi	PRF Cluster	Kalhoud	Guava	farmer	Mahendra Thakur
18-Nov-21	Mandi	APMC	Mandi	NA	Auction recorder	Suresh Kumar
NA	Shimla	Others	Patti/Rampur Bushar	Pomegranate	Farmer	Arjun Negi
18-Nov-21	Sirmaur	FLD Cluster	Fatehpur	Guava	Farmer	Netar Singh
18-Nov-21	Sirmaur	FLD Cluster	Fatehpur	Guava	Farmer	Vivek Chaudhary
18-Nov-21	Sirmaur	FLD Cluster	Fatehpur	Guava	Farmer	Ravinder Kumar
18-Nov-21	Sirmaur	FLD Cluster	Fatehpur	Guava	Farmer	Prashant Kumar
18-Nov-21	Sirmaur	Processing unit	Fruit Canning Unit, Dhaulakuan	NA	Fruit Technologist	Dr. Neena Thakur
18-Nov-21	Sirmaur	KVK	CSKHPKV at Dhaulakuan	NA	Coordinator	Mr. Sukhdev Singh Paliyal

Date of Visit	District	Visit Category	Location	Crop	Designation	Stakeholder names
22-Nov-21	Solan	FLD Cluster	Chunad, bugar and jialang	Guava	ADHO	Prem Karolibalera
22-Nov-21	Solan	FLD Cluster	Chunad, bugar and jialang	Guava	HPSHIVA	Amarchand Sanan
22-Nov-21	Solan	FLD Cluster	Chunad, bugar and jialang	Guava	HEO	Kamlesh
22-Nov-21	Solan	FLD Cluster	Chunad, bugar and jialang	Guava	HEO	Sant Ram
22-Nov-21	Solan	FLD Cluster	Chunad, bugar and jialang	Guava	HPSHIVA	Santosh Panjeena
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	Farmer	Lalit Chaudhary
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	Farmer	Musthakh
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	Farmer	Vipin
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	HEO	Aasha Rana
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	HEO	Alka Ram Shehar
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	HEO	Hemraj, Dhang
23-Nov-21	Solan	FLD Cluster	Belikhoh-II	Guava	HEO	Tarun Thakur
11-Nov-21	Una	FLD Cluster	Sanhal	Guava	Farmer	Sanjay
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Randhir Singh
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Rakesh Kumar
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Mehar Singh
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Dilraj Singh
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Anil Kumar
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Yog raj
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Neelam Kumar Thakur
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Sayat Singh
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Balwan Singh
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	Farmer	Surjit Singh
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	HEO	Pawan Kumar
11-Nov-21	Una	FLD Cluster	Thanakhurd	Pomegranate	ADHO	Sanjay Kumar
11-Nov-21	Una	Processing unit	Cremica	NA	Plant activities incharge	Kerul
NA	Una	Others	Aghlor Mandli	Pomegranate	Farmer	Vishal Bali
NA	Una	Others	Aghlor Mandli	Pomegranate	Farmer	Rajender Bali
NA	Una	Others	NA	Pomegranate	Farmer	Ajay Sharma
NA	Kangra	Others	Jajwar	Pomegranate	Farmer	Chirag Sharma
NA	Kullu	Others	Kullu	Pomegranate	Farmer	Vijay Thakur
NA	Kullu	Others	Dalasni	Pomegranate	Farmer	Dev Raj Thakur
NA	Kullu	Others	Bhuntar	Pomegranate	Farmer	Rishabh Guleria

Date of Visit	District	Visit Category	Location	Crop	Designation	Stakeholder names
NA	Kullu	Others	Hurla	Pomegranate	Farmer	Raj Kumar
NA	Kullu	Others	Khokhan	Pomegranate	Farmer	Virender Thakur
NA	Kullu	Others	Shurad	Pomegranate	Farmer	Bhawani Charan
NA	Kullu	Others	Reri	Pomegranate	Farmer	Krishan Mohan
NA	Kullu	Others	Khokhan	Pomegranate	Farmer	Yashpal Sharma

Annexure III: Infrastructure Development models

This presents the financial analysis of Collection centers, pack houses and Processing units. These facilities may be managed and maintained by Cluster Associations/FPO/ CHPMA as an income-generating activity that are profitable and therefore sustainable.

Data Sources and General Assumptions

The data used in this analysis have been collected from various sources, including other projects of this nature in the neighbouring state of Punjab, CCDP guidelines, information on production from the Department of Horticulture and the Horticulture Key Experts for CSO3 assignment, and focused group discussions held with farmers. Processing unit facilities are based on Model DPR by NABARD. In addition, information on horticulture fruits from Socio Economic Research Planning Commission Government of India and other journals.

Collection Center

Assumptions	
Depreciation	10%
Inflation	5.6%
Discounting factor	12%
Interest rate	12%

Investment with government subsidy and promoter's contribution		
70% Government subsidy	20.93	70%
30% Contributors contribution	8.97	30%

Particular	Unit	Unit rate	Total (in lakhs)
Investment Inputs			
Land development- 500 sq.mt, 250 Rs/ sq.m	500	150	0.75
Building and civil structures (sq.m)	350	800	2.80
Machinery and Equipment			
Weighing Scales			2.50
SS Preparation table	1	45,000	0.45
Pre cooling units of ecozen (5 MT/hr)	1	12,00,000	12.00
Fruit Washer	1	1,50,000	1.50
Round Fruit Grader 2 MT/hr	1	2,00,000	2.00
Supporting equipment's like crates, MS trolleys	1	1,00,000	1.00
Pick up van (5 MT)	1	6,50,000	6.50
Tan 90 boxes for transport	10	4,000	0.40
Sub-total			29.90

Item	Unit	Unit price	With Project (Years)																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenue Calculations																						
Collection Center Handling capapcity (MT)			0	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786	3786
Sorting, Grading and Packaging service charge INR / Kg	100%	0.5	0	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Packing material INR / Kg	100%	0.5	0	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Revenue - Sub total			0	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
Revenue from Transport	5 MT / truck, INR 1000 / trip; 4 trips in day; 240 days		0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Residual value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
TOTAL REVENUE			0	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	51
TOTAL REVENUE (With Inflation)			0	50	53	56	59	62	66	69	73	78	82	86	91	96	102	107	113	120	127	142

Item	Unit	Unit price	With Project (Years)																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenue Calculations																						
Operating Cost																						
Security Guards	2	Rs 8000/month		2.03	2.14	2.26	2.39	2.52	2.66	2.81	2.97	3.14	3.31	3.50	3.69	3.90	4.12	4.35	4.59	4.85	5.12	5.41
Labour	10 persons for 240 days	Rs 500/day		12.67	13.38	14.13	14.92	15.76	16.64	17.57	18.56	19.60	20.69	21.85	23.08	24.37	25.73	27.17	28.69	30.30	32.00	33.79
Manager	1	60000/ month		7.60	8.03	8.48	8.95	9.45	9.98	10.54	11.13	11.76	12.42	13.11	13.85	14.62	15.44	16.30	17.22	18.18	19.20	20.27
Supervisor	2	40000/month		10.14	10.71	11.30	11.94	12.61	13.31	14.06	14.85	15.68	16.55	17.48	18.46	19.49	20.59	21.74	22.96	24.24	25.60	27.03
POL cost for the truck	240 days/ year	2500/day		6.26	6.54	6.83	7.13	7.44	7.77	8.11	8.47	8.84	9.23	9.64	10.06	10.50	10.96	11.45	11.95	12.48	13.02	13.60
Insurance	1000/ month			0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.34
Electricity	3 kwh/ 2 MT per hour @4.6/ Kva			0.85	0.90	0.95	1.00	1.06	1.12	1.18	1.25	1.32	1.39	1.47	1.55	1.64	1.73	1.82	1.93	2.04	2.15	2.27
Water	1262 lit/ day @ 30 rs kl			0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.16	0.17	0.17	0.18	0.19	0.21	0.22	0.23	0.24	0.26
Chemicals/ materials required				2.11	2.23	2.36	2.49	2.63	2.77	2.93	3.09	3.27	3.45	3.64	3.85	4.06	4.29	4.53	4.78	5.05	5.33	5.63
Misllaneous expenses				2.11	2.23	2.36	2.49	2.63	2.77	2.93	3.09	3.27	3.45	3.64	3.85	4.06	4.29	4.53	4.78	5.05	5.33	5.63
Sub-Total				44.00	46.39	48.91	51.57	54.37	57.33	60.44	63.73	67.20	70.85	74.71	78.78	83.07	87.60	92.37	97.40	102.72	108.32	114.23
Principal Repayment (say 5 years)	5			1.79	1.79	1.79	1.79	1.79														
Interest @12%			1.08	1.08	0.86	0.65	0.43	0.22														
Debt Service			1.08	2.87	2.66	2.44	2.22	2.01														
TOTAL COST			30.98	46.87	49.05	51.35	53.79	56.38	57.33	60.44	63.73	67.20	70.85	74.71	78.78	83.07	87.60	92.37	97.40	102.72	108.32	114.23
Net Benefit			-30.98	3.25	3.88	4.54	5.23	5.94	8.49	9.06	9.66	10.30	10.99	11.71	12.48	13.30	14.17	15.10	16.08	17.13	18.24	27.83
Present worth at 12% (NPV)	27.22		-27.66	2.59	2.76	2.88	2.97	3.01	3.84	3.66	3.48	3.32	3.16	3.01	2.86	2.72	2.59	2.46	2.34	2.23	2.12	2.89
IRR	21.4%																					
Payback period	Year 10		-27.66	-25.07	-22.31	-19.43	-16.46	-13.45	-9.61	-5.95	-2.47	0.85	4.01	7.01	9.87	12.60	15.19	17.65	19.99	22.22	24.34	27.22

Packhouses

Assumptions	
Depreciation	10%
Inflation	5.6%
Discounting factor	12%
Interest rate	12%

Investment with government subsidy and promoter's contribution		
70% Government subsidy	297.92	70%
30% Contributors contribution	127.68	30%

Investment Inputs	Unit area	Cost (INR lakhs)	Total cost (INR lakhs)
Land development (sq.m)	2500	250	6.25
Boundary wall (RM)	200	500	1.00
Pack house building of 1500 sqm @3000/ sq.m	1500	3,000	45.00
Post harvest unit -Structure, washing, sorting, drying, waxing, grading, packing -lines, 260 lac for1000sqm	1000	26,000	260.00
Weighing Scale/ Weighbride -60 MT	1	700000	7.00
Weighing scale small	1	250000	2.50
Dock shelter, leveller, motorized overhead door	5	7,00,000	35.00
Material handling equipments Forklifts, etc for 10 men for 10 m	10	17000	1.70
Servo Stabilizer 200 KVA	1	185000	1.85
Genset 100 KVA	1	710000	7.10
SS tables for manual sorting /frading packing, etc. Length 3-5 m width 1-1.5 m	1	150000	1.50
Pre cooling unit (6 MT)	1	2500000	25.00
Cold Room Cum Staging Unit 30 MT	30	18000	5.40
Refrigerated Truck 5MT	1	1500000	15.00

Plastic crates (20 kg capacity) crates	275	2000	5.50
Guard room (sq. m)	10	3,000	0.30
Office inside pack house shed (sq.m)	15	3,000	0.45
Water source/ Tube well	1	2,50,000	2.50
Labour change room with washroom outside /inside packhouse shed (sq.m)	15	3,000	0.45
Laboratory -Inside or outside pack house shed (sq.m)	10	3,000	0.30
Store room inside the pack house shed (sq.m)	10	3,000	0.30
Rainwater harvesting arrangement	1	1,50,000	1.50
Sub-total			425.60

Item	Unit	Unit price	With Project (Years)																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenue Calculations																						
Packhouse Handling capapcity (MT)			0	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464	9464
Volume after Spoilage (3%)	3%		0	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180
Capapcity utilization			0	30%	40%	50%	60%	70%	80%	90%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Volume			0	2754	3672	4590	5508	6426	7344	8262	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180	9180
Sorting, Grading and Packaging service charge INR / Kg		1	0	26	33	39	44	49	53	56	59	56	53	50	48	45	43	41	38	36	34	33
Packing material (Net) INR / Kg		1	0	26	33	39	44	49	53	56	59	56	53	50	48	45	43	41	38	36	34	33
Storage service charge INR/ kg		1	0	26	33	39	44	49	53	56	59	56	53	50	48	45	43	41	38	36	34	33
Revenue - Sub total (A+B)			0	78	99	117	133	147	159	169	178	169	160	151	143	136	128	122	115	109	103	98
Revenue from Transport	5 MT / truck, INR 3000 / trip; 4 trips in day; Max 240 days		0	9	12	14	17	20	23	26	29	29	29	29	29	29	29	29	29	29	29	29
Residual value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43
TOTAL REVENUE			0	87	110	131	150	167	182	195	207	197	189	180	172	164	157	150	144	138	132	169
TOTAL REVENUE (With Inflation)			0	92	123	155	187	219	252	286	320	322	325	328	331	334	337	341	344	348	352	476

Item	Unit	Unit price	With Project (Years)																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenue Calculations																						
Operating Cost																						
Security Guards	2	Rs8000/month		2.03	2.14	2.26	2.39	2.52	2.66	2.81	2.97	3.14	3.31	3.50	3.69	3.90	4.12	4.35	4.59	4.85	5.12	5.41
Labour	Max- 15 persons for 240 days	Rs 500/day		5.70	8.03	10.60	13.43	16.55	19.97	23.72	27.83	29.39	31.04	32.78	34.61	36.55	38.60	40.76	43.04	45.45	48.00	50.69
Manager	1	60000/ month		7.60	8.03	8.48	8.95	9.45	9.98	10.54	11.13	11.76	12.42	13.11	13.85	14.62	15.44	16.30	17.22	18.18	19.20	20.27
Assistant Manager	1	50000/ month		6.34	6.69	7.07	7.46	7.88	8.32	8.79	9.28	9.80	10.35	10.93	11.54	12.18	12.87	13.59	14.35	15.15	16.00	16.90
Supervisor	2	40000/month		10.14	10.71	11.30	11.94	12.61	13.31	14.06	14.85	15.68	16.55	17.48	18.46	19.49	20.59	21.74	22.96	24.24	25.60	27.03
POL cost for the truck	240 days/ year	3000/day		2.26	3.14	4.10	5.13	6.25	7.46	8.76	10.16	10.61	11.07	11.56	12.07	12.60	13.16	13.74	14.34	14.97	15.63	16.32
Insurance	5000/ month			0.63	0.67	0.71	0.75	0.79	0.83	0.88	0.93	0.98	1.03	1.09	1.15	1.22	1.29	1.36	1.43	1.52	1.60	1.69
Electricity	15 kwh/ 5 MT per hour @4.6/ Kva			2.13	2.25	2.37	2.51	2.65	2.79	2.95	3.12	3.29	3.47	3.67	3.87	4.09	4.32	4.56	4.82	5.09	5.37	5.67
Water	3000/ day @ 30 rs kl			0.23	0.24	0.25	0.27	0.28	0.30	0.32	0.33	0.35	0.37	0.39	0.42	0.44	0.46	0.49	0.52	0.55	0.58	0.61
Chemicals/ materials required				3.17	3.35	3.53	3.73	3.94	4.16	4.39	4.64	4.90	5.17	5.46	5.77	6.09	6.43	6.79	7.17	7.58	8.00	8.45
Misllaneous expenses				3.17	3.35	3.53	3.73	3.94	4.16	4.39	4.64	4.90	5.17	5.46	5.77	6.09	6.43	6.79	7.17	7.58	8.00	8.45
Sub Total (operating expenses)				43.39	48.58	54.20	60.28	66.85	73.95	81.61	89.88	94.79	99.97	105.43	111.20	117.28	123.70	130.47	137.61	145.14	153.09	161.48
contingency	5%			2.17	2.43	2.71	3.01	3.34	3.70	4.08	4.49	4.74	5.00	5.27	5.56	5.86	6.18	6.52	6.88	7.26	7.65	8.07
Sub Total																						
Principal Repayment (say 5 years)	5			25.54	25.54	25.54	25.54	25.54														
Interest @12%			15.32	15.32	12.26	9.19	6.13	3.06														
Debt Service			15.32	40.86	37.79	34.73	31.66	28.60														
TOTAL COST			440.92	84.24	86.37	88.93	91.95	95.45	73.95	81.61	89.88	94.79	99.97	105.43	111.20	117.28	123.70	130.47	137.61	145.14	153.09	161.48
Net Benefit			-440.92	7.50	36.63	65.73	94.78	123.80	178.32	204.21	230.06	227.64	225.10	222.41	219.58	216.60	213.46	210.15	206.66	202.98	199.11	314.87
Present worth at 12% (NPV)	518		-393.68	5.98	26.07	41.77	53.78	62.72	80.66	82.48	82.96	73.30	64.71	57.09	50.32	44.32	39.00	34.28	30.10	26.40	23.12	32.64
IRR	24%																					
Payback period	Year 9		-393.68	-387.70	-361.63	-319.86	-266.08	-203.35	-122.69	-40.22	42.75	116.04	180.75	237.84	288.16	332.48	371.48	405.76	435.86	462.26	485.37	518.01

Processing unit

Type	Percentage	Capacity
Pulp	40%	120
Juice	20%	60
Jam, jelly, Squash	30%	90
Canned fruits	10%	30
Total		300

Assumptions	
Depreciation	10%
Inflation	5.6%
Discounting factor	12%
Interest rate	12%

Investment with government subsidy and promoter's contribution		
70% Government subsidy	157.14	70%
30% Contributors contribution	67.35	30%

Investment Inputs	Unit	Unit Price	Total cost (INR lakhs)
Land Development (2025 sq.m)	2025	250	5.06
Electricity (including 3 phase meter and transformer 100 KVA)	1	1,50,000	1.50
Water provision	1	3,00,000	3.00
Waste Disposal	1	1,00,000	1.00
Building Construction	600	3,000	18.00
Plant and Machinery			-

Fruit washing machine (5 MT)	1	1,50,000	1.50
Sorting or inspection conveyer	1	1,60,000	1.60
Screw Feeder (2MT/ hr)	1	3,33,000	3.33
Industrial Mixer Systems with Screw Feeder, Capacity: 350 Kg/Batch	1	1,70,000	1.70
Twin pulper (3 MT)	1	2,70,000	2.70
Industrial Juice Processing Machine (500 kg/hour)	1	1,10,000	1.10
Autoclave	1	1,50,000	1.50
Automatic Natural Fruit Juice Bottle Packaging Machine (50-60 bottles per minute)	1	60,000	0.60
Steam jacketed kettle (500 kgs)	1	90,000	0.90
Miscellaneous	1	6,00,000	6.00
Aseptic processing line	1	17500000	175.00
Sub-total			224.49

Item	Unit	Unit price	With Project (Years)																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenue Calculations																						
Installed capacity- Output (MT)			300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
Capacity utilization			0	30%	40%	50%	60%	70%	80%	90%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Net capacity (MT)			0	90	120	150	180	210	240	270	300	300	300	300	300	300	300	300	300	300	300	300
Volume procurement	3		0	270	360	450	540	630	720	810	900	900	900	900	900	900	900	900	900	900	900	900
Cost of procurement Per kg	-8		0	-22	-29	-36	-43	-50	-58	-65	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Pulp (% of output and Price/ MT)	40%	62000	0	22	30	37	45	52	60	67	74	74	74	74	74	74	74	74	74	74	74	74
Juice	20%	70000	0	13	17	21	25	29	34	38	42	42	42	42	42	42	42	42	42	42	42	42
Jam, jelly, Squash	30%	60000	0	16	22	27	32	38	43	49	54	54	54	54	54	54	54	54	54	54	54	54
Canned fruits	10%	62000	0	5.58	7.44	9.3	11.16	13.02	14.88	16.74	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6
Revenue - Sub total			0	35	47	59	70	82	94	105	117	117	117	117	117	117	117	117	117	117	117	117
Residual value			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
TOTAL REVENUE			0	35	47	59	70	82	94	105	117	117	117	117	117	117	117	117	117	117	117	139
TOTAL REVENUE (With Inflation)			0	37	52	69	87	108	130	154	181	191	202	213	225	238	251	265	280	295	312	393

Item	Unit	Unit price	With Project (Years)																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Operating Cost																						
Security	2	Rs8000/		2.03	2.14	2.26	2.39	2.52	2.66	2.81	2.97	3.14	3.31	3.50	3.69	3.90	4.12	4.35	4.59	4.85	5.12	5.41
Labour	10 persons for 250 days	Rs 500/day		13.20	13.94	14.72	15.54	16.41	17.33	18.30	19.33	20.41	21.56	22.76	24.04	25.38	26.80	28.31	29.89	31.56	33.33	35.20
Manager	1	60000/		7.60	8.03	8.48	8.95	9.45	9.98	10.54	11.13	11.76	12.42	13.11	13.85	14.62	15.44	16.30	17.22	18.18	19.20	20.27
Supervisor	2	40000/m		10.14	10.71	11.30	11.94	12.61	13.31	14.06	14.85	15.68	16.55	17.48	18.46	19.49	20.59	21.74	22.96	24.24	25.60	27.03
POL cost for the truck	250 days/year	3000/day		7.83	8.17	8.53	8.91	9.30	9.71	10.14	10.58	11.05	11.54	12.04	12.57	13.13	13.70	14.31	14.94	15.59	16.28	17.00
Insurance	5000/month			0.63	0.67	0.71	0.75	0.79	0.83	0.88	0.93	0.98	1.03	1.09	1.15	1.22	1.29	1.36	1.43	1.52	1.60	1.69
Electricity	15 kwh/ 5 MT per hour @4.6/ Kva			2.13	2.25	2.37	2.51	2.65	2.79	2.95	3.12	3.29	3.47	3.67	3.87	4.09	4.32	4.56	4.82	5.09	5.37	5.67
Water	5000 lit/day @ 30 rs kl			0.42	0.44	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.68	0.72	0.76	0.80	0.85	0.89	0.94	1.00	1.05	1.11
utensils,				5.28	5.58	5.89	6.22	6.57	6.93	7.32	7.73	8.16	8.62	9.10	9.61	10.15	10.72	11.32	11.96	12.63	13.33	14.08
Chemicals, gas, fuel, materials				5.28	5.58	5.89	6.22	6.57	6.93	7.32	7.73	8.16	8.62	9.10	9.61	10.15	10.72	11.32	11.96	12.63	13.33	14.08
Misllaneous				3.17	3.35	3.53	3.73	3.94	4.16	4.39	4.64	4.90	5.17	5.46	5.77	6.09	6.43	6.79	7.17	7.58	8.00	8.45
Sub Total				57.70	60.84	64.15	67.64	71.32	75.20	79.30	83.62	88.17	92.98	98.05	103.39	109.03	114.98	121.26	127.87	134.86	142.22	149.99
Principal Repayment	5			13.47	13.47	13.47	13.47	13.47														
Interest			8.08	8.08	6.47	4.85	3.23	1.62														
Debt Service			8.08	21.55	19.93	18.32	16.70	15.09														
TOTAL COST			232.57	79.26	80.78	82.47	84.34	86.41	75.20	79.30	83.62	88.17	92.98	98.05	103.39	109.03	114.98	121.26	127.87	134.86	142.22	149.99
Net Benefit			-232.57	-42.19	-28.59	-13.58	2.95	21.14	54.59	74.90	97.31	102.88	108.78	115.01	121.59	128.55	135.91	143.68	151.90	160.59	169.77	242.68
Present worth at	116		-207.66	-33.63	-20.35	-8.63	1.68	10.71	24.69	30.25	35.09	33.13	31.27	29.52	27.87	26.30	24.83	23.44	22.12	20.88	19.71	25.16
IRR	16%																					
Payback	Year 15		-207.66	-241.29	-261.64	-270.27	-268.59	-257.88	-233.19	-202.94	-167.85	-134.72	-103.45	-73.93	-46.07	-19.76	5.07	28.50	50.63	71.51	91.22	116.38

Annexure IV: Domestic and International Market Analysis

The summary of Key findings from Market Analysis:

Key Findings of Market Analysis

Domestic Market Analysis

- ▶ In 2018, expenditure on food per capita for India was 372.2 US dollars. Expenditure on food per capita of India increased from 193 US dollars in 2009 to 372.2 US dollars in 2018 growing at an average annual rate of 7.73%. People in Himachal Pradesh spent 18.02 % on cereals while 6.82% in vegetables and 6.00% in fruits (Shadab and Pala, 2017).
- ▶ Kinnaur had the highest arrival of Fruits followed by Kangra. In Kinnaur and Kullu fruits comprise 82% and 69% of the total arrival of the markets, and target fruits comprise of 18.9% and 14.3% of the total arrivals in the markets. In the rest of the APMCs' target fruits comprise between 2 to 4% of the total arrival.
- ▶ On average Target Fruits comprise of 12.4% of the Total Fruits that arrive in all the APMCs, and Kinnaur and Kullu Target fruits comprise 23% and 21% of the Total Fruits arrival. We find that Mandi Kangra, Kinnaur and Kullu are the major trading hubs for Target Fruits.
- ▶ Most of the production and arrivals in the state of Himachal Pradesh are consumed fresh or consumed as processed. The production hubs that have positive average annual growth rate are Bilaspur with the highest growth rate of 40% followed by Mandi (14%), Sirmour (11%) and Una (7%).
- ▶ Mandi District is in the lead in the production of sub-tropical fruits, followed by Kangra and Sirmour which all have a positive trend. The overall production is growing, and the trend line shows that it will continue to in the future.
- ▶ There is an overall growth trend in the expansion of total area under various types of fruits in the sub-tropical zone districts of Himachal Pradesh. Additionally, it shows that Kangra and Mandi are on the lead in the expansion of cultivated area followed by Hamirpur. This trend will continue in the future especially with the further coverage of areas under the project.
- ▶ Arrival and Dispatch reports of different commodities transacted in Principal Market Yard/Submarket Yards of APMC for the year, 2020-21(excluding Sirmour APMC) show that the total volume of fruits that was traded in the yards was 100742 Quintals, which is also equivalent to the amount arrived in the market. Target fruits arrival was 12133 MT. The total arrival to the market yard was 529466 MT where the target fruits form 2% of the total arrivals. Target fruits form 12% of the total fruit arrival.
- ▶ All fruits arriving at the APMC yards have shown an increasing growth trajectory during 2020-21. However, Orange/Kinnow, Kagzi Lime and Malta/Mousambi have shown significant growth rates, which Plum is the only produce which shown a sharp decline during the period. The Plum trend needs to be revived by finding new domestic and international marketing destination, including entry as a product in the niche markets.

International Market Analysis

The analysis provides overall trends for the world trade, the Biggest 20 (B20) importing countries which are mature markets, Emerging Market (EM) where there is economic growth and growth in consumer income, and other countries. The analysis captured the overall trends for global trade of the targeted fruits mentioned above where there was sufficient data available for price, volume and value. The analysis led to the following findings.

- ▶ China, Ireland, Thailand and Spain distinctly show rising trend in the import of fruits and vegetables from the base year 2016. Whilst more advanced economies like Japan and Germany show a decline in the rate of import of fruits and vegetables.
- ▶ The analysis forecasted that the total volume of fruits and vegetables imported by the best twenty countries in the world (B20) would be around 236436 MT by 2030 having an annual average growth rate of 10%. Whilst B20 countries form 84% of the world import, this share will grow to 88% by 2030. The EM total volume imported will be 58545 MT by 2030 and has

the highest annual average growth rate of 21% as compared to World (7%) and they form the 10.5% of the B20 and 15.3% of the import volume for fruits and vegetable of the World. Clearly showing EM to be the future markets for fruits and vegetable.

- ▶ Among the biggest ten importers ("B10") with growth in import value, China, Ireland, Thailand and Spain has a higher rate of growth and the trend seems to show a faster growth rate than the rest of the countries with positive growth, and this will continue into the future. These markets also provide the highest price per MT.

Background

The global horticultural value chains are an important component of the global agricultural products value chain. Annual average growth of the agricultural products is 1% as compared to a -4% growth in fuels and mining products, where manufacturing shows no growth since the base year 2014 till 2020. Table below also shows that Agricultural Products average annual growth as percentage of total World Trade during the same period was 2%.

Manufacturing has shown a dip in the growth rate during 2015 and then an increase in the rate of growth from 2017 onward and stabilizing thereafter; similar pattern is noticed in the Fuel and mining products. However, the agricultural products growth rate seems to be stable throughout the period 2014 - 2020 as shown in Figure 110. The horticulture products global growth rate is covered under the agricultural products growth rate.

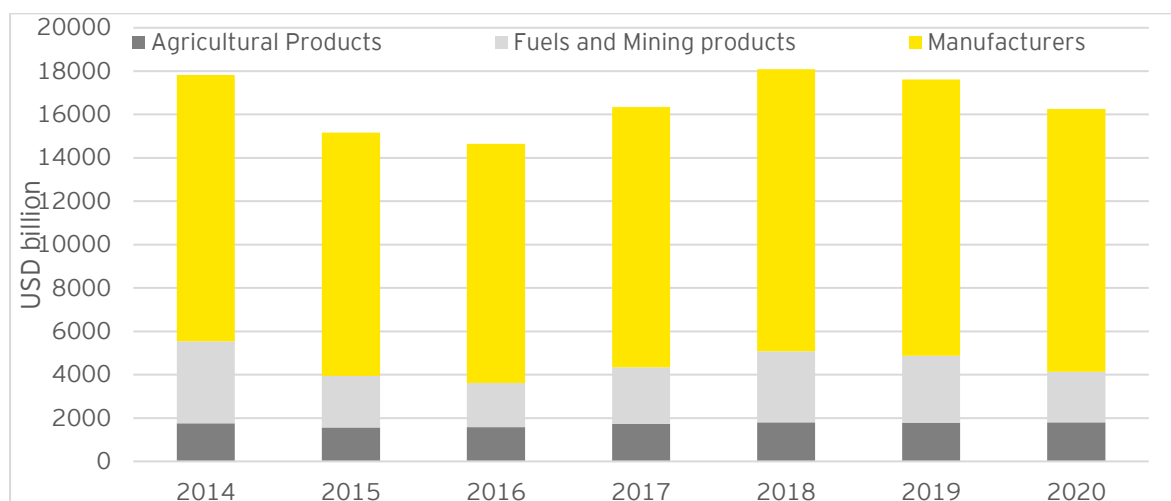


Figure 109: Agricultural trade as compared to other major sectors of the economy (USD Billion)

Methods of Analysis

Methods of Market Trend Analysis

Sub- tropical horticulture fruits are grown in small fields and back yards of small holder framers and also in larger orchards of individuals and groups of framers. The trade statistics from the ITC Trade Map- Trade Statistics for International Business Development database classifies Horticulture crops broadly into the following codes: (i) code HS2006 and HS2006000- which show all fruits traded globally under fruits and vegetables; (ii) HS-0805 and 080590 -includes Citrus fruits fresh or dried, covering sweet lime, lemon, and oranges; (iii) HS081050 - is for globally traded fresh Kiwi; (iv) HS-080450 covers globally traded fresh Guava and Mangoes (v) HS- 080940 - is for globally traded fresh Plum; and (vi) HS 081070 - globally traded fresh Persimmon. Litchi globally traded data could not be extracted from Trade Maps as the data is small it is under HS-081090 covering all the tropical fruits.

As part of the value chain up-grading study and to explore potential markets for the selected fruits, analysis was done on the overall trends for global trade of the targeted fruits mentioned above where there was sufficient data available for price, volume and value. The analysis provides overall trends for the world trade, the Biggest 20 (B20) importing countries which are mature markets,

Emerging Market (EM), and other countries. The analysis does not provide detailed trade information for specific fruit such as Litchi as the data is not sufficient to undertake such analysis.

The International Monetary Fund has identified the following countries as the emerging markets (EM) of 2021: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Philippines, Poland, Russia and Saudi Arabia. There is no definition for emerging markets, but the IMF uses the following criteria for identifying a country as an emerging market based on i) per capita income level ii) export diversification, and iii) degree of integration into the global financial system.

Table 100: Emerging countries in the world by region

Rapidly Emerging	Eastern Europe	Africa
China Brazil India Russia China	Latvia Romania Bulgaria Czech Republic Hungary Slovenia Kazakhstan	Algeria Tunisia Morocco Egypt South Africa
Asia	Middle East	Latin America
Latvia Romania Bulgaria Czech Republic Hungary Slovenia Slovakia Kazakhstan	Saudi Arabia Iran Bahrain Kuwait UAE Qatar Oman	Argentina Brazil Chile Colombia

Source: World Population review 2021

The data from the IMF shows that while the global growth rate is 3.4% the emerging economies (EM) and the developing economies (DE) have a higher growth rate of 4.6%. The advanced economies on the other hand have 1.6%. Such growth in the Emerging Markets have created additional consumer demand for fruits as a result of higher income, which gives them a choice for purchasing selected fruits and their substitutes.

Table 101: Global growth trend, Advanced Economies (AE) and Emerging (EM) and Developing Economies (DE)

	2018	2019	2020	2021
World	3.6	2.9	3.3	3.4
AE	2.2	1.7	1.6	1.6
EM & DE	4.5	3.7	4.4	4.6

World Imports of Horticulture products (fruits, vegetables, nuts, fruit peel and other edible parts of plants)

Volume of import:

The forecast shows a growing trend in the World by an average annual growth rate of 7%. The total volume imported by the best twenty countries in the world (B20) would be around 236436 MT by 2030 having an annual average growth rate of 10%. Whilst B20 countries form 84% of the world import, this share will grow to 88% by 2030. The EM total volume imported will be 58545 MT by 2030 and has the highest annual average growth rate of 21% as compared to World (7%) and they form the 10.5% of the B20 and 15.3% of the import volume for fruits and vegetable of the World.

Table 102: Trend in volume of fruits and vegetables in the World, B20, EM and others

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Average Annual Growth
World	124497	152177	127327	135620	150019	148274	162429	171680	180931	190182	199433	208683	217934	227185	236436	7
China	2499	3560	4319	16317	22050	25307	30493	35679	40864	46050	51236	56422	61608	66794	71980	50
Thailand	9991	10232	9566	12198	16124	15892	17315	18738	20161	21585	23008	24431	25854	27277	28701	12
Ireland	1879	2651	2631	6860	11383	12046	14368	16689	19011	21333	23654	25976	28298	30619	32941	38
United Kingdom	12294	12671	8591	7607	9425	6877	5797	4717	3636	2556	1476	396	-684	-1765	-2845	30
United States of America	8123	8474	9370	8518	8717	9010	9133	9256	9380	9503	9626	9749	9872	9996	10119	2
Malaysia	4953	5492	6120	6927	6607	7443	7917	8391	8866	9340	9814	10289	10763	11237	11711	9
Germany	8871	8209	7542	6997	6546	5874	5288	4702	4116	3530	2943	2357	1771	1185	599	-23
Japan	8103	7938	7765	7654	6224	6324	5920	5516	5112	4707	4303	3899	3495	3091	2686	-10
France	4935	5285	4210	4528	6027	5425	5568	5711	5853	5996	6139	6281	6424	6567	6709	4
Spain	630	832	1114	4076	4015	5138	6139	7140	8142	9143	10145	11146	12147	13149	14150	47
Chile	2646	2969	5231	3852	3643	4531	4819	5107	5394	5682	5970	6258	6545	6833	7121	13
Philippines	116	358	5439	857	3463	4205	4924	5643	6362	7082	7801	8520	9240	9959	10678	197
Taipei, Chinese	4242	3387	2883	3249	2649	2285	1952	1620	1288	955	623	290	-42	-374	-707	55
Italy	3644	3750	3326	3133	2457	2365	2066	1767	1467	1168	869	570	271	-28	-327	74
Australia	3431	3081	3158	2569	2397	2153	1895	1637	1379	1121	863	605	347	89	-169	-56
Argentina	1167	2795	1704	1432	2232	2096	2173	2250	2326	2403	2480	2556	2633	2710	2786	16
Canada	2381	2936	2563	1946	1684	1587	1348	1110	872	633	395	156	-82	-320	-559	0
Turkey	530	713	357	841	1661	1537	1776	2015	2254	2493	2732	2971	3210	3449	3688	30
Slovakia	418	1297	1749	1625	1608	2152	2423	2693	2964	3235	3506	3777	4047	4318	4589	35
Poland	937	1057	1172	1235	1577	1633	1779	1925	2070	2216	2362	2508	2654	2799	2945	12
Belgium	1345	1145	871	1115	1548	1318	1355	1393	1430	1468	1506	1543	1581	1618	1656	4
Total B20 in MT	83135	88832	89681	103536	122037	125197	134447	143698	152949	162200	171451	180701	189952	199203	208454	10
B20 % of World	67	58	70	76	81	84	83	84	85	85	86	87	87	88	88	
EM Total	26138	33868	35128	37155	26163	45319	41444	43581	45719	47856	49994	52132	54269	56407	58545	21
EM% of B20	31	38	39	36	21	36	31	30	30	30	29	29	29	28	28	10.5
EM% of World	21	22	28	27	17	31	26	25	25	25	25	25	25	25	25	15.3
Others	41218	63118	37646	32084	27982	27982	27982	27982	27982	27982	27982	27982	27982	27982	27982	-1.5

Figure below shows the trend in the import volume of fruits and vegetables by B20 countries. As can be seen, China, Ireland, Thailand and Spain distinctly show rising trend in the import of fruits and vegetables from the base year 2016. Whilst more advanced economies like Japan and Germany show a decline in the rate of import of fruits and vegetables.

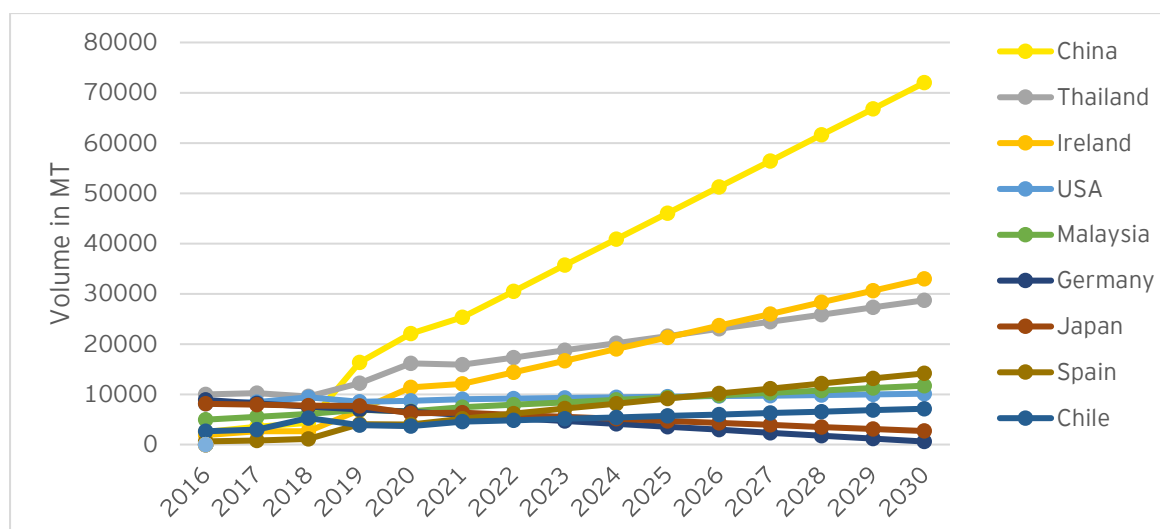


Figure 110: Global Trend in the Volume of Import of fruits and vegetables with positive growth (Derived from ITC Trade Map- Trade Statistics for International Business Development)

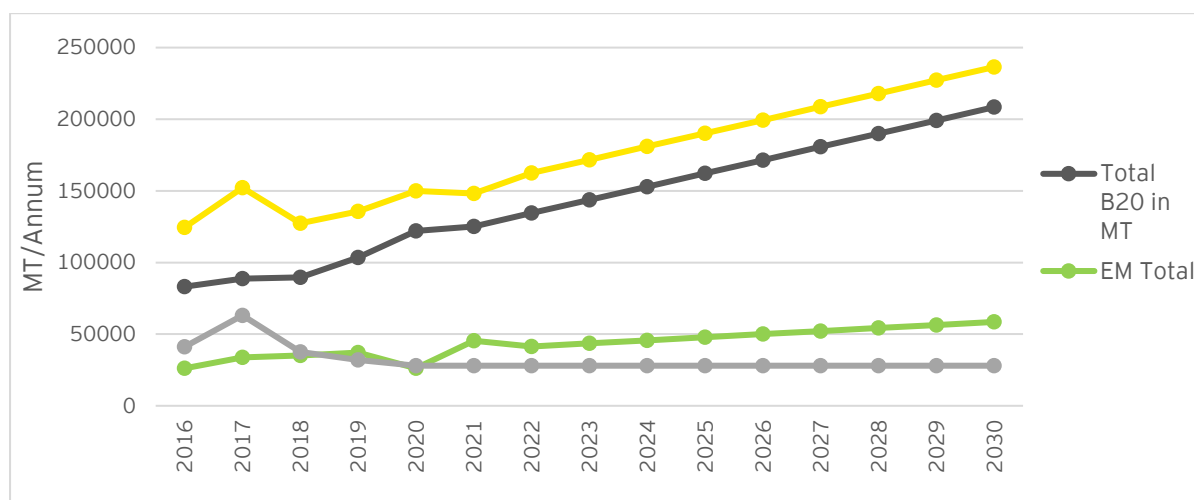
Among the destination countries for export of fruits and vegetables the Emerging Market group shows a higher annual growth rate of 21% as compared to B20 countries (10%), World 4%. While the remaining group shows a drastic slowing down of imports to -1.5%. The Emerging markets and the B20 markets form a high proportion of the annual growth rate by 25% and 82% respectively as shown below:

Table 103: Growth rate of destination markets.

Growth Destination	% Annual Growth of Group	Base year 2016 used of Projecting Growth Forecast in MT	Average Annual Growth Forecast Proportion of world Growth Rate		Total Forecasted 2030,MT
			%	MT	
B20	10	83135	82	143698	208454
EM	21	26138	25	43581	58545
Others	-1.5	41218	18	32125	27982
World Total	4	124497	100	175520	236436

(Derived from ITC Trade Map- Trade Statistics for International Business Development)

Among the destination markets the trend for fruits and vegetables the total volume of import is increasing in the B20 group and EM group along with the world trend. In the remaining countries, we see a declining trend.



S

Figure 111: Destination market for import of fruits and vegetables

Value of Imports:

The value of trade in Fruits and Vegetable is dependent on the type and nature of products being traded and the value added to such products. Along with volume the value did not drop in 2020 and 2030. This shows that there hasn't been an income/substitution elasticity of demand even when there was disruption of the market due to COVID and political instability in many part of the emerging economies. Table below shows the B20 average annual growth in value of imports of fruits and vegetables to be 7% as compared to the as compared to 5% of the World value.

Table 104: Trends in import value and average annual growth of World, B20, EM and Others importers in US\$'000 for fruits and vegetables

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Avg Annual Growth
World	328304	370657	352472	371997	381999	393705	404578	415451	426324	437197	448070	458943	469816	480689	491562	5
China	16051	18434	22090	47683	55108	64082	74818	85555	96291	107027	117764	128500	139236	149972	160709	30
United States of America	26105	28692	31668	28314	31056	32024	32977	33929	34881	35834	36786	37739	38691	39643	40596	5
United Kingdom	33574	37386	27777	24745	30839	25431	23620	21809	19998	18187	16375	14564	12753	10942	9131	-13
Japan	26907	26220	25036	24743	23040	22426	21505	20584	19663	18741	17820	16899	15978	15057	14136	-7
France	22015	23382	23188	22197	22129	22295	22199	22104	22008	21912	21817	21721	21625	21530	21434	0
Germany	22940	21327	19860	18569	19355	17432	16439	15446	14453	13461	12468	11475	10482	9489	8497	-10
Ireland	4165	5939	6081	15882	18654	21821	25713	29605	33497	37389	41281	45173	49065	52957	56849	36
Thailand	9227	9988	9897	12644	17815	17864	19847	21830	23813	25797	27780	29763	31746	33729	35713	15
Malaysia	10371	12143	13290	13419	11389	13116	13447	13778	14110	14441	14772	15103	15434	15766	16097	6
Italy	14067	14728	12922	13004	9760	9795	8761	7727	6693	5660	4626	3592	2558	1524	491	-26
Singapore	10899	10447	10639	9428	8752	8439	7908	7377	6845	6314	5783	5251	4720	4189	3657	-11
Australia	12329	13356	13226	9731	8737	8233	7152	6071	4990	3910	2829	1748	667	-414	-1495	-14
Spain	2127	2951	3718	7223	8465	9981	11676	13371	15066	16760	18455	20150	21845	23540	25234	31
Netherlands	6410	7881	6688	5358	5904	5388	5034	4681	4327	3974	3620	3267	2913	2560	2206	-10
Belgium	4538	4732	3964	4230	5066	4672	4728	4783	4838	4894	4949	5005	5060	5115	5171	1
Russian Federation	2500	4104	4631	3734	4885	5291	5731	6171	6611	7051	7491	7931	8371	8811	9251	16
Canada	5613	6341	5975	5090	4871	4758	4484	4211	3937	3664	3390	3117	2843	2570	2296	-9
Philippines	550	2223	7141	1411	4667	5425	6167	6909	7652	8394	9136	9878	10620	11363	12105	80
Poland	2872	2665	3089	3226	4560	4464	4857	5251	5645	6038	6432	6826	7219	7613	8007	11
India	1398	2019	3441	3410	4338	5103	5830	6557	7284	8011	8738	9465	10192	10919	11646	27
Total B20 in US\$ '000'	234658	254958	254321	274041	299390	308038	322892	337747	352602	367457	382311	397166	412021	426875	441730	7
B20 % of World Value	71	69	72	74	78	78	80	81	83	84	85	87	88	89	90	
EM Total Value	47314	66147	75714	93469	100678	116879	130284	143689	157094	170499	183904	197309	210714	224119	237524	11
EM % of B20 Value	20	26	30	34	34	38	40	43	45	46	48	50	51	53	54	3.7
EM% of World Value	14	18	21	25	26	30	32	35	37	39	41	43	45	47	48	6.1
Others	93226	114879	98070	97956	82609	85900.9	82085.2	78269.5	74453.8	70638.1	66822.4	63006.7	59191	55375.3	51559.6	-5

(Derived from ITC Trade Map- Trade Statistics for International Business Development)

Among the B10 importers with positive growth in import value, China, Ireland, Thailand and Spain has a higher rate of growth and the trend seems to show a faster growth rate than the rest of the countries with positive growth, and this will continue into the future.

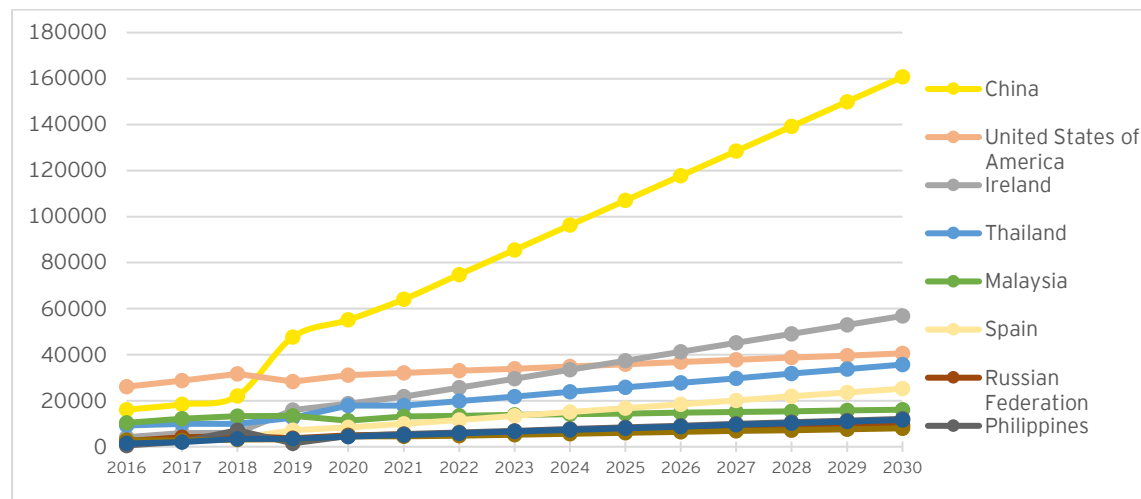


Figure 112: Trend in import value of B10 importers with positive growth in US\$'000

There is an overall positive growing trend in the total value of imports from World, B20 and EM group of countries. The remaining countries/others are showing a decline in the total value of imports as shown below.

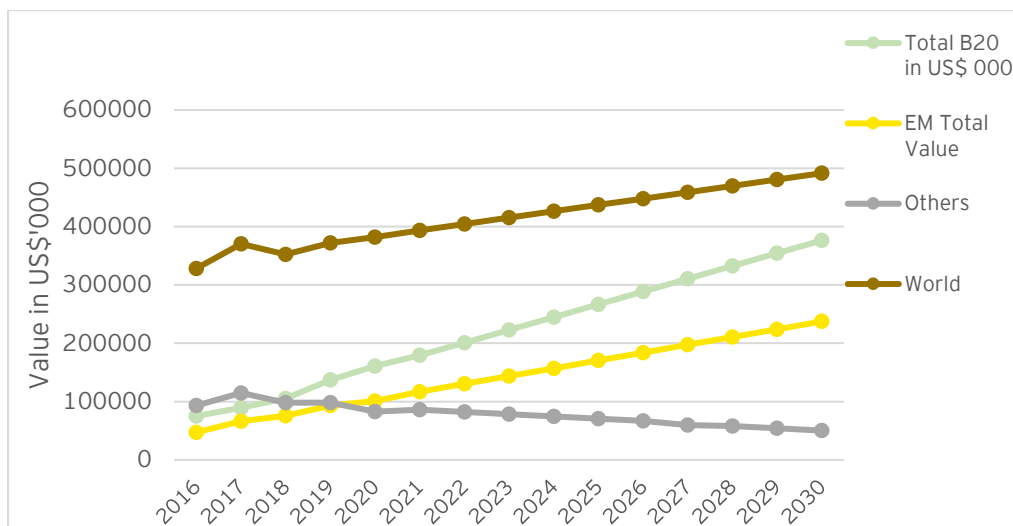


Figure 113: Trends in import value of World, B20, EM and Others importers in US\$'000 for fruits and vegetables

Import Prices 2020

The following figure show a large variation in prices paid by different importing countries - this is related to the type of products imported and the level of added value in terms of grades, packing and quality. The countries paying the highest prices are all importing a large share from one of the hubs of world trade in Fruits and Vegetables, namely the USA, France, Italy, Belgium and the Emerging Market group of counties.

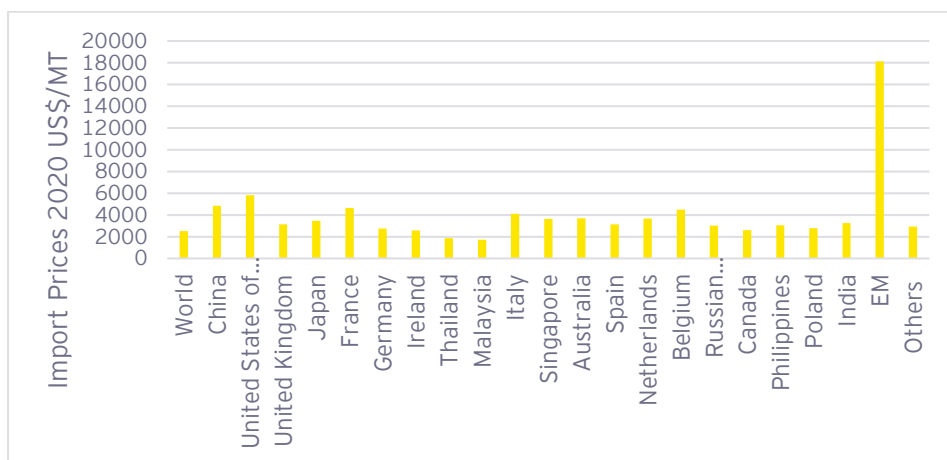


Figure 114: Import Prices for Horticulture (Vegetables and Fruits) at different locations in 2020, USD/MT

(Derived from ITC Trade Map- Trade Statistics for International Business Development)

Overall prices experienced year on year show positive development with steady annual average growth across B20 and EM. However, the EM locations experienced a price drop in 2016 and 2019 which could be a reflection of the international financial crisis indicating income elasticity demand by the end consumer of fruits and vegetable products.

Figure below shows that the average annual growth of the world since 2012 to 2020 is negative (-5%). Whilst during the same period B20 and EM showed a positive annual average growth.

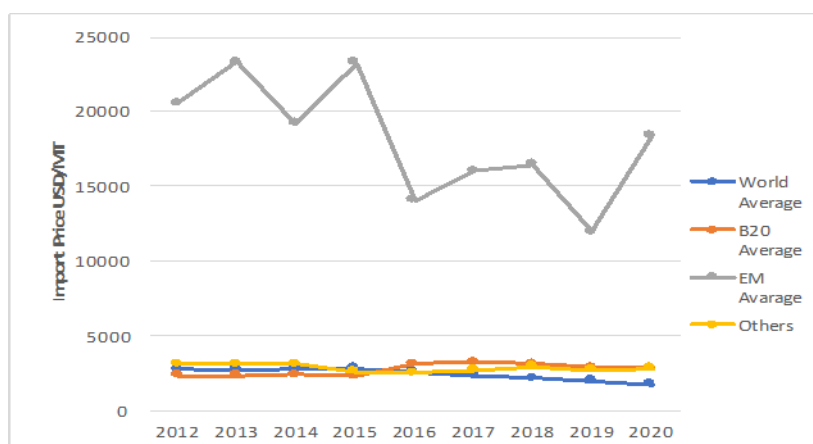


Figure 115: Development of Import Price

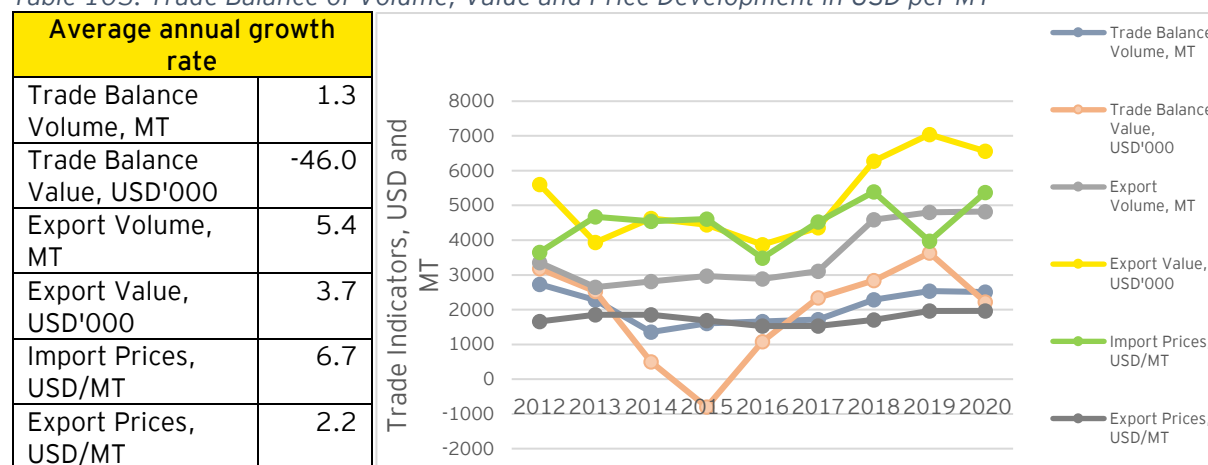
Location	2012	2013	2014	2015	2016	2017	2018	2019	2020	% Average Annual Growth
World Average	2826	2793	2874	2856	2637	2436	2235	2034	1833	-5
B20 Average	2419	2403	2444	2436	3175	3277	3208	2925	2917	3
EM Average	20547	23281	19166	23219	14081	16013	16452	11988	18444	2
Others	3186	3202	3194	2661	2595	2770	3020	2754	2900	-1

India Trade and Exports of Fruits and Vegetables

In India export volume, value and price development of Fruits and vegetables experienced an annual average growth of 5.4%, 3.7% and 2.2% respectively, but with considerable variations between years. In addition, the import prices are far higher than the export prices. India's import price of Fruits and Vegetables experienced an average annual growth of 6.7%. India's horticulture production was expected to increase by 2.93 per cent to a record level of 329.86 million MT in 2020-21. Large number of varieties of Fruits and Vegetables are grown in India, with Indian processing industries adding considerable amount of value, and the potential for production of fruits and vegetable for value addition appears to be significant.

The trade balance is varying considerably both in volume and value suggesting that the local supply plays a role in imports. Both export volume and value are steadily increasing. Trade balance in terms of volume is growing positively at 1.35% while in value it is negative. This is because of a prolonged period of disproportionate pricing of exports to that of imports. As the trade balance in value dropped in 2019 the trade balance in volume increased in the same year. Whilst export volume is showing an increasing trend along with the export value, but it dropped slightly in 2020.

Table 105: Trade Balance of Volume, Value and Price Development in USD per MT



Market Analysis of Target Fruits

Citrus

World Import of Citrus

Volume of Citrus Import:

World import of citrus is increasing and the demand for citrus is growing. Volume of import of Citrus has increased from 14810104 MT in 2016 to 17785832 MT in 2020. Emerging market share has increased and is higher than the rest of the countries with an annual average growth rate of 51%. This trend will continue in the future. The B20 share of the total world growth in volume is increasing at an average annual rate of 61%.

The B20 and EM markets are growing in the import of citrus. B20 has imported the highest. EM on the other hand comprise around 29% of the share of the B20 markets with an annual average growth rate of 2%. Out of these USA, Russia, Netherlands and Germany show a higher growth trend in import of citrus followed by Saudi Arabia, Canada, Italy, China and Ukraine.

Table 106: Trend in volume of Citrus in the World, B20, EM and others

Importers/Twenty Biggest Importing Countries, Other	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Average Annual Growth
World	14810104	14704559	17048489	16214884	17000358	17785832	1871306	9533365	8365437	7197509	6029581	4861653	3693726	2525798	1357870	-761
Russian Federation	1526792	1564907	1682755	1696735	1668217	1752285	1781045	1827959	1868065	1908171	1948278	1988384	2028490	2068596	2108703	28
United States of America	0	0	1355638	1348381	1516966	2158891	2619708	3048260	3488911	3929562	4370213	4810865	5251516	5692167	6132818	303
Germany	1145560	1090206	1090613	1083390	1215137	1164683	1210849	1209969	1226731	1243493	1260256	1277018	1293780	1310542	1327305	12
Netherlands	1050258	1069696	1125297	1101678	1158961	1175994	1200204	1254555	1250316	1275176	1300037	1324898	1349758	1374619	1399479	18
France	1119121	1121542	1059508	1068531	1083382	1053070	1043286	1029695	1017531	1005368	993205	981041	968878	956714	944551	-9
United Kingdom	797426	766283	748759	750608	790156	761582	773076	763834	762367	760901	759435	757969	756502	755036	753570	-1
Saudi Arabia	669234	631645	653550	641589	687370	670542	690424	688505	694762	701019	707275	713532	719788	726045	732301	5
Canada	493226	471229	477972	498887	507830	506889	522914	524170	530964	537759	544553	551347	558142	564936	571731	5
Poland	428408	441820	482945	212127	506192	392061	384148	376950	369484	362017	354551	347085	339619	332153	324687	-1
Italy	358357	486157	414458	456252	464585	490727	480216	510799	525972	541145	556318	571491	586664	601837	617010	14
China	295641	466751	533203	566740	431180	570023	544936	608697	639140	669583	700026	730469	760912	791355	821798	28
Iraq	511018	515117	737169	441851	399933	432387	354482	345665	310940	276215	241490	206764	172039	137314	102589	-29
Ukraine	291607	265482	337844	358719	385090	411809	453759	475810	505322	534835	564348	593861	623373	652886	682399	24
Hong Kong, China	358538	414732	454573	434014	355713	407604	379392	393430	391625	389819	388014	386208	384403	382597	380792	0
United Arab Emirates	458270	447318	398130	395423	352159	331025	301244	276276	249503	222731	195958	169185	142413	115640	88867	-24
Bangladesh	139108	149689	153549	206432	291498	296512	349015	378160	416064	453968	491872	529776	567680	605584	643488	35
Spain	277988	263591	314729	240642	278888	268823	265721	264029	261809	259588	257368	255147	252926	250706	248485	-2
Romania	266925	247003	268458	261793	249906	253043	254099	250896	249291	247686	246080	244475	242869	241264	239658	-2
Portugal	166573	204348	228316	189143	238774	244190	247997	264822	276765	288709	300652	312595	324539	336482	348425	13
Japan	253973	240671	227609	227409	224060	212818	208737	200045	193082	186119	179156	172193	165230	158267	151304	-7
Total of B20	10608023	10858187	12745075	12180344	12805997	13554957	14065250	14663425	15228645	15793864	16359083	16924303	17489522	18054742	18619961	380
B20 % of World Total	7.2	7.4	7.5	7.5	7.5	7.6	7.5	15.4	18.2	21.9	27.1	34.8	47.3	71.5	137.1	61
EM Total	3491735	3637604	3950095	3769112	3829439	3977672	4000628	4106063	4180569	4255075	4329581	4404086	4478592	4553098	4627603	51
EM of Total of B20	33	34	31	31	30	29	28	28	27	27	26	26	26	25	25	-2
Others	4202081	3846372	4303414	4034540	4194361	4243650	4361737	4355661	4396064	4436468	4476871	4517275	4557679	4598082	4638486	27

(Source: ITC Trade Map- Trade Statistics for International Business Development)

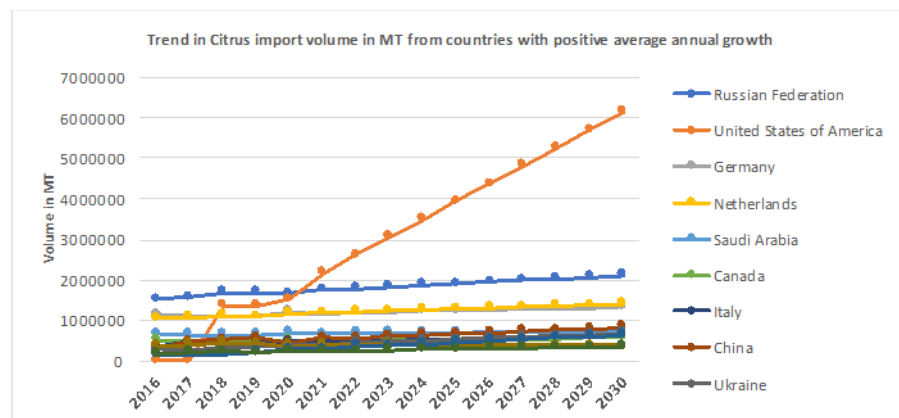


Figure 116: Trend in Citrus Import Volume in MT from countries with positive average annual growth

The B20 Markets have annual average growth of 61% in the volume of import of citrus with an average import volume of 14663425 MT, which is forecasted to reach 18619961 MT by 2030. Similarly, the next destination is the EM with annual growth of 51% and an average import volume of 4106063 MT, which is also forecasted to reach 4627603 MT by 2030.

Value of Citrus Imports:

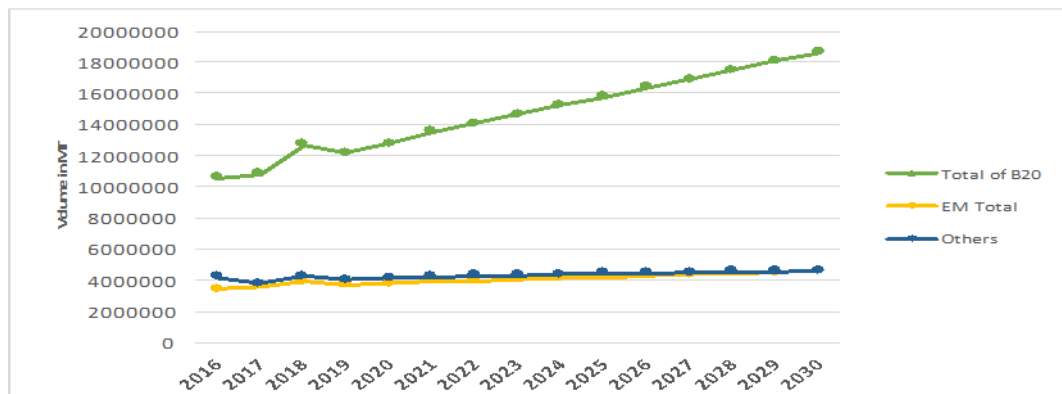


Figure 117: Import volume growth in the destination markets, average volume, and forecast volume

Growth Destination	% Annual Growth of Group	Base year 2016 used of Projecting Growth Forecast in MT	Average Annual Growth Forecast Proportion of world Growth Rate		Total Forecasted 2030,MT
			%	MT	
B20	61	10608023	63	14663425	18619961
EM	51	3491735	18	4106063	4627603
Others	27	4202081	19	4344183	4638486
World Total	-761	14704559	100	23113671	1357870

In terms of value the World import of citrus has experienced an annual average growth rate of 43%. It is forecasted that this growth will continue and amount to an average of USD18 billion per year reaching a total of USD 21.7 billion by 2030. During the same period the B20 have experienced an average annual growth in value of 41%. It is forecasted that the growth in the B20 will continue and amount an average of USD12.3 billion with an average growth rate of 75%, whilst the growth in the EM will also continue and amount an average of USD 3.8 million and a growth of 57%. There will be an average growth of 30% percent in the share of B20 in the total world value. Likewise, there will be an average growth of 18% in the share of value of EM in the total value of B20.

Table 107: Trends in import value and average annual growth of World, B20, EM and Others importers in US\$'000 for Citrus

Twenty Biggest Importing Countries, Others Total and World Total Value (US\$'000)	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	%Average Annual Growth
World	14392834	14911073	16109116	14943152	16977813	17027409	17547612	18067816	18588020	19108224	19628427	20148631	20668835	21189038	21709242	43
Germany	1213141	1212946	1321919	1180736	1570811	1504850	1573163	1641476	1709789	1778102	1846415	1914728	1983041	2051354	2119666.6	62
United States of America	1060459	1223128	1466503	1390785	1552077	1683858	1798948	1914037	2029126	2144216	2259305	2374394	2489483	2604573	2719662	99
France	1214519	1233973	1236900	1118056	1358146	1283720	1300854	1317987	1335121	1352255	1369388	1386522	1403656	1420790	1437923.2	20
Russian Federation	1160771	1189212	1231478	1281039	1249706	1303350	1330320	1357290	1384259	1411229	1438199	1465169	1492138	1519108	1546077.6	29
Netherlands	1013795	1015491	1105080	1005031	1167042	1150098	1179701	1209305	1238908	1268512	1298115	1327718	1357322	1386925	1416528.6	36
United Kingdom	824125	822873	839802	788802	897348	868303	879540	890778	902015	913253	924490	935728	946965	958203	969440	17
Canada	548823	581233	612071	566474	610916	616732	627674	638617	649560	660502	671445	682388	693330	704273	715215.8	27
Poland	364958	390339	464326	217383	517729	430723	443981	457240	470499	483757	497016	510274	523533	536792	550050.2	119
China	354733	551894	633749	594239	491602	620068	651677	683285	714893	746501	778110	809718	841326	872935	904543	112
Italy	383614	459829	440631	404372	479699	474643	488314	501986	515657	529328	542999	556671	570342	584013	597684.6	48
Saudi Arabia	349834	328813	363609	358877	422887	417655	435272	452889	470506	488123	505740	523357	540974	558591	576208	53
Hong Kong, China	373871	458224	504261	482644	420307	483049	494778	506507	518237	529966	541695	553424	565153	576883	588611.8	50
Japan	369239	362150	361635	342335	335924	328323	319679	311034	302390	293745	285101	276456	267812	259167	250522.6	-38
Belgium	331639	320251	288145	249365	312555	267675	256769	245864	234959	224053	213148	202242	191337	180432	169526.2	-60
Ukraine	196732	171570	216511	256445	292601	309756	337417	365078	392740	420401	448062	475724	503385	531046	558707.4	113
Spain	299423	247500	329133	217114	288688	260815	255629	250444	245258	240072	234887	229701	224516	219330	214144.4	-15
United Arab Emirates	320804	319131	248507	237904	264866	220312	201001	181691	162381	143070	123760	104450	85139	65829	46518.8	-173
Korea, Republic of	287873	294586	327606	274259	254218	261417	252654	243890	235126	226363	217599	208835	200071	191308	182544	-42
Switzerland	198990	204599	211178	195685	243899	235141	243232	251322	259413	267503	275593	283684	291774	299865	307955	47
Portugal	126146	160498	184948	139696	217215	214101	230235	246369	262502	278636	294769	310903	327037	343170	359303.8	125
Total of B20 in USD'000	10993489	11548240	12387992	11301241	12948236	12934588	13300838	13667087	14033337	14399586	14765836	15132085	15498335	15864584	16230834	41
B20 % of World	76	77	77	76	76	76	76	76	75	75	75	75	75	75	75	-2
EM Total Value	2759230	3005843	3291481	3205878	3362816	3547212	3687932	3828653	3969374	4110095	4250815	4391536	4532257	4672977	4813698	57
EM % of B20	25	26	27	28	26	27	28	28	28	29	29	29	29	29	30	18
Others Total Value	28762746	3356779	3710993	3641911	4029577	4077743	4224629	4371523	4518398	4665283	4812168	4959053	5105938	5252823	5399708	-39

(Source: ITC Trade Map- Trade Statistics for International Business Development)

All the top importers in terms of value of import will continue to grow. Out of these the top four important destination markets for citrus are Germany, USA, France, and the Russian Federation. However, tariff and restrictions based on standards of production will play an important role in these markets. The other markets with positive annual average growth rates that will keep growing are the Netherlands, United Kingdom, Canada, Poland, China, Italy and Saudi Arabia.

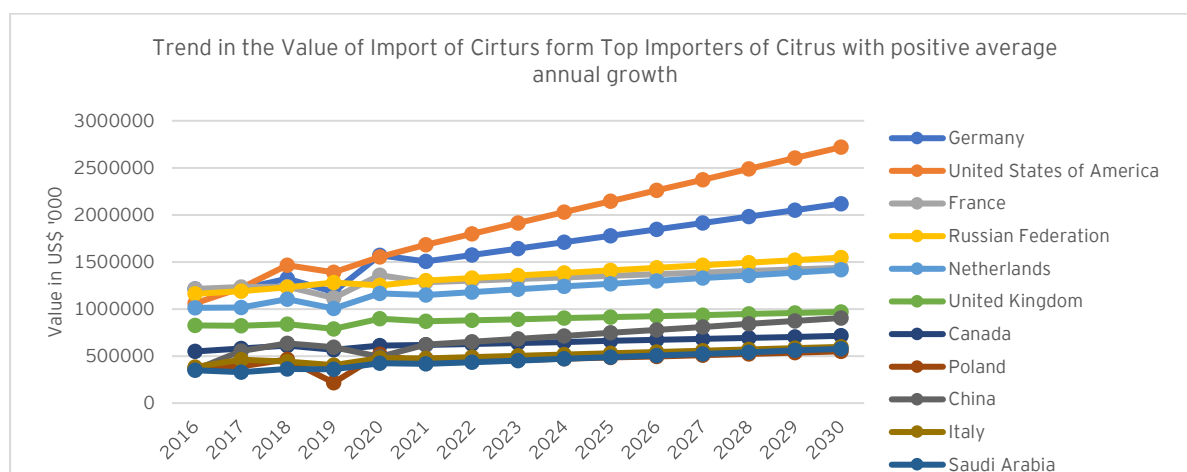


Figure 118: Trend in the Value of Import of Citrus from Top Importers of Citrus with positive annual growth

Import Prices 2020

Overall prices experienced year on year shows positive development with steady annual average growth across B20 and World. However, the EM locations experienced a price drop in 2018 and then steady growth in 2019 and 2020, indicating income elasticity demand by the end consumer of citrus. Among the B20 countries Republic of Korea, Switzerland, Japan and Belgium offered the

highest per MT, followed by Germany and France. EM prices were just above USD 600 per MT.

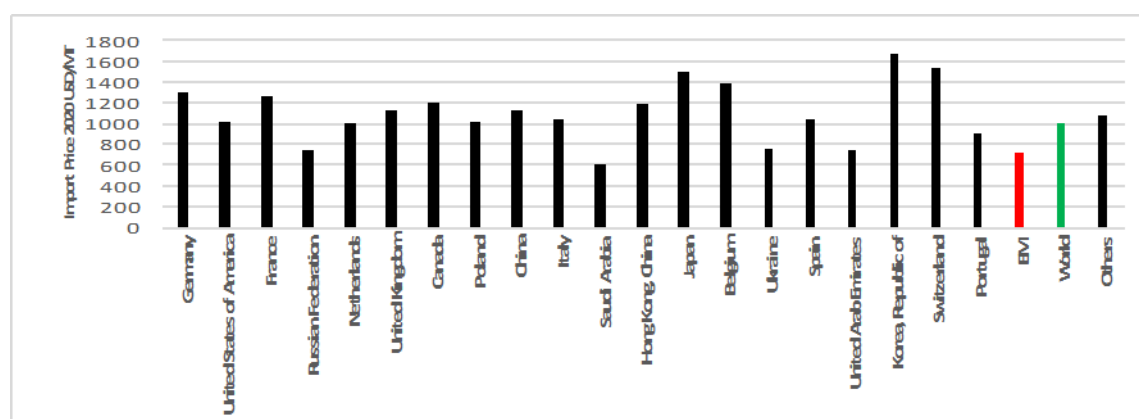
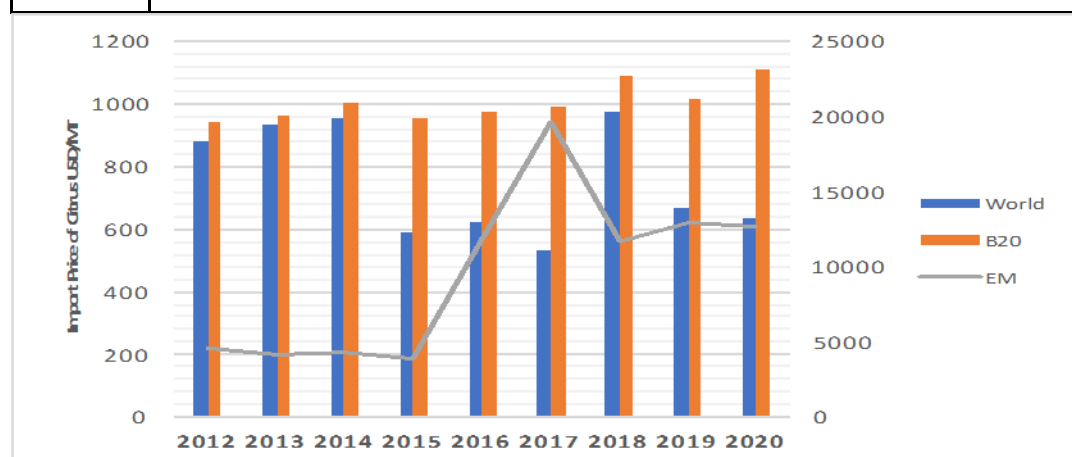


Figure 119: Import Prices for Citrus Fruits (fresh or dried) at different locations in 2020, USD/MT

The World price for citrus developed at the rate of 1% from 2012 to 2020 and the trend is growing, while the B20 experienced 2% growth and will keep growing with average price of USD999 per MT. The highest prices are offered in the EM with an annual average growth of 25% and will tend to grow and offered an average import price of USD9514.

Table 108: Development of Import Price of Citrus

Location	2012	2013	2014	2015	2016	2017	2018	2019	2020	% Average Annual Growth
World	882	937	954	587	623	536	979	665	635	1
B20	941	964	1000	907	973	988	1088	1019	1110	2
EM	4621	4165	4260	3846	11851	19684	11642	12925	12632	25



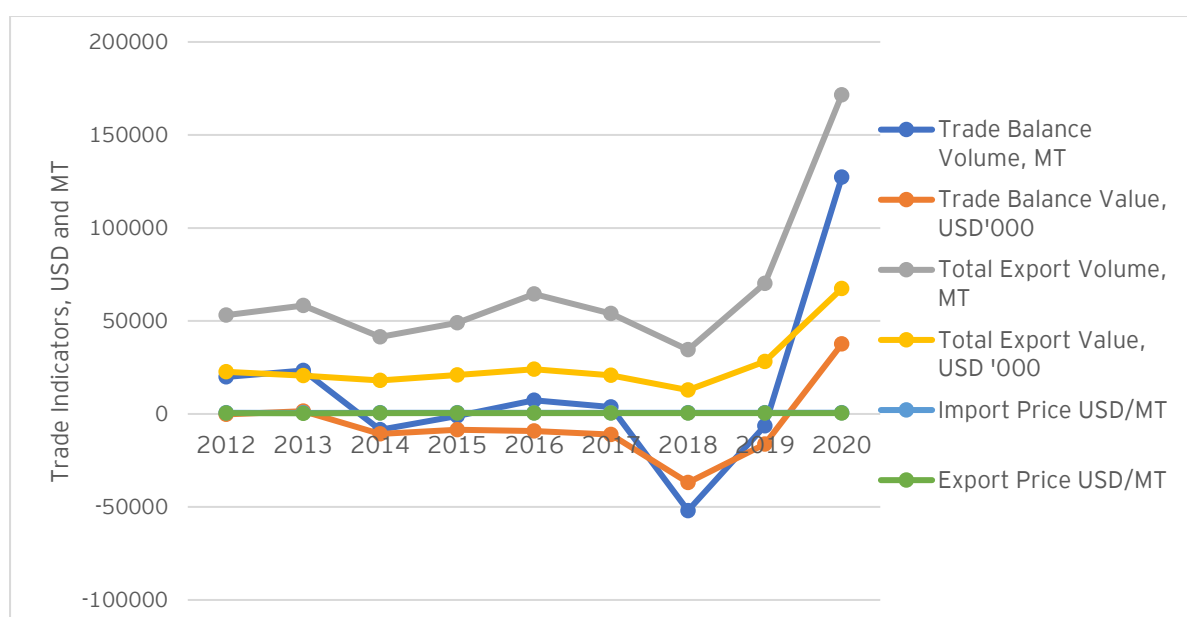
In India export volume, value and price development of Citrus experienced average volume of 66271 MT, USD261788, and an average export price of USD397 per MT, but with considerable variations between years. In addition, the import prices are far higher than the export prices. The average import price is USD 602 per MT which is more than USD 206. India's citrus production has shown higher performance in 2021, wherein 6 million MT of Orange was produced and 3.69 million Sweet Orange/Mousambi. However, a large number of varieties of citrus are grown in India, with Indian processing industries adding considerable amount of value, the potential for production of citrus appears to be significant both for domestic consumption and exports.

India Trade and Exports of Citrus

As can be seen in Table below, there was deficit trade balance in volume in 2014 and in 2018 for citrus. A prolonged period of deficit in trade in terms of value from 2013 through 2018. Trade balance surplus in volume and value appeared after 2019 and continues to be steady in 2020. There has been a sharp spike in export volume and value since 2019; this is possibility the impact of the Horticulture Mission activities.

Table 109: Trade Balance of Volume, Value and Price Development in USD per MT for Citrus

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Trade Balance Volume, MT	19836	23341	-8519	-1089	7349	3641	51957	-6457	127236
Trade Balance Value, USD'000	-254	1520	-10715	-8542	-9129	11152	36914	-16192	37561
Total Export Volume, MT	53039	58280	41441	49034	64550	53935	34480	70081	171602
Total Export Value, USD '000	22711	20671	17994	20903	24044	20812	12838	28207	67419
Import Price USD/MT	665	548	575	587	580	636	576	580	673
Export Price USD/MT	428	355	434	426	372	386	372	403	393



Export Case of Sweet Orange.

The data from the DGCIS Annual Export report is the source of data given in the box below. Sweet Orange which is also a popularly known as Mousambi is one of the target crops for development in the the project by the DoH. In 2020, Netherlands, Russia, Saudi Arabia, Germany, China and France were the top five importing countries of Sweet Orange from India. But in terms of price Republic of Korea, Hong Kong China and the USA offered USD1649/MT, 1042/MT and USD1007/MT.

Table 110: Sweet Orange Export from India

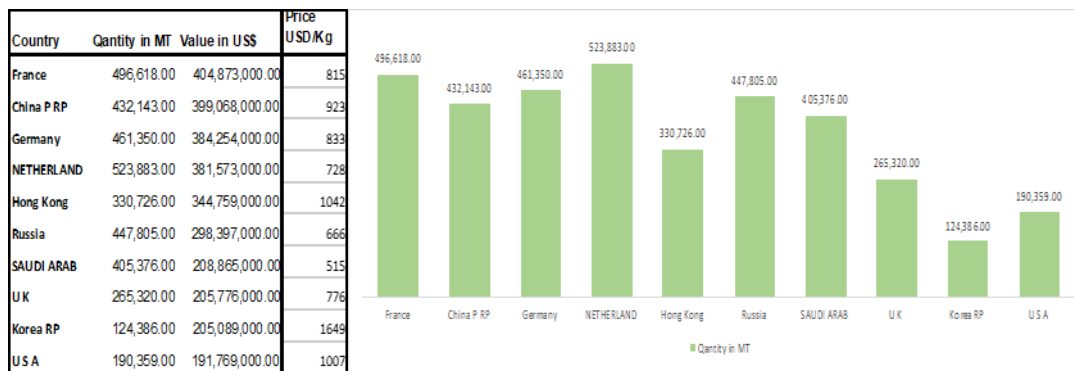


Figure below shows the top 10 countries importing Sweet Orange from India in 2019, where France, China, Germany, Netherlands and Hong Kong and Russia with the higher value of export. Global data analysis also shows that future export destinations will be Germany, Netherlands, Russian Federation, and France, and Saudi Arabia in the Emerging Markets of the Middle East.

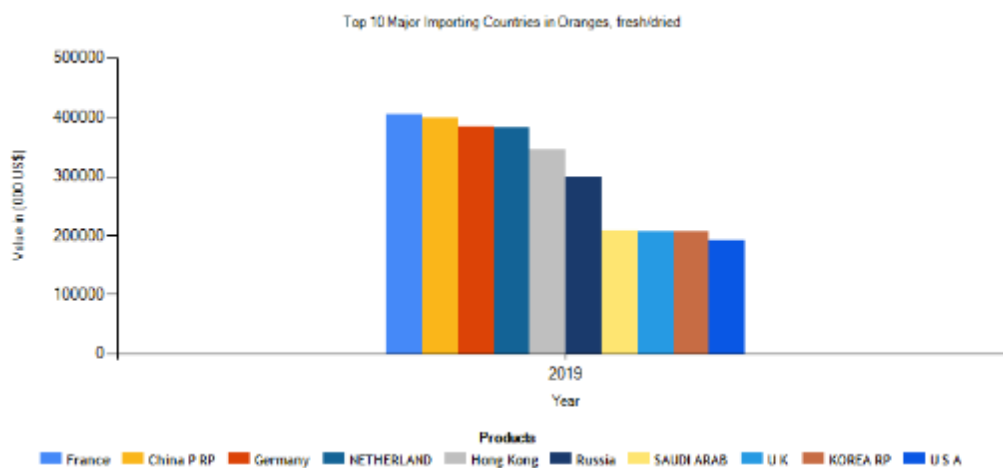


Figure 120: Top 10 Countries of Sweet Orange form India

Persimmon

World Import of Persimmon

Volume of Import.

The import market of Persimmon witnessed a positive annual average growth of 5% which is similar to B20 group of countries and this trend is likely to continue. Morocco has shown the highest annual average growth rate of 22% followed by Thailand and Czech Republic (both growing at the rate of 16%) followed by Ukraine, and the United Kingdom.

Table 111: Trend in volume of Persimmon in the World, B20, EM and others

Importers	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Annual Growth Rate
World	414249	519317	469958	513205	578215	595535	627717	659899	692081	724263	756445	788627	820809	852991	885173	5
Russian Federation	111520	145726	162460	148125	172904	185697	198214	210731	223247	235764	248281	260797	273314	285831	298347	7
Kazakhstan	51412	52783	34911	23498	58663	39819	38340	36862	35384	33905	32427	30949	29470	27992	26514	1
Germany	41354	47230	45318	54468	52900	57353	60386	63419	66452	69485	72518	75551	78584	81617	84650	5
Ukraine	21222	29274	32814	40821	40405	47881	52872	57864	62855	67846	72838	77829	82820	87811	92803	11
Italy	23671	27294	21439	27849	30661	30543	31997	33450	34904	36357	37811	39264	40718	42171	43625	5
Thailand	9857	15032	10532	19788	27845	28830	32904	36977	41050	45123	49196	53270	57343	61416	65489	16
France	20297	27993	25573	26964	27716	29851	31232	32613	33994	35375	36756	38137	39518	40899	42279	5
Belarus	22705	32031	20663	23231	18946	18620	16988	15356	13724	12093	10461	8829	7197	5565	3934	-10
Lithuania	15344	22289	17321	19165	16001	17481	17300	17119	16938	16757	16576	16395	16214	16033	15852	1
United Kingdom	6382	7520	7131	12461	11970	13928	15540	17151	18763	20375	21986	23598	25210	26821	28433	12
Poland	9766	11630	8164	10489	11847	11286	11588	11890	12192	12494	12796	13098	13400	13702	14004	3
Canada	6742	8386	7820	8693	9270	9791	10327	10864	11400	11936	12473	13009	13545	14081	14618	5
Portugal	5078	7300	6503	6535	6821	7264	7536	7808	8080	8352	8624	8896	9168	9441	9713	5
Switzerland	6059	6104	5157	5681	6801	6279	6385	6491	6597	6703	6809	6915	7021	7127	7234	1
Netherlands	5111	5858	4670	6643	5822	6283	6504	6724	6945	7166	7386	7607	7828	8048	8269	4
Malaysia	4020	5299	4015	4502	5452	5278	5484	5691	5898	6105	6311	6518	6725	6931	7138	5
Saudi Arabia	3302	4235	2943	3748	4505	4322	4514	4706	4898	5090	5282	5474	5666	5857	6049	5
Morocco	1113	3376	2439	2800	4434	4652	5259	5865	6472	7079	7685	8292	8898	9505	10112	22
Czech Republic	1824	2265	1709	4194	4099	4762	5410	6058	6706	7353	8001	8649	9297	9945	10593	16
Finland	2333	3153	2026	2620	3364	3158	3311	3464	3617	3770	3922	4075	4228	4381	4534	6
Total of B20	369112	464778	423608	452275	520426	533077	562090	591102	620115	649127	678140	707152	736165	765177	794190	5
B20% of World	89	89	90	88	90	90	90	90	90	90	90	90	90	90	90	0
EM Total	131840	170270	181498	171968	199455	212085	225777	239470	253163	266856	280549	294241	307934	321627	335320	7
EM % of B20	36	37	43	38	38	40	41	42	42	43	44	44	45	46	46	2
Other	44992	54323	46350	60930	57789	62537	65757	68977	72197	75417	78638	81858	85078	88298	91518	5

The Emerging Markets have shown a higher average annual growth rate of 7% for volume of imports followed by the B20 group of countries, where B20 volume of import is around 90% of the global share, and EM groups share is around 46% of the share of the B20 group's total import and is growing at 2%. Therefore, the EM group of markets are a favorable export destination for Persimmon.

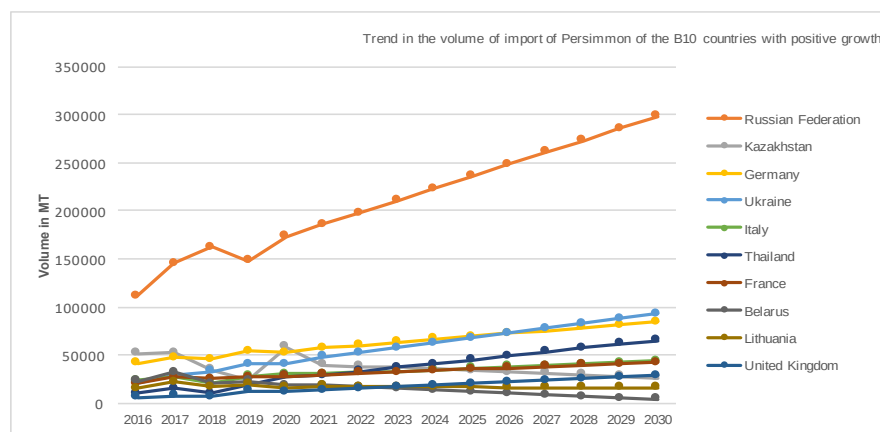


Figure 121: . Trend in the import of Persimmon by B10 countries with positive growth rate

Among the B10 countries with positive growth all the countries are showing an increasing trend in the import of Persimmon, except for Belarus. The four-important market location and destination for Indian export of Persimmon in terms of capturing the volume of market share are Russian Federation, Ukraine, Thailand and Germany.

Value of Import

The following Table below shows that the World market for Persimmon is experiencing a value growth rate of 12% and this growth is going to continue. The total value was USD402 million in 2016 and is forecasted to grow in value up to USD 840 million. The B20 countries has a growth rate of 6% and will continue to grow with a total value of USD349 million in 2016, which is forecasted to reach USD713 million, in 2030. The Emerging Market group of countries are the star markets with

growth rate of 13% -a point higher than the world markets and covers a share of 34% of the B2O countries with value of USD108 million in 2016, which is forecasted to grow up to USD279 million.

Table 112: Trends in Persimmon import value and average annual growth of World, B2O, EM and Others importers in US\$'000

Importers	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Average Annual Growth
World	402256	504978	490486	499717	550933	577302	606511	635720	664930	694139	723348	752558	781767	810976	840186	12
Russian Federation	87337	112165	131207	118346	129434	142810	151848	160885	169923	178960	187998	197035	206073	215110	224148	12
Germany	47732	59112	65554	66884	73984	80736	86764	92791	98819	104846	110874	116902	122929	128957	134984	13
France	23001	30865	36436	32203	36974	40681	43609	46538	49466	52395	55323	58251	61180	64108	67037	13
Ukraine	12681	17624	19027	25015	31260	34486	38941	43396	47851	52306	56761	61215	65670	70125	74580	19
Italy	21302	24552	24043	24451	29581	29723	31369	33014	34660	36306	37951	39597	41243	42888	44534	12
Belarus	34742	48678	27965	30820	21980	19822	15484	11146	6808	2470	-1869	-6207	-10545	-14883	-19221	10
Kazakhstan	29708	31909	22912	17066	20671	14578	11286	7995	4703	1411	-1880	-5172	-8464	-11755	-15047	-1
Thailand	8959	11664	9573	14699	19188	19865	22214	24563	26912	29262	31611	33960	36310	38659	41008	20
Canada	10876	13429	13973	14940	16902	18093	19449	20805	22162	23518	24874	26231	27587	28943	30300	14
Lithuania	9031	16018	14941	14224	13903	16008	16803	17598	18393	19188	19983	20778	21573	22368	23163	15
Poland	8034	9803	8374	9100	13121	12528	13475	14422	15369	16316	17263	18210	19157	20104	21052	15
Switzerland	9721	9903	9323	8794	11980	10967	11308	11649	11990	12331	12671	13012	13353	13694	14035	10
United Kingdom	10966	11169	11746	12779	10012	11245	11215	11185	11156	11126	11096	11066	11036	11007	10977	7
Malaysia	5281	6079	5359	5924	7471	7290	7713	8135	8558	8980	9403	9825	10248	10670	11093	13
Portugal	4451	6342	7048	6243	7280	7941	8496	9052	9608	10164	10720	11276	11832	12388	12944	14
Singapore	6306	6270	5317	5167	6643	5812	5769	5726	5683	5640	5597	5555	5512	5469	5426	7
Hong Kong, China	6328	9566	6242	6883	6338	6273	6006	5740	5474	5207	4941	4675	4408	4142	3876	7
United States of America	4365	5159	3878	5017	6213	5993	6348	6703	7059	7414	7770	8125	8480	8836	9191	14
Netherlands	4069	4981	5639	6470	5824	6896	7396	7896	8396	8896	9396	9896	10396	10895	11395	13
Saudi Arabia	4249	4904	3860	4537	5719	5426	5683	5940	6198	6455	6712	6970	7227	7484	7741	13
Total of B2O	349139	440192	432417	429562	474478	497172	521177	545182	569186	593191	617196	641201	665206	689210	713215	12
B2O% Of World	87	87	88	86	86	86	86	86	85	85	85	85	84	84	84	6
EM Total	108592	137598	153897	145254	162118	175904	187375	198846	210317	221787	233258	244729	256200	267671	279141	13
EM% of B2O	31	31	36	34	34	36	37	38	38	39	40	41	42	43	44	8
Others	52565	64696	58069	70155	76455	80360	85684	91008	96331	101655	106979	112303	117627	122951	128275	14

The growth in value forecasted for the B10 countries show that these group of countries will continue to grow in the future except for Belarus. The five top counties that show higher growth trend in the future in terms of value of Persimmon are Russian Federation, Germany, Ukraine, France and Italy. These countries are suitable export market destinations for Persimmon produced in India and particularly in Himachal Pradesh as shown below.

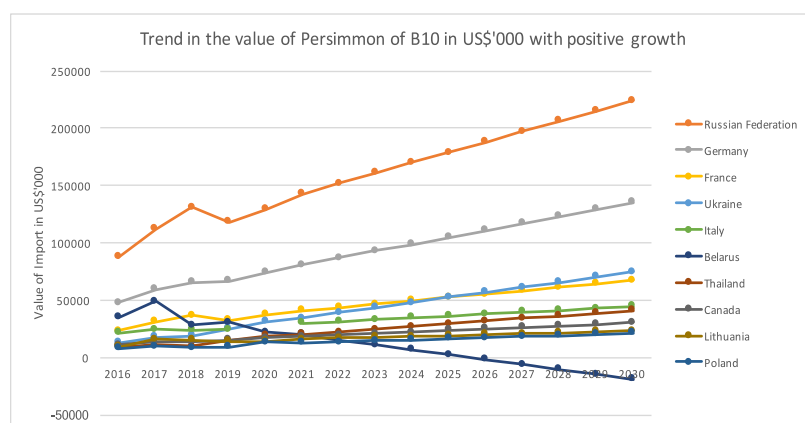


Figure 122: Trend in the value of Persimmon of B10 with positive growth in USD '000

Import Prices 2020

Import prices for fresh Persimmon at different locations show a variation. Hong Kong China, USA, Singapore, Canada and Switzerland are the top five countries offering prices higher than the rest of

the B20 countries with positive growth. These countries are providing prices way above the world prices per MT.

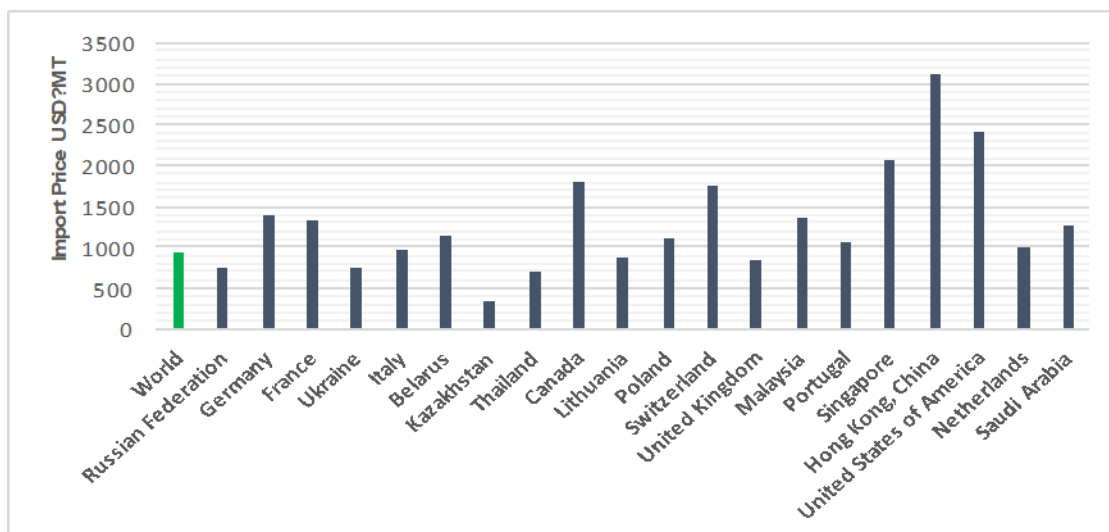


Figure 123: Import Prices for Fresh Persimmon fruit at different locations in 2020, USD/MT

India Trade and Exports of Persimmon

India has a trade deficit in case of Persimmon, where the country has been a net importer of the fruit. India imported around 57 MT of the fruit up to 2020 from Spain and South Africa, which comprised a value of USD130,000. India imported the fruit from Spain and South Africa at USD1973/MT and USD 1722/MT respectively.

In 2020 India also exported a total of 10 MT of Persimmon. It exported 10 MT to UAE at USD917 per MT and 1 MT to Kuwait at USD909/ MT. The total value of export was USD11,000. This scenario can change if target destination markets can be tapped through B2B or B2C arrangements in the B10 countries more specifically China, Singapore, USA, Switzerland, Canada, Germany, France, and Malaysia as shown below

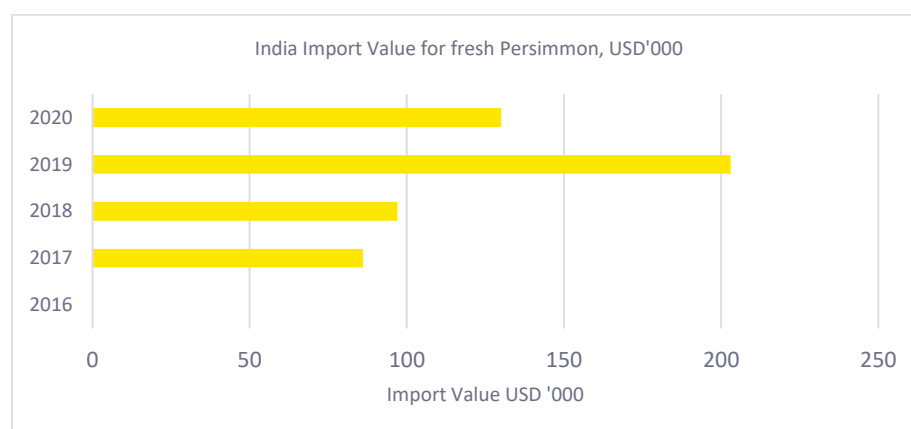


Figure 124: Value of fresh Persimmon imported by India
(Derived from ITC Trade Map- Trade Statistics for International Business Development)

Guava and Mangoes

World Import Guava and Mangoes

Volume of Guava and Mangoes Import:

The World import market of these fruits witnessed a positive annual average growth of 6%, which is higher than the B20 group of countries, which experienced a growth rate of 3%, and this trend is likely to continue. Among the B20 countries the highest annual average growth rate is experienced is Uganda with 58% in the volume of import of Guava and Mangos, followed by China, Russian Federation, and Thailand with rates 25%, 24%, and 11% respectively. These are also attractive export destination for absorbing Indian export of these fruits which is cultivated in Himachal Pradesh and other states of India.

Table 113: Trend in volume of Guava and Mangoes in the World, B20, EM and others

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Average Annual Growth
World	1687604	1897911	2095641	2291519	2417251	2448566	2695619	2854439	3013260	3172080	3330900	3489720	3648540	3807360	3966181	6
United States of America	464793	508635	500416	518161	573766	558649	588978	608476	627973	647471	666969	686466	705964	725461	744959	3
China	72762	76937	170668	379792	378778	398765	520750	599169	677588	756006	834425	912844	991263	1069682	1148101	25
Netherlands	165847	168322	211492	208975	231447	231587	254501	269231	283961	298692	313422	328152	342882	357613	372343	6
Germany	75050	87238	102579	91558	101718	103160	110847	115789	120731	125673	130615	135557	140499	145441	150383	5
Hong Kong, China	32462	35461	27920	50623	100801	79821	100067	113082	126096	139111	152126	165141	178156	191171	204186	17
Saudi Arabia	54098	69572	53572	54723	79584	69534	74351	77447	80543	83640	86736	89832	92928	96025	99121	5
Canada	57110	65571	67298	71202	77418	76969	83135	87099	91064	95028	98992	102956	106920	110884	114848	5
United Kingdom	82937	84869	86161	79579	73227	76413	73118	71000	68882	66764	64646	62528	60410	58292	56174	-3
Spain	38168	43428	53510	60590	70302	69486	80343	87323	94302	101282	108262	115242	122221	129201	136181	9
United Arab Emirates	103417	87504	78723	89852	70142	73087	64527	59024	53521	48018	42515	37012	31509	26006	20503	-10
Malaysia	51158	61389	62411	44684	63054	57957	58902	59509	60116	60724	61331	61939	62546	63154	63761	2
France	58212	62183	67107	70371	60720	66359	68120	69252	70383	71515	72647	73779	74911	76042	77174	2
Belgium	29222	30835	34356	33340	44067	40803	45096	47855	50615	53374	56134	58894	61653	64413	67172	6
Russian Federation	6119	11907	25683	31119	38695	39577	50826	58057	65288	72520	79751	86982	94213	101444	108676	24
Portugal	28253	31050	38906	34142	38301	38768	41860	43847	45835	47822	49810	51797	53785	55773	57760	5
Thailand	26597	29945	71684	28369	37410	42811	45484	47203	48921	50640	52359	54077	55796	57514	59233	11
Singapore	20336	23651	26824	25547	27198	27835	29918	31257	32596	33934	35273	36612	37951	39290	40629	5
Oman	17444	23596	35467	21765	21543	25236	26085	26631	27177	27723	28268	28814	29360	29906	30451	5
Uganda	843	3098	6462	3558	19325	14142	19132	22340	25547	28755	31963	35171	38378	41586	44794	58
Korea, Republic of	11747	13972	17383	18840	17417	19113	21274	22664	24053	25442	26831	28221	29610	30999	32389	7
Total of B20	453046	494663	483033	499321	556349	539535	567704	585812	603920	622029	640137	658245	676354	694462	712570	3
B20% of World	27	26	23	22	23	22	20	19	18	17	16	15	14	13	12	-5
EM % of B20	50	55	75	108	108	113	136	150	165	179	193	208	222	237	251	12
Others	14710	14984	15211	14723	16695	16006	16501	16819	17137	17455	17773	18091	18408	18726	19044	2
EM Total	228505	271608	362188	599157	665999	786252	906506	1026759	1147013	1267267	1387520	1507774	1628027	1748281	1868535	16

The B20 countries are experiencing an average annual growth rate of 3% with 453046 MT in 2016 and forecasted to reach 712570 MT in 2030. Among the B20 countries the five ranking countries in terms of volume of imports are USA, China, Netherlands, Uganda and the Russian Federation. All these countries are showing positive growth and will continue to grow in future.

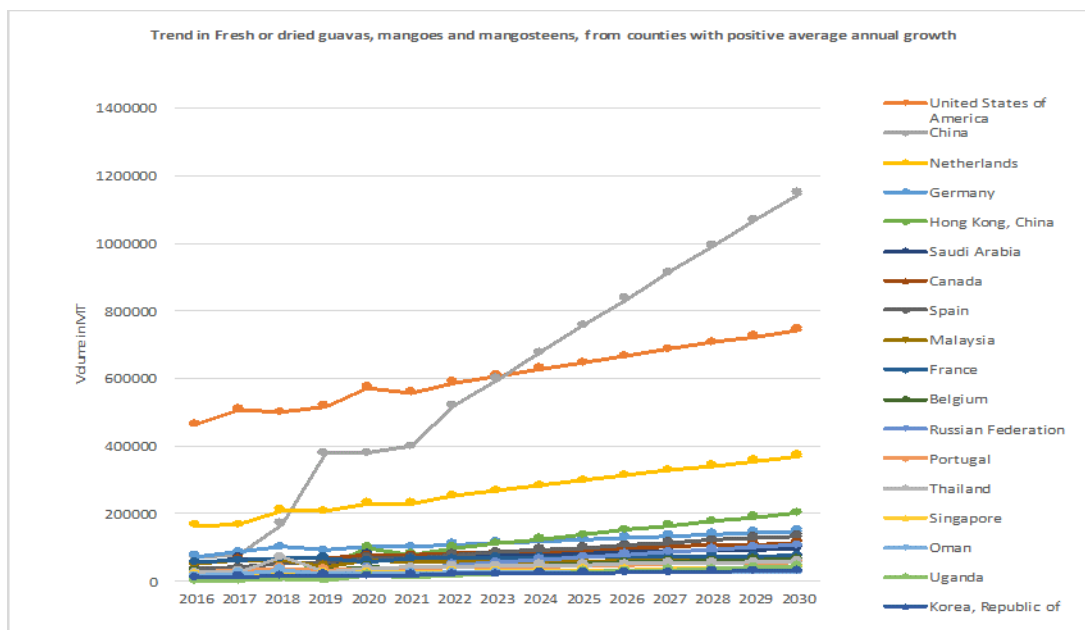


Figure 125: Trend in Fresh or dried guavas and mangoes from countries with positive average annual growth

The EM markets group has a higher rate of growth of 16% than the B20 group of countries. This group comprise 50% of the volume of B20 countries. Figure 22 shows that the positive growth of the EM will continue in the long run while the B20 will slow down. EM will keep pace with the World growth. Hence export agencies need to focus on the EM group as future export market destination for Guava and Mangoes.

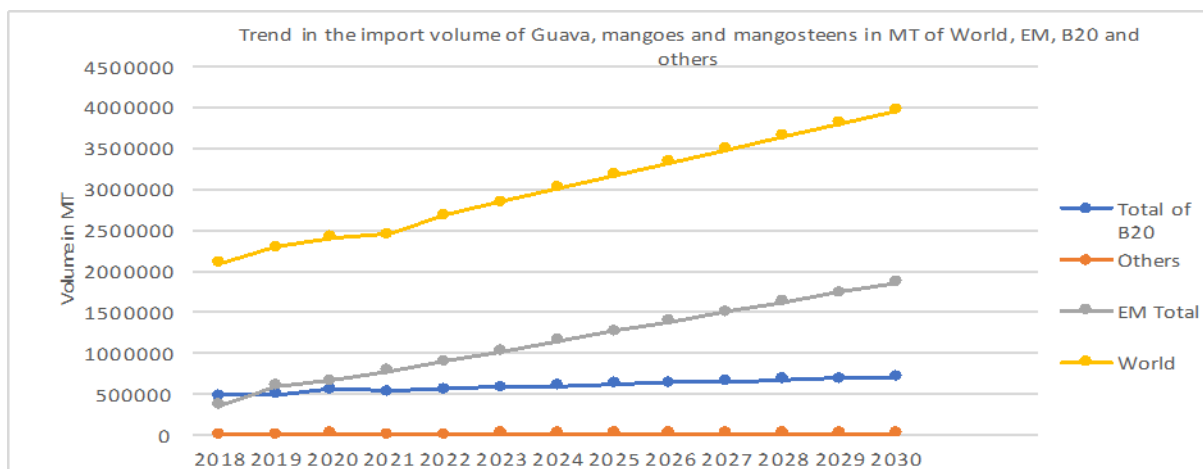


Figure 126: Trend in the import volume of Guava and Mangoes in MT of World, EM, B20 and others

Value of Imports

World market for Guava and Mango is experiencing an annual average growth rate of 7 % in terms of value, and this growth is going to continue in the future. The total value was USD2.57 billion in 2016 and is forecasted to grow up to USD7.2 billion by 2030. The B20 countries has a growth rate of 8% and will continue to grow with a total value of USD2.1 billion in 2016, will reach forecasted USD6.8 million, in 2030. The Emerging Market group of countries has witnessed growth rate of 19% in value, and will continue to grow, which covers a share of 14% of the value of the B20 group. The EM group's value was USD3 billion in 2016, which is forecasted to grow up to USD30.7 billion by 2030.

Table 114: Trends Guava and Mangoes import value and average annual growth of World, B20, EM and Others importers in US\$'000

Importers	2016	2017	2018	2019	2020	2021	2020	2023	2024	2025	2026	2027	2028	2029	2030	%Average Annual Growth
World	2575794	2915494	3236808	3786044	3782748	4250357	3921912	4907249	5235695	5564141	5892586	6221032	6549478	6877924	7206370	7
China	168818	166745	370644	822329	752766	1024709	842361	1389405	1571753	1754101	1936449	2118797	2301145	2483493	2665841	26
United States of America	583376	655950	637205	658227	718787	736015	708705	790635	817944	845254	872564	899874	927184	954494	981804	4
Netherlands	249404	240234	287591	334437	365666	395453	362781	460799	493471	526144	558817	591490	624162.3	656835	689508	7
Germany	176579	202296	227083	198000	218534	222736	214775	238659	246621	254582	262543	270505	278466.3	286428	294389	4
Hong Kong, China	56165	58097	49207	87177	173325	172711	146371	225391	251731	278071	304411	330751	357091	383431	409771	18
United Kingdom	170770	170851	179548	175222	163382	166935	167975	164854	163813	162773	161732	160692	159651.3	158611	157570	-1
France	127753	133303	145958	152427	142594	153661	148780	163422	168303	173183	178064	182945	187825.3	192706	197586	3
Canada	87424	106415	101851	118391	121389	132377	124386	148358	156348	164339	172330	180320	188310.8	196301	204292	6
Spain	71861	82763	100586	110054	120251	133454	121046	158268	170675	183082	195489	207896	220303.3	232710	245117	9
Russian Federation	11718	24261	50815	70326	83592	104418	85437	142381	161362	180343	199325	218306	237287.3	256269	275250	28
Belgium	50753	54528	57626	56714	80233	78901	72786	91130	97245	103359	109474	115588	121703	127818	133932	7
United Arab Emirates	106209	98370	87266	86503	76900	70850	77899	56753	49705	42656	35608	28559	21510.5	14462	7414	-15
Portugal	50208	57352	70329	65005	69863	74696	70000	84089	88785	93481	98177	102874	107570	112266	116963	6
Korea, Republic of	48263	53891	68827	72355	68610	78527	72611	90359	96275	102190	108106	114022	119937.8	125854	131769	7
Saudi Arabia	52675	59828	42106	47818	61196	56889	56386	57895	58398	58902	59405	59908	60411.25	60914	61418	2
Switzerland	43589	47081	46416	45811	52713	52392	50694	55788	57485	59183	60881	62579	64276.5	65974	67672	3
Italy	28006	30852	32015	38713	39559	43573	40476	49766	52863	55959	59056	62153	65249.5	68346	71443	7
Singapore	29390	31373	35712	31572	31868	32597	32082	33628	34144	34659	35175	35690	36205.75	36721	37237	2
Japan	29315	31273	35201	35817	31424	34586	33710	36338	37214	38091	38967	39843	40719.25	41595	42472	3
Poland	15246	23638	28810	30951	29143	35277	31766	42298	45809	49319	52830	56341	59851.5	63362	66873	11
Total of B20	2157522	2329101	2654796	3237849	3401795	3800755	3461026	4480214	4819943	5159673	5499402	5839131	6178861	6518590	6858320	8
B20 % of World	84	80	82	86	90	90	88	94	96	97	99	101	103	105	106	2
Total of EM	301078	333198	552144	1009881	970821	1258595	1056978	1661829	1863446	2065063	2266680	2468297	2669913	2871530	3073147	19
EM% of B20	14	14	21	31	29	36	31	45	50	54	59	63	68	73	77	13
Others	407240	585444	581674	548195	380953	453511	462493	435547	426564	417582	408600	399617	390635	381653	372670	0

As can be seen in the figure below all the B20 countries are having a positive growth and will continue to grow. However, there are three ranking countries among the B20 group that has a steeper growth in terms of value of imports these are namely China, USA, Netherlands and Germany.

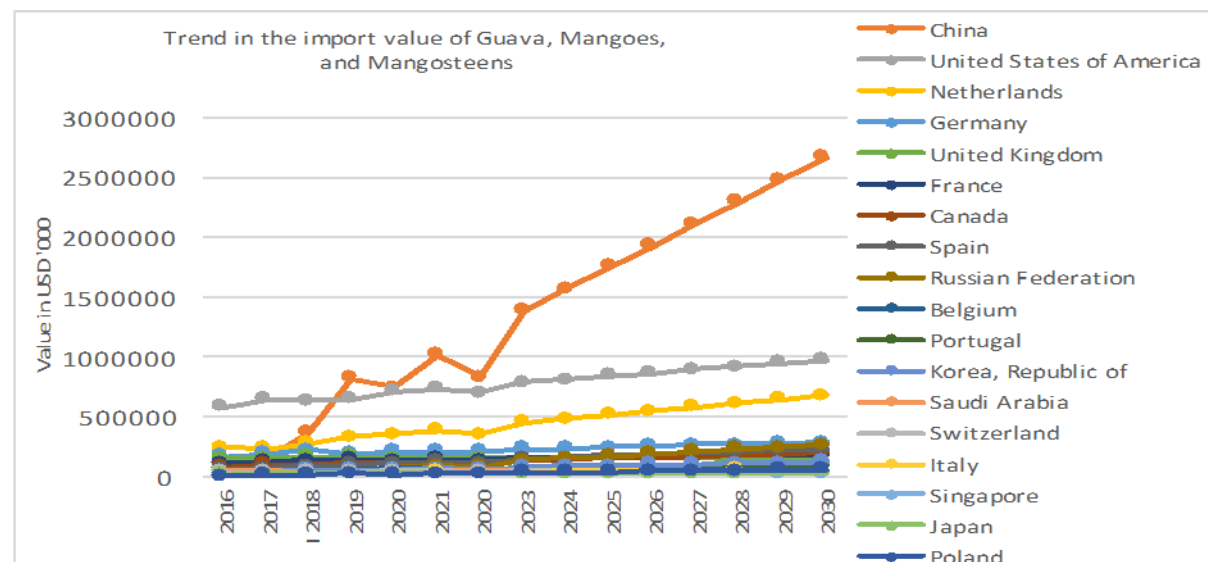


Figure 127: Trend in the import value of Guava and Mangoes

Import Prices 2020.

Figure 24 show a large variation in prices paid by different importing countries - this is related to the type of products imported and the level of added value in terms of grades, packing and quality. The countries paying the highest prices are all importing a large share from one of the hubs of world

trade in Guava and Mangos namely the China, Germany, Russian Federation, and Netherlands. However, there are countries with lower import volume but paying relatively higher than the major importers Japan, Republic of Korea, Switzerland and Italy. The average price paid by the EM group is USD2000/MT, which is comparable to the largest importer China.

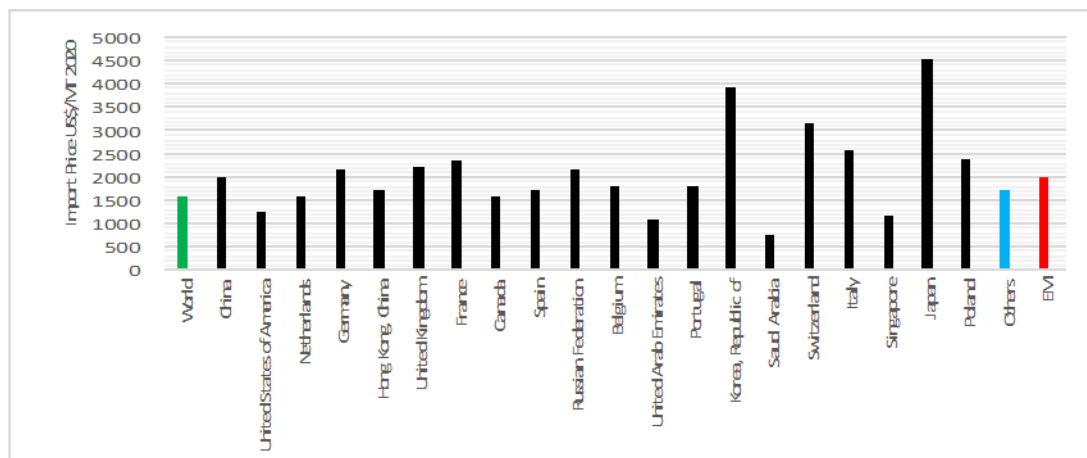
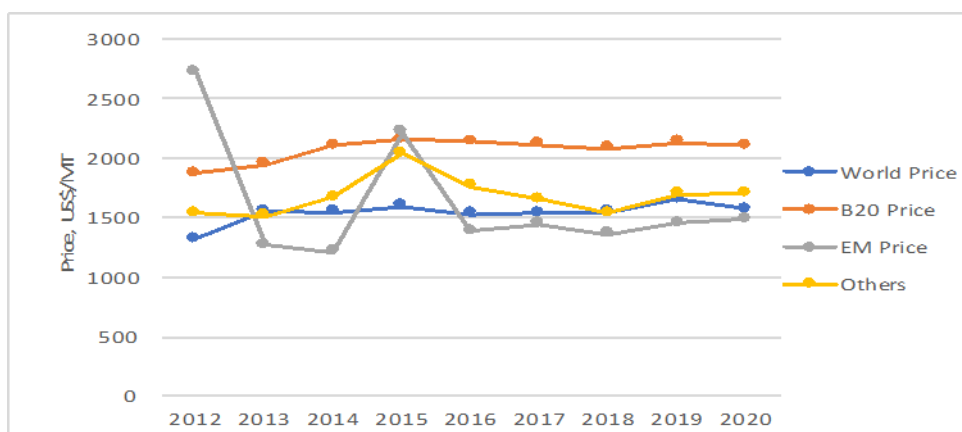


Figure 128: Import Prices for Guava and Mangoes at different locations in 2020, USD/MT

Overall prices experienced year on year positive development with steady annual average growth across B20 and the World. However, the EM locations experienced a price drop in 2013, 2014 and 2016 and is just recovering albeit slowly. This indicates income elasticity demand by the end consumer for Guava and Mango and matching prices of substitutes in sub-tropical fruits.

Table 115: Development of Import Price for Guava and Mangoes

	2012	2013	2014	2015	2016	2017	2018	2019	2020	% Average Annual Growth
World Price	1315	1555	1547	1594	1526	1536	1545	1652	1565	2
B20 Price	1872	1944	2107	2150	2137	2109	2075	2125	2100	1
EM Price	2723	1267	1212	2214	1386	1446	1362	1450	1485	-1
Others	1532	1513	1669	2038	1760	1652	1531	1694	1703	2



India Trade and Exports in Guava and Mangoes

Overall India has a trade surplus both in volume and value for these fruits. In India export volume, value and price development of Guava and Mangoes experienced average volume of 180043MT, 980,000 USD, and an average export price of USD990 per MT, but with considerable variations between years. In case of these fruits the import prices are far lower than the export prices. The average import price is USD 193 per MT, which is less than USD 695, which was the export price in 2020. The export price over the period 2012 to 2020 is USD 990 per MT, which has a growth rate of 4% so there is a high possibility of better export prices. The average import price is around USD

797 per MT during the same period, with a higher growth rate of 9%, which is one of the reasons for a negative growth in the Trade Balance by value. There was a cumulative trade balance surplus of 127370 MT and USD 136 million in 2020. India is trade balance deficit in value since 2018, but trade surplus in volume was witnessed after that year. The total Indian export volume stands at 128026 and is expected to increase in the future.

Table 116: Trade Balance of India in Value USD'000, Volume, MT, Import and Export price USD/MT

Trade Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	% average annual growth
Trade Balance, MT	213863	230553	205326	173055	192859	171948	152639	146331	127370	-5
Trade Balance, USD '000	166138	202681	195056	182412	201734	181394	158953	149688	136762	-2
Total India Export volume	214640	231206	206362	173806	193383	172441	153284	147242	128026	-5
India Import value	720	738	1080	1155	806	822	1112	1718	697	6
Import Price USD/MT	506	783	770	821	757	892	803	891	950	9
Export Price USD/MT	777	880	950	1056	1047	1057	1044	1028	1074	4

Figure below clearly shows a declining export volume and export price of Guava and Mangoes from India and also a decline in the Trade Balance in volume and in value since 2012 till 2020. This is an indication that India is losing market share with the five top exporters of Guava, and Mangoes - Thailand, Mexico, Netherland, Peru, and Brazil. India ranks 8th in the world in the export of Guava and Mangoes.

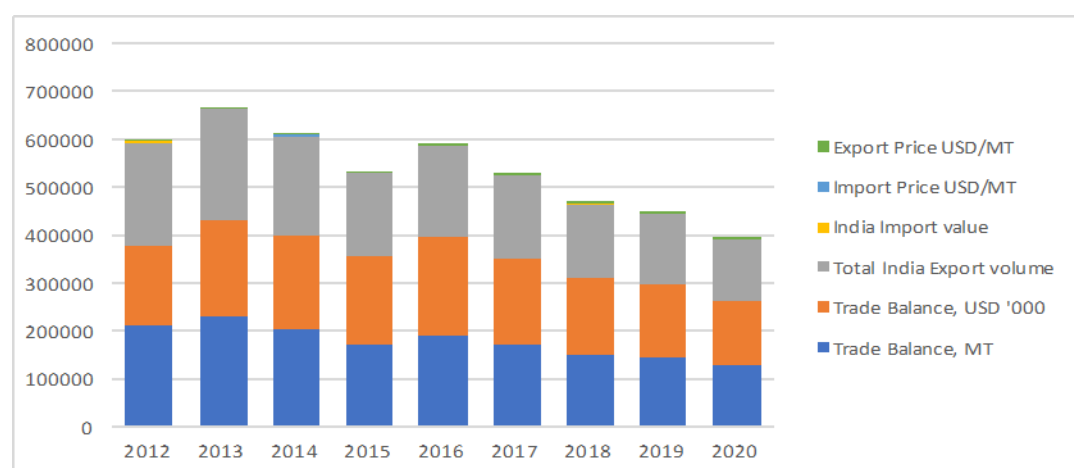


Figure 129: Trade Indicators for Guava and Mangoes

Plum

World Import of Plum

Import of Plum.

The import market of Plum witnessed a negative annual average growth of -2% which is similar to B20 group of countries, which witnessed a growth rate of -1% and this trend is likely to continue. Brazil has shown the highest annual average growth rate of 35% followed by Poland (20%), Romania and China.

Table 117: Trend in volume of Plum in the World, B2O, EM and others

Importers	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Average Annual Growth
World	723362	592510	719269	597253	666754	627288	616440	605593	594746	583899	573051	562204	551357	540509	529662	-2
Russian Federation	58400	78110	77073	80053	74937	84220	87721	91223	94725	98227	101728	105230	108732	112233	115735	5
China	44623	40620	48604	84421	66455	83184	91931	100677	109424	118170	126917	135663	144410	153156	161903	10
China	36534	41644	50306	85115	63934	84988	94815	104642	114469	124296	134123	143951	153778	163605	173432	12
Germany	56922	61175	43466	44666	52413	44070	41518	38965	36412	33860	31307	28754	26201	23649	21096	-6
United Kingdom	55552	49712	39543	37395	36359	28501	23431	18361	13290	8220	3150	-1921	-6991	-12061	-17131	-1
Netherlands	33605	28468	31973	30400	30112	29395	28890	28385	27879	27374	26868	26363	25858	25352	24847	-2
Iraq	61342	77786	77354	37826	26106	22953	11910	867	-10176	-21220	-32263	-43306	-54349	-65392	-76436	-82
Poland	9752	36346	10576	18904	19515	19644	19852	20061	20269	20477	20686	20894	21103	21311	21519	20
United States of America	27184	22080	22558	23657	18888	18369	16867	15366	13864	12363	10861	9360	7858	6357	4855	-10
Canada	20307	17100	16480	16346	15555	14080	13054	12029	11003	9977	8951	7925	6900	5874	4848	-9
Romania	6927	9473	11971	15126	14947	18197	20366	22535	24705	26874	29043	31213	33382	35551	37720	12
Kazakhstan	21169	20781	19300	24319	14574	17133	16168	15203	14237	13272	12307	11342	10377	9411	8446	-5
France	17071	15420	16204	11979	14254	12263	11356	10448	9541	8633	7726	6818	5911	5003	4096	-9
Italy	9456	10819	9335	9794	14217	13273	14123	14973	15822	16672	17522	18372	19221	20071	20921	6
Egypt	15521	0	19748	0	13546	8578	8183	7788	7393	6998	6603	6208	5813	5418	5023	1
Brazil	33575	27541	28313	31351	12222	14932	11042	7152	3263	-627	-4516	-8406	-12296	-16185	-20075	35
Saudi Arabia	20870	18721	12442	11064	11401	6921	4262	1602	-1057	-3717	-6376	-9036	-11695	-14355	-17014	5
Belgium	12945	13200	10177	10865	10480	9354	8627	7901	7174	6448	5721	4995	4268	3542	2815	-9
United Arab Emirates	19017	15882	13490	16068	10278	9759	8030	6301	4572	2843	1113	-616	-2345	-4074	-5803	2
Austria	9751	7632	8368	7904	9988	8952	9027	9102	9176	9251	9325	9400	9475	9549	9624	0
Total of B2O	570523	592510	567281	597253	530181	548767	541173	533579	525985	518391	510797	503203	495609	488015	480420	-1
B2O % of World	79	100	79	100	80	87	88	88	88	89	89	90	90	90	91	2
Total of EM	198418	219835	217441	251819	218429	242790	249991	257191	264392	271593	278793	285994	293194	300395	307596	3
EM % of B2O	35	37	38	42	41	44	46	48	50	52	55	57	59	62	64	4
Others	152222	145655	151959	164476	136573	146518	145261	144004	142747	141490	140232	138975	137718	136461	135204	-1

In terms of market destination for export of Plum to capture import volume is China, Russian Federation, Romania, and Poland, which are showing steep import volume growth trends among the B2O at growth rates of 10%, 5%, 12% and 20%. These steep trends will continue into the future. It is also important to note that while these countries are experiencing increase in import volume growth the rest of them are showing declining trend for the future

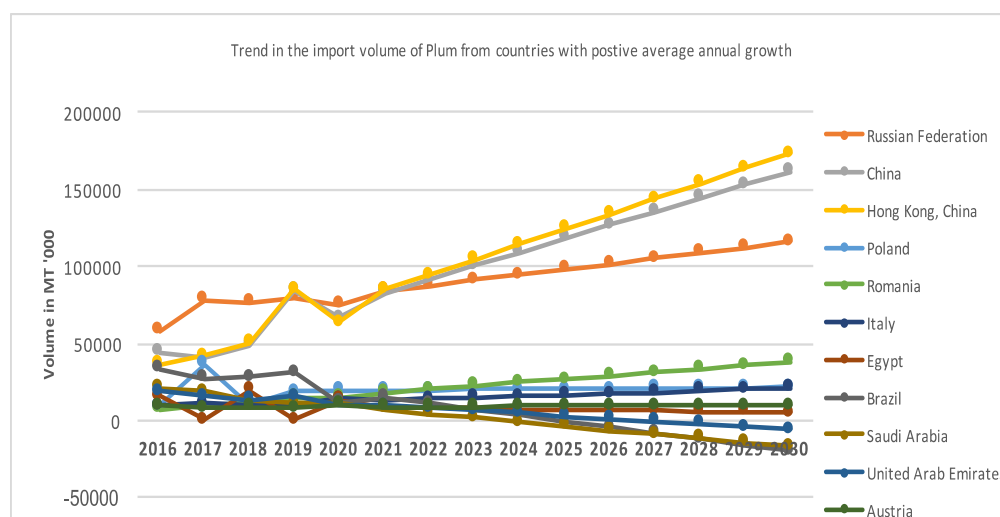


Figure 130: Trend in the import volume of Plum from countries with positive annual growth

The figure below shows an increasing trend in the volume of import in the Emerging Markets and a decline in trend in the B2O and Others. Hence in terms of absorption of volume of Plum the countries in the EM group are good export destinations.

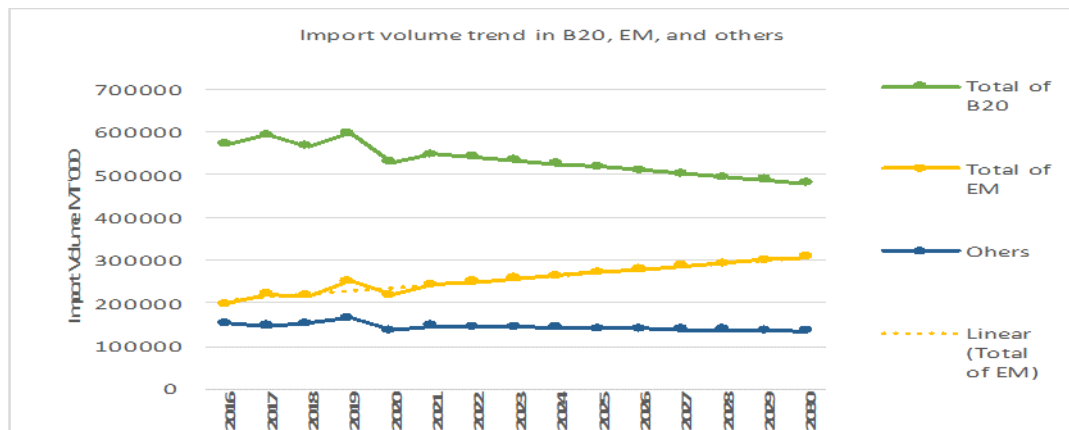


Figure 131: Trend in the import volume of Plum in B2O, EM and Others

Value of Imports

In terms of value the World import of Plum have experienced an annual average growth rate of 1%. It is forecasted that this growth will continue and amount to an average of USD 1.01 billion per year reaching a total of USD 10.7 billion by 2030. During the same period the B2O did not experienced any growth. It is forecasted that the total of B2O will continue to grow and amount to USD492 million, whilst the growth in the EM will also continue and amount an average of USD 388 million and a growth of 3%. EM will have an average share of 46% in the total of B2O value. Likewise, there will be an average share of 82 % by B2O in the World Total.

Table 118: Trends of Plum import value and average annual growth of World, B2O, EM and Others importers in US\$'000

Importers	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	% Average Annual Growth
World	948679	964227	972311	1037818	947369	996172	1003669	1011166	1018663	1026161	1033658	1041155	1048652	1056149	1063646	1
China	121851	103451	117520	194247	154781	185367	201032	216698	232364	248029	263695	279360	295026	310692	326357	8
Hong Kong, China	73439	95184	101117	158359	121403	157631	173542	189452	205362	221273	237183	253093	269003	284914	300824	11
Germany	67361	77695	63872	55891	80835	70674	71188	71703	72217	72732	73246	73760	74275	74789	75304	2
Russian Federation	48491	57733	56295	57578	60746	63475	65911	68346	70782	73217	75653	78088	80524	82959	85395	4
United Kingdom	78416	66346	65506	53897	58296	48686	43417	38148	32879	27610	22341	17072	11803	6534	1269	-20
Netherlands	62380	47814	66506	51264	51322	50257	48391	46524	44658	42791	40924	39058	37191	35325	33458	-3
United States of America	65501	52472	56605	52418	45110	42170	38087	34003	29920	25836	21752	17669	13585	9502	5418	-14
Canada	37214	35282	32140	30311	32606	29255	27836	26417	24998	23580	22161	20742	19324	17905	16486	-5
Egypt	23839	10464	23407	27028	21053	24456	25555	26654	27753	28853	29952	31051	32150	33249	34349	7
Poland	9912	29224	13380	16784	20095	20257	21049	21842	22635	23427	24220	25012	25805	26598	27390	14
Italy	13676	15251	15906	13317	19759	18651	19675	20698	21721	22744	23767	24791	25814	26837	27860	6
France	23026	20016	22041	13145	18569	14624	13045	11467	9888	8310	6731	5153	3574	1996	417	-18
Belgium	22896	22120	20283	16120	17823	15005	13390	11775	10161	8546	6932	5317	3702	2088	473	-19
Brazil	38855	34010	38767	32443	14016	16245	11120	5996	871	-4253	-9378	-14502	-19627	-24751	-29878	-37
Saudi Arabia	19516	18922	14271	13385	12560	9896	7951	6006	4061	2117	172	-1773	-3718	-5663	-7608	-81
United Arab Emirates	25182	21933	19603	20201	12453	11717	8998	6279	3560	841	-1878	-4597	-7316	-10035	-12754	-20
Iraq	16887	33778	25205	10347	12404	10005	6765	3526	286	-2954	-6193	-9433	-12673	-15912	-19152	-70
Austria	9252	8979	8955	7714	11114	9941	10186	10432	10678	10924	11170	11416	11662	11908	12154	2
Switzerland	11801	13557	9557	9361	10860	9204	8596	7988	7380	6773	6165	5557	4949	4341	3734	-7
Portugal	8696	7009	10177	5784	8917	7882	7803	7725	7647	7569	7490	7412	7334	7255	7177	1
Total of B2O	778191	771240	781113	839594	784722	815396.8	823538.4	831680	839821.6	847963.2	856104.8	864246.4	872388	880529.6	888671.2	1
B2O % of World	82	80	80	81	83	82	82	82	82	83	83	83	83	83	84	0
Total of EM	288493	283178	300431	384076	312575	358469.2	373375.4	388281.6	403187.8	418094	433000.2	447906.4	462812.6	477718.8	492629	4
EM % of B2O	37	37	38	46	40	44	45	47	48	49	51	52	53	54	55	3
Others	167785	192933	191148	198223	162647	181172	180709	180241	179773	179306	178838	178371	177903	177435	176968	1

All the top importers in terms of value of import will continue to grow. Out of these the top four important destination markets for Plum are China, Hong Kong China, Germany, and the Russian Federation. However, tariff and restrictions based on standards of production will play an important role in these markets. The other markets with positive annual average growth rates that will keep growing are the Egypt, Poland, and Portugal.

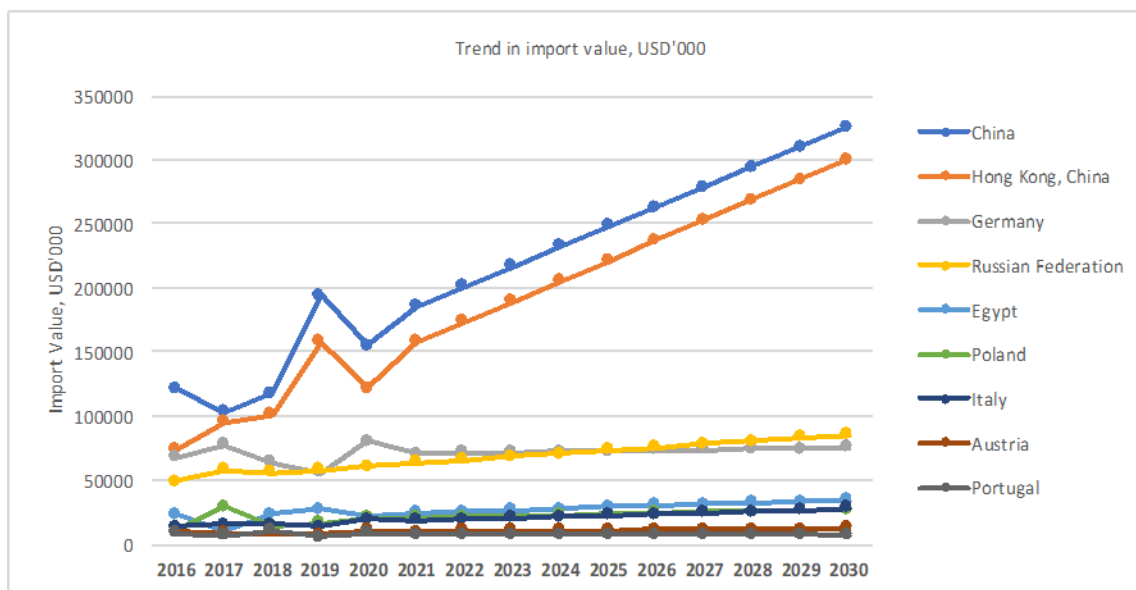


Figure 132: Trend in the import value of Plum from countries with positive annual growth

The below figure shows an increasing trend in the value of import in the Emerging Markets and the B20 while a decline in the Others. Hence in terms of value import of Plum the countries in the EM group are good export destination. The value of import of Plum is forecasted to grow from USD 288.4 million in 2016 to USD 492.6 million in 2030.

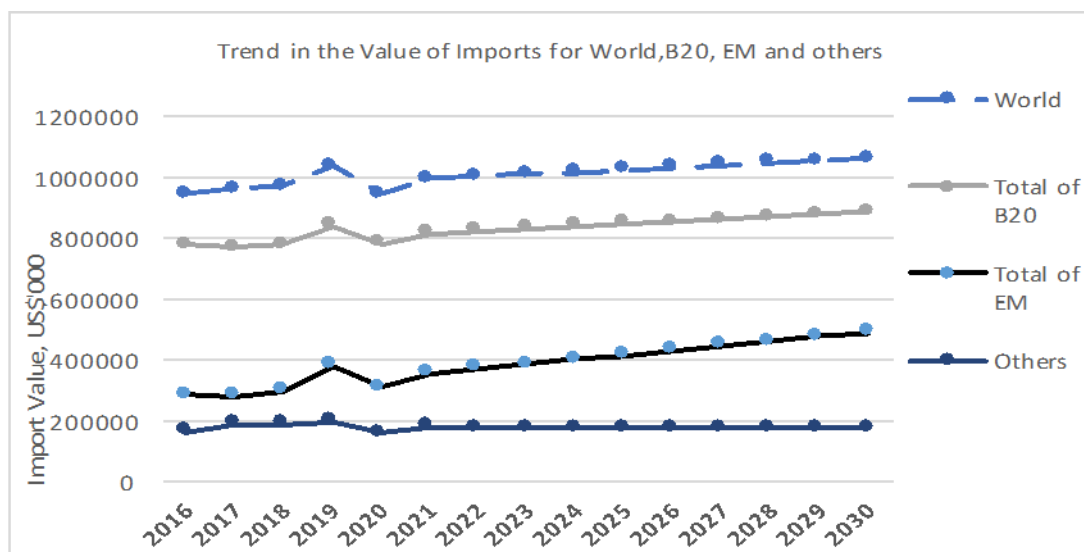


Figure 133: Trend in the import value of Plum in B20, EM and Others

Import Prices 2020 for Plum.

The following figure shows a large variation in prices paid by different importing countries - this is related to the type of products imported and the level of added value in terms of grades, packing and quality. However, variation in grades is more than other sub-tropical fruits. The countries paying the highest prices are all importing a large share from one of the hubs of world trade in Plum, namely China and Russian Federation. In addition, Kazakhstan, Brazil, Belgium, UK and Brazil although with lower import volumes are also attractive export destination for Indian Plums.

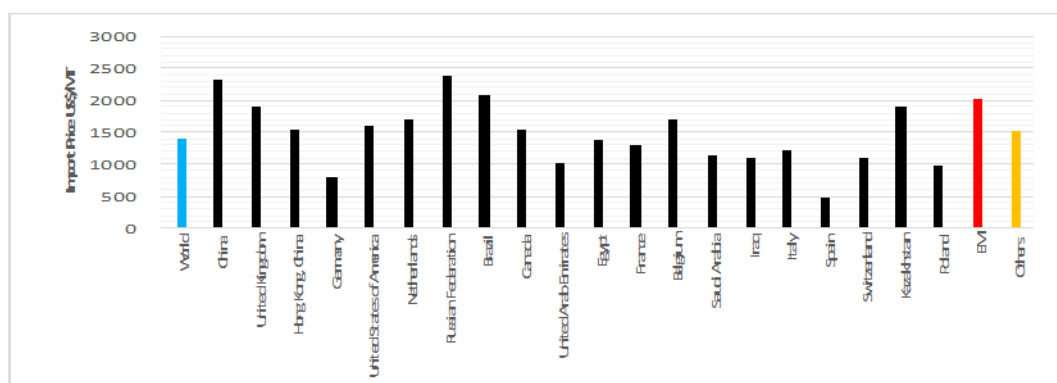


Figure 134: Import Price of Plum in 2020 in different locations

The table below shows that World Prices have an average annual growth of 9% along with B20 and EM with 10% and 20% respectively and it has a growing trend since 2012 to 2020.

Table 119: Development of Import Price for Plum

Locations	2012	2013	2014	2015	2016	2017	2018	2019	2020	% Average Annual Growth
World Price	1411	1455	1443	1327	1309	2932	1352	1982	1421	9
B20 Price	1527	1720	4070	1413	1436	1440	1530	1329	1463	10
EM Price	1620	1659	5060	1449	1491	2217	2166	1991	2077	20
Others	1455	1416	1403	1436	1284	1353	1413	1290	1389	0

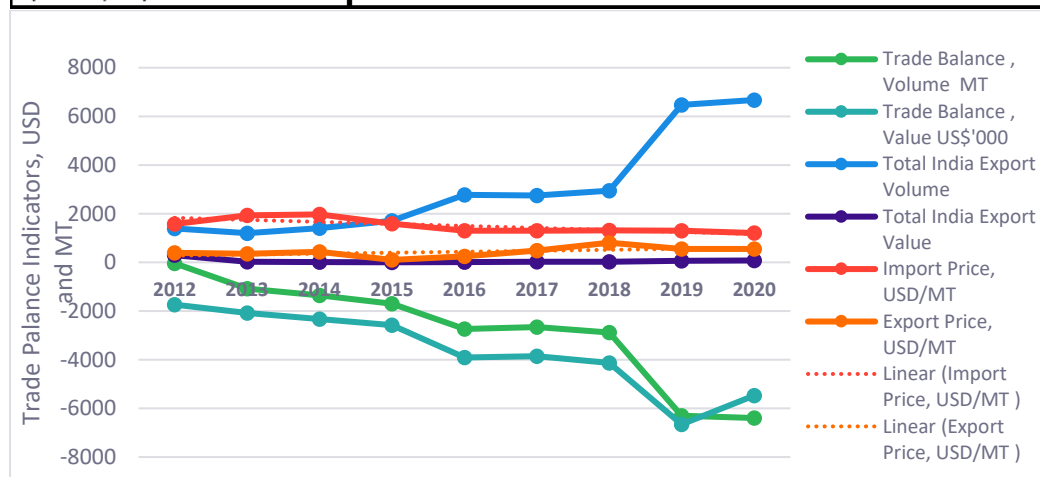
India Trade and Export of Plum

India has a trade deficit of 2785 MT and USD 3.64 million. In India export volume, value and price development of Plum experienced average volume of 3034MT, and a value of 276000 USD, and an average export price of USD436 per MT, but with considerable variations between years. In addition, the average import prices are far higher than the export prices. The average import price is USD1497 per MT, which is more than the export price by USD 1061 in 2020.

Plum export price over the period 2012 to 2020 is USD 552 per MT, which has a growth rate of 24% so there is a high possibility of better export prices, the average import price is around USD 1497 per MT during the same period, but declining at the rate of -2.2%. There was a cumulative trade balance deficit of USD 6.4 million in 2020. India is trade balance deficit in value with a cumulative USD5.5 million. Indian export has to increase far more and ask higher prices to overcome the trade deficit. This is also an opportunity to increase exports of Indian Plums

Table 120: Trade Balance

Trade Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020
Trade Balance , Volume MT	-43	-1079	-1355	-1693	-2737	-2665	-2880	-6306	-6396
Trade Balance , Value US\$'000	-1739	-2087	-2329	-2587	-3915	-3863	-4129	-6657	-5472
Total India Export Volume	1392	1199	1405	1706	2768	2743	2946	6476	6672
Total India Export Value	294	26	13	2	7	19	26	58	78
Import Price, USD/MT	1571	1932	1970	1586	1304	1299	1312	1296	1205
Export Price, USD/MT	395	356	429.25	100	249	484	807	554	552



Pomegranate

World Import of Pomegranate

Import Volume.

The top five importers of Pomegranate from India are UAE, Bangladesh, Qatar, Nepal and Netherlands. UAE and Bangladesh markets have a high growth rates of 49% and 44% respectively and will continue to grow. The B20 countries formed 18% of the total market in 2020 and imported 12351 MT of the fruit from India, and has an average annual growth rate of 3% which will continue to grow. The EM formed 25% of the B20 and has a negative growth of -12% and its share will continue to decline.

Table 121: Trend in volume of export of Pomegranate in the World, B20, EM and others

Country	2018	2019	2020	2021	2022	2023	2024	2025	% Average Annual Growth
U Arab Emts	19030.4	15897.7	12508.6	9290	6029	2769	-492	-3753	49
Bangladesh	10511.5	33813.1	36525.8	52964	65972	78979	91986	104993	44
Qatar	3110.6	2633.6	2349.7	1937	1557	1176	796	415	-21
Nepal	10018.8	8776.0	6788.1	5297	3682	2066	451	-1164	-71
Netherland	4449.5	3031.9	758.8	-944	-2789	-4635	-6480	-8325	0
Saudi Arab	5923.6	5083.4	1964.1	364	-1616	-3595	-5575	-7555	-61
Oman	4199.2	2539.1	3174.7	2280	1768	1255	743	231	-25
Sri Lanka Dsr	1238.7	1189.8	568.0	328	-7	-343	-678	-1013	571
Egypt A Rp	934.7	793.6	734.1	620	520	420	319	219	-16
Baharain Is	973.4	795.0	571.2	378	177	-25	-226	-427	83
Switzerland	65.1	161.6	120.7	171	199	227	255	283	27
Kuwait	1372.8	1262.2	557.4	249	-159	-567	-975	-1382	11
Malaysia	774.0	658.8	284.6	83	-162	-406	-651	-896	-24
Hong Kong	34.9	28.7	197.5	250	331	412	494	575	86
Indonesia	322.5	236.5	105.0	4	-105	-214	-322	-431	-356
France	7.7	3.8	70.0	89	121	152	183	214	227
Thailand	1321.8	1144.7	104.8	-360	-968	-1577	-2186	-2794	-31
Canada	152.9	189.1	100.5	95	69	43	17	-10	-39
U K	576.9	464.4	78.1	-126	-375	-624	-874	-1123	-4
Singapore	430.0	244.9	157.9	5	-131	-267	-403	-539	-309
Total of B20	18600	15653	12351	9285	6160	3035	-90	-3215	404
B20 % of Total	27	19	18	12	8	3	-1	-6	3
Total of EM	690	625	577	517	461	404	348	291	-10
EM% of Total B	48	45	25	17	5	-6	-17	-28	-12
Others	2443.01	1599.92	257.43	-752	-1845	-2938	-4030	-5123	-30

Figure below shows that India export to Hong Kong China will continue to increase in the future in terms of volume of export, which has an annual average growth rate of 86%. This is followed by France, Bangladesh, UAE and Switzerland.

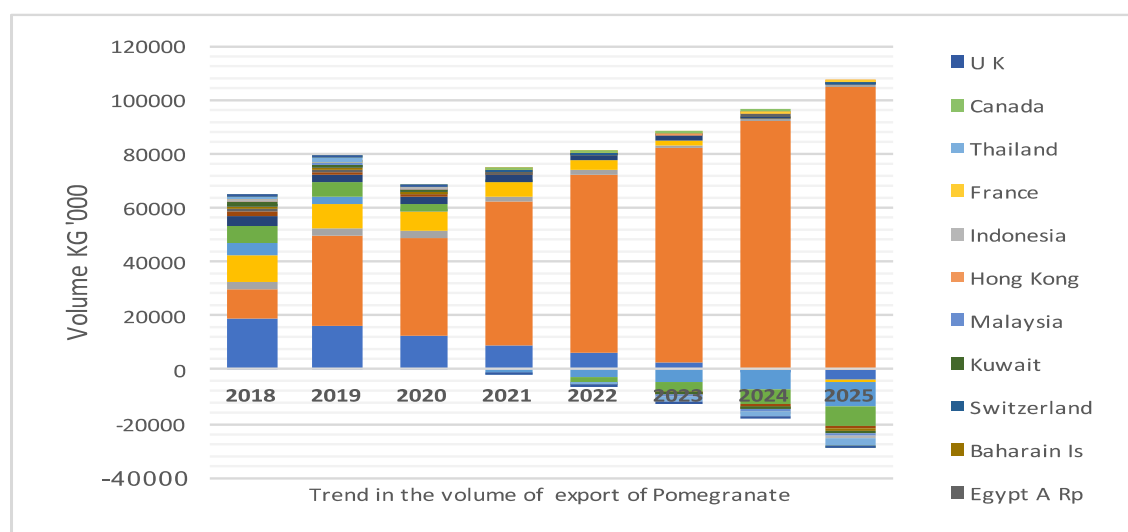


Figure 135: Trend in the volume of export of Pomegranate
(Derived from Ministry of Commerce, Government of India database)

Export Value.

India is experiencing a negative growth in the value of export of Pomegranate to B20 countries and the EM group with -17% and -10% growth rate respectively. In the EM group the value in 2018 was USD14.3 million, which decreased to USD1.9 million -the trend is declining. Likewise, the value in 2018 in the B20 group was USD9.1 million, which decreased to USD6.9 million in 2020. Both the trends are likely to continue if the scenario does not change. Hence a greater thrust is required to increase exports to the five top importers of the fruit from India and negotiation a better export price per MT.

Table 122: Trend in the value of Export of Pomegranate from India to B2O, EM and other locations- USD '000

Country	2018	2019	2020	2021	2022	2023	2024	2025	% Average Annual Growth
U Arab Emts	29,759.37	25,884.09	21,750.53	17789.2	13784.7	9780.3	5775.9	1771.5	-26
Bangladesh P	6,518.11	19,521.69	21,567.71	30918.8	38443.6	45968.4	53493.2	61018.0	41
Qatar	4,719.04	4,206.29	4,017.67	3613.0	3262.3	2911.6	2560.9	2210.2	-9
Nepal	5,347.77	5,154.28	3,638.23	3003.9	2149.1	1294.3	439.6	-415.2	-47
Netherland	13,031.79	9,000.53	3,478.46	-1049.7	-5826.4	-10603.1	-15379.7	-20156.4	49
Saudi Arab	8,603.75	7,879.08	3,225.81	1191.6	-1497.4	-4186.3	-6875.3	-9564.3	-9
Oman	5,473.82	3,561.18	2,617.40	1027.7	-400.5	-1828.7	-3256.9	-4685.1	27
Sri Lanka Dsr	2,552.21	2,550.20	1,379.30	987.7	401.2	-185.3	-771.7	-1358.2	14
Egypt A Rp	1,577.36	1,255.20	1,366.05	1188.2	1082.6	976.9	871.3	765.6	-8
Baharain Is	1,534.64	1,222.41	1,124.55	883.8	678.7	473.7	268.6	63.6	-28
Switzerland	559.78	1,269.18	1,051.52	1451.9	1697.8	1943.6	2189.5	2435.4	25
Kuwait	2,138.37	2,054.36	1,034.68	638.8	86.9	-464.9	-1016.8	-1568.6	-80
Malaysia	1,470.53	1,382.51	731.63	456.0	86.5	-282.9	-652.4	-1021.8	-51
Hong Kong	151.34	127.61	358.73	419.9	523.6	627.3	731.0	834.7	32
Indonesia	750.74	541.22	319.16	105.5	-110.3	-326.1	-541.9	-757.7	-5
France	64.65	19.75	317.43	386.7	513.1	639.5	765.9	892.3	194
Thailand	2,946.46	2,691.28	313.09	-649.8	-1966.4	-3283.1	-4599.8	-5916.5	-8
Canada	297.38	435.32	257.1	289.7	269.5	249.4	229.2	209.1	-2
U K	2,736.01	2,131.20	255.92	-772.4	-2012.4	-3252.5	-4492.5	-5732.6	-28
Singapore	747.53	370.8	197.59	-111.3	-386.3	-661.2	-936.2	-1211.2	17
Total of B2O	90,980.65	91,258.18	69,002.56	61,769.04	50,780.00	39,790.95	28,801.91	17,812.86	-17
EM	14,344.06	11,843.56	5,642.65	1,908.68	-2,442.03	-6,792.73	-11,143.43	-15,494.14	-10
EM% of B2O	16	13	8	3	-5	-17	-39	-87	17
Others	7972.13	4932.34	707.14	-2727.79	-6360.28	-9992.7767	-13625.272	-17257.77	-45

Figure below shows the trend in the B2O importers of Pomegranate from India. As can be seen, Hong Kong China, France, Singapore, Switzerland, Oman, Sri Lanka, Netherlands, and Bangladesh are showing positive growth and this trend will continue into the future. In terms of market value and better export price these countries need to be targeted for export of Pomegranate from India.

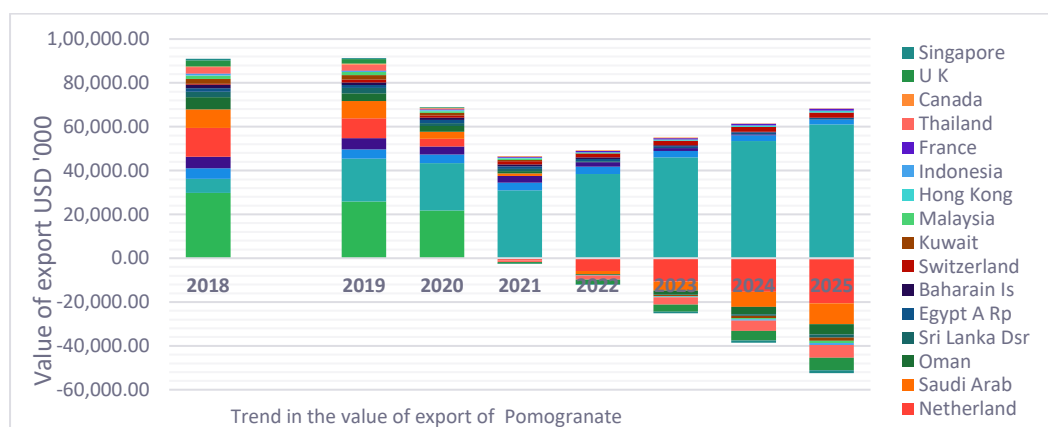


Figure 136: Trend in the value of export of Pomegranate (Derived from Ministry of Commerce, Government of India database)

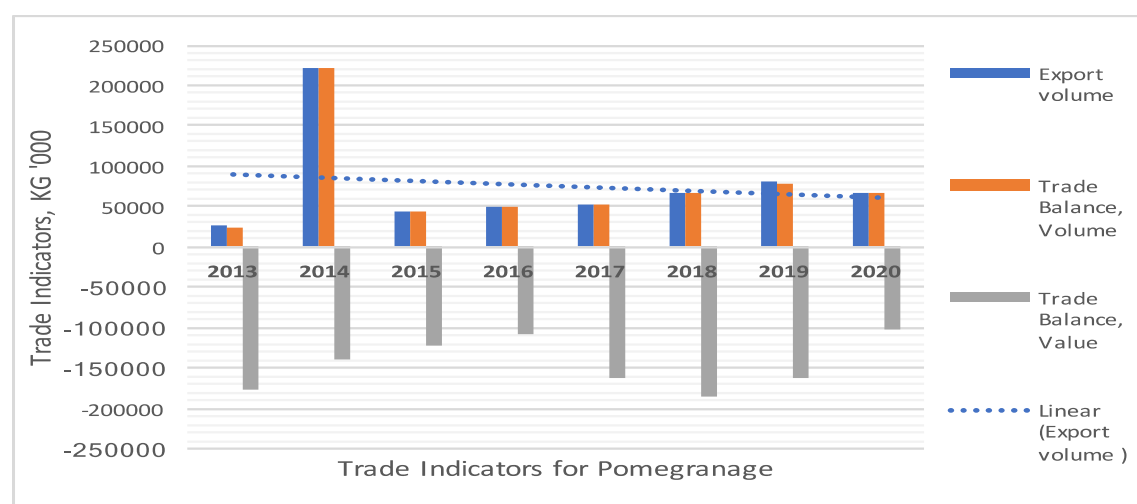
India Trade of Pomegranate

India has a deficit Trade Balance in Value but a surplus in terms of volume of trade in Pomegranate. The trade surplus in 2013 was 24199.79 MT which grew to 67372 MT in 2020, however the growth rate is -4% for this period and shows a declining trend. Likewise, export seem to have grown from

25504.21 MT in 2013 to 67979.67 MT in 2020, and the volume dropped in 2020, and a negative growth rate of -4% is witnessed.

Table 123: India Trade Balance by volume and value and exports

Trade Indicators	2013	2014	2015	2016	2017	2018	2019	2020	% Average Annual Growth
Export volume	25504.21	221029.82	44722	49852	52391.82	67891.83	80547.74	67976.67	-4
Trade Balance, Volume	24199.79	220393.59	44069.36	48678.67	51365.35	67770.83	79528.29	67372.23	-4
Trade Balance, Value	-176331.35	-137694.93	-121716.66	-108504.6	-162054.78	-184000.34	-161348.24	-102627.4	-1



(Derived from Ministry of Commerce, Government of India database)

Except for the Netherlands the rest of the export destinations are in the Middle East namely UAE, Oman, Egypt, Qatar and Bahrain. Figure 33 shows that currently Netherlands and then followed by Sri Lanka and Bahrain are the ones offering the best prices INR338,568, INR 180,256, and INR 147,121 respectively in 2020. Bangladesh had imported the highest volume 356,267MT but offered the lowest price of INR4353/MT in 2020.

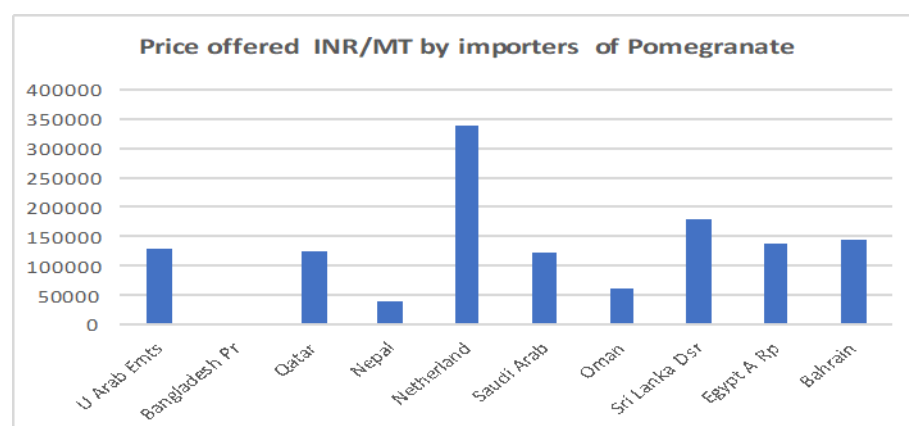


Figure 137: Price offered to Indian exporters by importers of Pomegranate (Derived from Ministry of Commerce, Government of India database)

Figure below shows that UAE, and Qatar imported the highest in terms of value of Pomegranate import from India. These countries were followed by Egypt, Bahrain, Netherlands and Saudi Arabia. UAE, Qatar and Bahrain should be the future export destination for India for Pomegranate as these markets are growing in terms of volume 49%, 44% and 83% respectively and offering INR129,201/MT, INR127,228 and INR147,121 respectively.

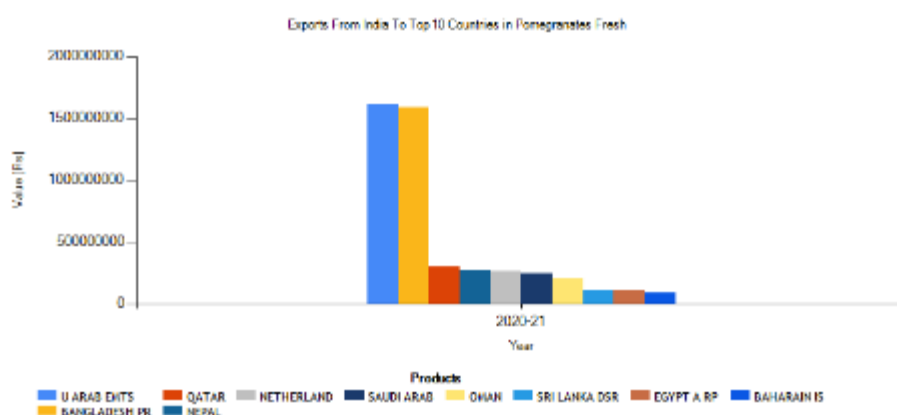


Figure 138: Top 10 Importer of Pomegranate from India in 2020-21
(Derived from Ministry of Commerce, Government of India database)

Litchi

World Import of Litchi

Import and Export of Litchi.

Figure below shows both trends in the export and import volume of Litchi. Export volume dropped in 2013 after a spike in 2012 and again dropped in 2015 after a spike in 2014, this was perhaps of bold initiative taken by Indian exporters to exploit the export markets of Litchi. However, the volumes of export slowed down over 2015 to 2020. On the other hand, the volume imported remained low, but maintained a steady level of import, but in a declining trend

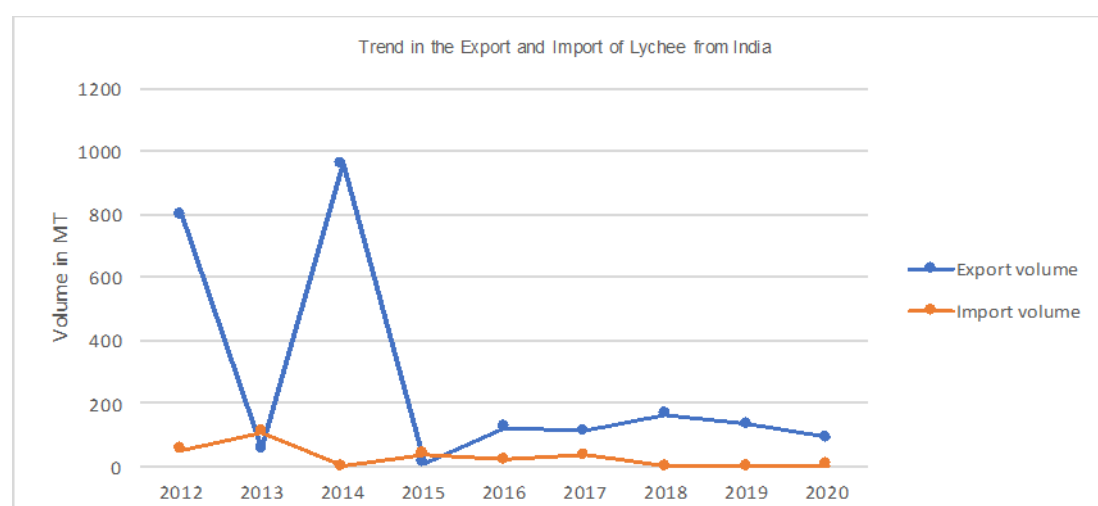


Figure 139: Trend in the Export and Import of Litchi from India.
(Derived from Ministry of Commerce, Government of India database)

The following figure shows both the trends of value of import and export of Litchi from India. As can be seen, the Import values are higher than the export values which is also a reason for a trade deficit for Litchi. Both export and import values seem to be cyclic, but the trend is stable

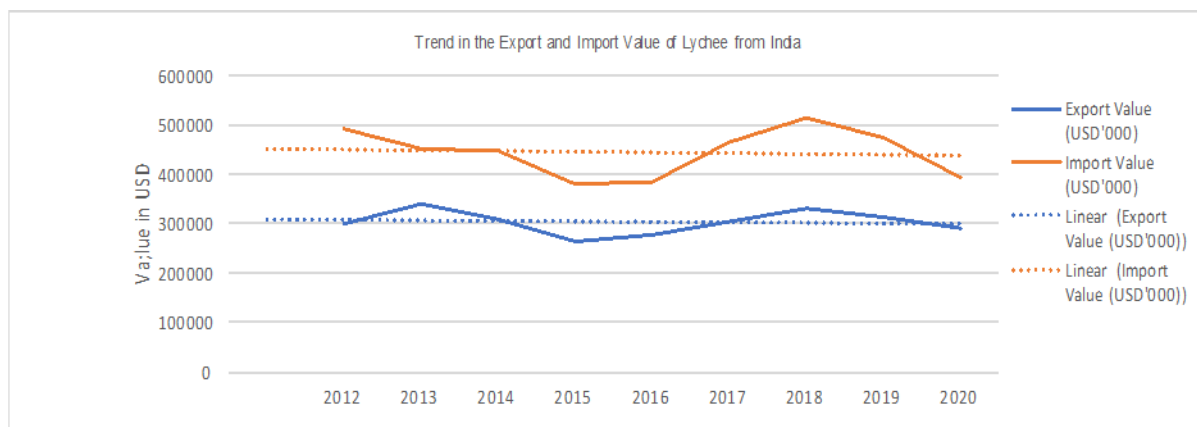


Figure 140: Trend in the Export and Import Value of Litchi from India
(Derived from Ministry of Commerce, Government of India database)

Trade Indicators for Litchi

As we have seen, the export and import values of Litchi are cyclic and the trend is stable over 2012 to 2020. On the one hand, Litchis has a trade surplus in terms of volume of export and imports, and on the other hand a deficit trade balance in terms of value of export and import.

Table 124: Trade Balance, Import, Export and Exports

Trade Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020
Export Volume (MT)	795	57	961.4	9.86	124	112	164	135	90
Export Value (USD)	300400	341405	310338	262291	275852	303526	330078	313361	291808
Trade Balance (Volume MT)	1217	1956	1052.6	2005.14	1892	1905	1854	1884	1930
Trade Balance (Value, USD)	-422	-1899	-91.2	-1995.28	-1768	-1793	-1690	-1749	-1840

(Derived from Ministry of Commerce, Government of India database)

Export destination.

From the available data, we have analyzed and come to a conclusion that the future export destinations for Litchi are Austria and United Kingdom in Europe; Bangladesh and Nepal in South Asia; and UAE and Qatar in the Middle East.

Annexure V: Details of Processing units and Cold/ CA storage

Summary of processing units

i. Fruit Canning Unit at Nagrota, Kangra

Fruit Canning Unit Nagrota Bagwan is one of the 8 fruit processing units of the Department of Horticulture, Himachal Pradesh. This unit is located at 870 meters above MSL that falls in sub-tropical area of the state and situated on Pathankot - Mandi national highway in Distt. Kangra. It is also well connected by rail and air. The foundation stone of this unit was laid on 7th November in 1974 by the then Chief Minister of Himachal Pradesh Dr. YS Parmar under Indo-German Project. The civil works were completed in 1977 while production started in the year 1978. The installed capacity of this unit is 120 MT per annum. Presently, this unit is providing services to the public in three dimensions namely- (i) Processing fruits and vegetables (ii) Training in home scale preservation and (iii) Community Canning service. The latter two services are also being provided through its 5 satellite centers in Kangra, Hamirpur and Una Districts.

Though being quite old, historical and outdated, still this unit is trying to keep pace with present era. With the passage of time, there has been complete transformation in consumer needs, preferences, choices and satisfaction level. Hence there is a dire need for the up-gradation of this unit by replacing its unsafe buildings and old machinery by assistance worth Rs 33 Crores by the state government. The upgradation will be helpful in processing the increased market surplus coming from clusters being developed under HPSHIVA project especially Litchi, Guava and Citrus fruits in this zone in near future.

ii. Fruit Canning Unit at Sirmour

The fruit canning facility was established in 1964 and processing capacity of 200 MT/ year. The crops that are currently handled in unit are Litchi, Kiwi, Strawberry products, Sarson ka saag, Brahmi syrup etc. under Brand Name "Himcu" The summary of production during last three years are as follows:

Table 125: Production during past three years in Sirmour processing unit

Years	2016-17	2017-18	2019-20	2020-21
Production (in MT)	16.0	5.5	6.5	9.7

Methods of procurement of raw material s and price determination for different raw material: Mostly, the fruit Growers are from the nearby villages. Rates are taken from Market Intervention Scheme (MIS), these rates are announced by the Government. Alternatively, department forms a committee to determine the rates of procurement. Procurement rate for strawberry- INR40/Kg, Galgal-INR 7/ Kg. Some of the issues noticed at fruit canning unit are as follows:

- ▶ The Fruit Canning Unit, Dhaulakuan, Sirmaur has been dismantled since past 2 years. As the building and adjoining land has been given to Indian Institute of Management (IIM)
- ▶ The departmental Processing Unit is being operated from a temporary space.
- ▶ Lack of skilled manpower at the Canning Unit.

Private Processing units

1. In Mandi district there is a wine processing unit which prepares wine @10 MT mainly and RTS from Litchi @ 30MT.

2. Private Processing Unit - R.S. N Enterprise. This processing unit is privately own by Mr. Rakesh Dhanial in Plot no-43, Industrial area Bilaspur. The unit produces processed fruit juice, jams, jelly,

syrups and pickles under the brand name LUSH. There are sale centres in the entire state. In Sirmaur district, there are 3 sale points

Site Pictures



Deteriorated roof in building at Nagrotta



Machinery and handling of fruits in Nagrotta FCU



Packaging and storage area in Nagrotta FCU



Steam Jacketed Kettle in Nagrotta FCU



Canning equipment at Dhaulakuan, Sirmaur



Processing equipment at Dhaulakuan, Sirmaur



Finished Galgal (Hill Lemon or Citrus pseudolimon) Juice at the canning unit



Bottle cleaning at Canning Unit, Sirmaur

List of food processing units established under MIDH till 2019-20

Detail of Food Processing Units established under MIDH w.e.f 2014-15 to 2019-20						
S. No.	Name of the Project & Entrepreneurs Address	Date of approval by the SLEC/EMC	Total cost of the project (Rs. in Lakh)	Capacity (MT/KL)	Admissible subsidy (Rs. in Lakh)	Status of Unit
1.	M/s Zoya Fruit Products Pvt. Ltd. Distt. Kangra HP	28-01-2015	877.0	8300	399.48	
2.	M/s Chelsi Foods, Sansarpur Terrace, Kangra HP	28-01-2015	854.38	8400	388.94	
3.	M/s Shubh Labh, Baddi Solan HP	28-01-2015	432.34	1981	136.68	
4.	M/s Kangra herbs Pvt. Ltd., Vill. Dargella, Distt. Kangra	28-01-2015	848.41	600	313.38	
5.	M/s Tridev Spices, Baddi, Solan HP.	28-01-2015	402.11	3335	153.42	
6.	M/s Chane Foods Pvt. Ltd., V. Samoor Khurd Bangana, Distt. Una HP.	28-01-2015	21.77	150	8.74	
7.	M/s Minchy's Food Products, Kandaghat, Solan. HP.	28-01-2015	382.21	3950	126.70	
8.	M/s Himalayan Agro Products, HN-88, Khasra No.657/403 Vill. Dela, PO Nichli Bhater Bilaspur HP.	28-01-2015	149.78	2000	56.24	
9.	M/s Suman Industries, Plot no. 13, Industrial area Bilaspur HP	28-01-2015	110.00	540	36.80	
10.	M/s SRS International, Baddi Solan HP.	28-01-2015	97.48	600	33.29	
11.	M/s Arogya Life, Prop. Smt. Harsham Kaur & Rajneesh Kamal, Village & P.O. Mohal, Tehsil & District Kullu, HP.	28-01-2015	203.35	1320	15.00	
12.	M/s Hadimba Agro Industry, V&PO Manglore, Tehsil Banjar, District Kullu, HP	28-01-2015	327.00	2400	65.00	Under Completion
13.	M/s Himalayan Fresh Organic, Vill. & PO. Jia, Tehsil & District Kullu, HP.	28-01-2015	204.00	2400	30.00	
14.	M/s Mahabalee Foods Pvt. Ltd. 16, Phase III Industrial Area, Tahliwal, District Una, H.P.	28-01-2015/ 20-01-2016	857.75	2400	400.00	
15.	M/s Naggar Fruit Processing Industry, at Village & P.O. Naggar, Tehsil & District Kullu, HP.	28-01-2015	494.90	3600	213.00	
16.	M/s Vostok Foods Pvt. Ltd. at Industrial Area	28-01-2015	499.93	500	240.00	

17.	M/s Zenkinns Food Products, I-J, Phase-I, Jharmajri, Tehsil Baddi, District Solan, HP.	28-01-2015	472.40	600	70.00	
18.	M/s SMS International Beverages Pvt. Ltd at Plot No. 49 Lodhi Majra Industrial Area, Tehsil Baddi District Solan (HP)	28-01-2015/ 18-10-2016	967.07	5700	374.77	
19.	M/s Chandigarh Agritech Pvt. Ltd. at Village Kunjhal, EPIP Road, Brotiwala, Tehsil Baddi, District Solan, HP	28-01-2015/ 18-10-2016	885.57	462	382.41	
20.	M/s Subhash Agro Industry, plot No.36, Industrial area Ghawalhai Distt. Bilaspur, HP.	28-01-2015	129.00	1200	58.80	Under Completion
21.	M/s Maya Aromatic, 453/2, Bela Bathari, Tehsil Haroli, Distt Una HP.	28-01-2015	484.00	4800	202.00	
22.	M/s Sri Sidh Agro Industries Plot No.123, Type -III. House Board Colony Baddi Solan HP.	28-01-2015	293.75	3335	73.00	
23.	M/s Hills Food Agro Beverages Pvt. Ltd, Plot No. 21 C, Industrial Area, Lodhimajra, Baddi (HP)	28-01-2015/ 18-10-2016	1287.55	13500	400.00	
24.	M/s Punarnava Agro, at Plot No. 7 A Phase-II (old) Industrial Area, Surli Khud, Tehsil Sadar, Distt. Mandi, HP.	17-05-2016	82.00	100	24.00	
25.	M/s Della Natura Beverages at Jhiri, P.O. Nagwain, Distt. Mandi, HP.	17-05-2016	285.00	1500	125.00	Under Completion
26.	M/s Elecon Beverages India Ltd. at Plot 633/1, 633/2, Village Kishanpura Baddi, Distt. Solan HP.	29-04-2017	498.00	10368	249.00	
27.	M/s Popular Agro products at Village Sair PO Gagal Shikar Pachhad, District Sirmour HP.	29-04-2017	8.00	184	4.00	

Cell Room

List of Integrated Pack House Management established under MIDH till 2019-20

List/Status of IPHM projects established w.e.f 2015-16 to 2019-20 under MIDH								
S. No.	Year	Project Code/State	Date of Sanction	Project Name / Name of Beneficiary	Address	District	Subsidy Released	Capacity MT
1	2015-16	CA Cold Store/HP.	28-01-2015 SLEC & 31-07-2012 EMC	M/s Anubhuti Apples Pvt. Ltd.,	Village Sainj, Tehsil Theog Distt.	Shimla	616.00	3500
2	2015-16	CA Cold Store/HP.	17-06-2013 BY EMC & 28-01-2015 BY SLEC	M/s A B Refer Warehousing Pvt. Ltd.,	Village Kotla, Tehsil Baddi	Solan	1423.47	5871
3	2015-16	Pre-Cooling Mobile Unit	28-01-2016	M/S Kalgidhar Trust Sh. Darshan Singh	V & PO Barusaheb, Tehsil Pachhad,	Sirmour	12.5	1250
4	2015-16	Cold Room	28-01-2015	M/S Kalgidhar Trust Sh. Dershan Singh	V & PO Barusaheb, Tehsil Pachhad,	Sirmour	7.50	30
5	2015-16	Banana Ripening Chamber	28-01-2016	M/S Agro Biotech Smt Pritma Arora	V&PO Lodhwan The. Noorpur	Kangra	20.00	2880
6	2015-16	CA Cold Store/HP.	28-01-2015	M/s Raamesht Enterprise.	Village Tipra, Tehsil Baddi	Solan	100	1000
7	2015-16	CA Cold Store/HP.	20-07-2015 By EMC	M/S Him Agri Fresh pvt., Ltd. Sh. Pardeep Agarwal	Village Balghar, tchsil Theog	Shimla	1426.18	5032
8	2016-17	CA Cold Store/HP.	17-05-2016	M/s HPMC,	at Rohru, Tehsil Rohru	Shimla	70.00	700
9	2016-17	CA Cold Store/HP.	17-05-2016	M/s HPMC,	at Patli Kuhl,	Kullu	0.00	700
10	2016-17	CA Cold Store/HP.	17-05-2016	M/s HPMC,	at Kumarsain, Tehsil Kumarsain	Shimla	70.00	70
11	2016-17	Cold Store/HP.	17-05-2016	M/S Shri Krishna Cold Store proprietor Sh Rajat katna	at khasra No. 5764 Village Badhera Tehsil Haroli,	Una HP	15.00	500
12	2017-18	C A Store & Pre-cooling	29-04-2017	M/s A R Transimition	Village Kishanpura, Tehsil Baddi	Solan	162.00	1678
13	2017-18	Pre cooling unit	29-04-2017	M/s Dharmender Sharma	Village & PO Vakna, Tehsil kandaghat	Solan	12.50	10
14	2018-19	Cold Store/HP.	23-05-2018	M/s Him Cold Store,	Village Bhumbhu, PO Kaloh, Tehsil Amb, Distt. Una	Una	20.00	500
15	2018-19	CA Cold Store/HP.	17-12-2018	M/s J C O Agri Fresh Pvt. Ltd.,	Village Kachi, Tehsil Theog, Distt. Shimla	Shimla	120.10	1201
17	2019-20	Ripening Chamber	9/4/2019	M/s Shiv Kela Bhandar,	Village Mahua, PO Goela, Tehsil Nalagarh, District Solan, HP.	Solan	46.50	93

Component wise Exp. and Balance Report of MIDH for the year 2019-20(up to till date)												
Name of Scheme	Year	1st Inst.		2nd Inst.		Total	Gen.	S.C.	Previous year balance	Total Funds	Expenditure	Balance
		GoI 90%	GOI 10%	GoI 90%	GoI 10%							
Mission Management	2019-20	-	-	-	-	-	49,50,990	1,08,00,000	47,57,792	2,05,08,782	1,35,23,814	69,84,968
Food Processing	2019-20	-	-	-	-	-	3,07,60,000	-	-	3,07,60,000	3,07,60,000	-
C.A. Store	2019-20	-	-	-	-	-	1,27,50,000	-	89,77,000	2,17,27,000	60,05,000	1,57,22,000
Research & Dev.	2019-20	-	-	-	-	-	-	-	2,392	2,392	-	2,392
Subsidy GIA rec. field	2019-20	-	-	-	-	-	-	-	-	-	-	40,000
Grading Pack house	2019-20	-	-	-	-	-	-	-	-	-	-	-
HRD Gardener & Skill Development	2019-20	-	-	-	-	-	4,11,500	-	4,92,016	9,03,516	-	9,03,516
Study Tour progressive states/units	2019-20	-	-	-	-	-	-	-	25,92,973	25,92,973	-	25,92,973
Creation of water Resources	2019-20	-	-	-	-	-	-	-	-	-	-	-
Himachal Pushap Kranti Yojna	2019-20	-	-	-	-	-	-	-	-	-	-	-
Value chain enhancement for Apple	2019-20	-	-	-	-	-	-	-	-	-	-	-
Study Tour outside the country	2019-20	-	-	-	-	-	-	-	24,33,866	24,33,866	-	24,33,866
Import of Plant Material	2019-20	-	-	-	-	-	-	-	1,65,46,629	1,65,46,629	-	1,65,46,629
Innovative Intervention seabuck thorn	2019-20	-	-	-	-	-	-	-	60,50,000	60,50,000	-	60,50,000
Centre of Excellence	2019-20	-	-	-	-	-	-	2,00,00,000	-	2,00,00,000	2,00,00,000	-
Total:-		0	0	0	0	0			1,68,62,173	1,68,62,173	5,02,88,814	5,12,76,344

Annexure VI: Packaging recommendations

Sweet Orange

Capacity: 15 kgs

A. Corrugated Fibreboard (CFB) Box

A. Minimum Specifications

Material of Construction*	CorrugatedFibreBoard
External Dimensions(mm)	520x315x300
Style of Box**	TELESCOPIC-0320
No. of Plies	3.0
Type of Flutes	B(Narrow)
Direction of Flutes	Vertical
Grammage(g/m ²) Outer to Inner(Indicative)	250/150/150
Burst Factor of Paper(Kraft) (Minimum)	25.00
Bursting Strength of Board(Kg/cm ²) (Minimum)	12.00
No. of Pieces per Box	Not more than two
Manufacturer's Joint	Bygluing
Compression Strength of Box (Kgf) (Minimum)	500
COBB (30Minutes) *** (g/m ²) (Maximum)	60
No. of Ventilation Holes	16.0
Diameter (mm) and Position of Holes	20.0
Two Sides Each	3
Two Ends Each	1
Top & Bottom Each	4
	Oneslotoneachofthe ndsofthebox

B. Recommended Specification

Edge Crush (Kgf)(Minimum)	66.00

B. Partitions and Separator Plates

Material of Construction*	Corrugated Fibre Board
No. of Plies	3
Type of Flutes	B (Narrow)
Grammage (g/m ²)	150 / 150 / 150
Burst Strength (Kg/cm ²) (Minimum)	5.00



Annexure VII: Marketable Volume

Table 126: Plantation Schedule

crop wise area under plantation in Ha	Spacing	2023	2024	2025	2026	2027	2028	Total area per each crop (ha)
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	
Sweet Orange	3*3	350	350	350	700	875	875	3500
Guava	3*3	300	300	300	600	750	750	3000
Litchi	4*4	150	150	150	300	375	375	1500
Pomegranate	3*3	100	100	100	200	250	250	1000
Mango	3*3	25	25	25	50	62.5	62.5	250
Pecan nut	6*6	25	25	25	50	62.5	62.5	250
Persimmon	4*4	25	25	25	50	62.5	62.5	250
Plum	4*4	25	25	25	50	62.5	62.5	250
Total area every year		1000	1000	1000	2000	2500	2500	10000

Table 127: Spoilage percentage

Fruit Crop	Harvesting		Aggregation		Spoilage %ge till Aggregation level
	Min	Max	Max	Min	
Mango	2	4	8	12	
Mango Mean		3		10	13
Pomegranate	4	6	4	8	
Pomegranate Mean		5		6	11
Sweet Orange	8	13	5	10	
Sweet Orange Mean		10.5		7.5	18
Guava	4	8	5	10	
Guava Mean		6		7.5	13.5
Litchi	15	20	5	7	
Litchi Mean		17.5		6	23.5
Persimmon	15	20	5	7	
Persimmon Mean		17.5		6	23.5
Pecannut	4	6	4	8	
Pecanut Mean		5		6	11
Plum	4	8	5	10	
Plum Mean		6		7.5	13.5

The marketable volume (MV) calculation is presented below for each fruit crop.

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Sweet Orange		0	0	15	20	30	30	30	30	30	30	30	30	30	30	30	30	20	15	15	15
Yield (MT/ha) *3 x 3 spacing = 1111 trees/ha	1111	-	-	16.67	22.22	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	22.22	16.67	16.67	16.67
Spoilage	18%	0.00	0.00	3.00	4.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	4.00	3.00	3.00	3.00
Remaining Volume of Produce MT /ha		0.00	0.00	13.67	18.22	27.33	27.33	27.33	27.33	27.33	27.33	27.33	27.33	27.33	27.33	27.33	27.33	18.22	13.67	13.67	13.67
MV from plantation in year 1	350	-	-	4,783	6,377	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	6,377	4,783	4,783	4,783
MV from plantation in year 2	350	-	-	-	4,783	6,377	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	6,377	4,783	4,783
MV from plantation in year 3	350	-	-	-	-	4,783	6,377	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	9,566	6,377	4,783
MV from plantation in year 4	700	-	-	-	-	-	9,566	12,754	19,131	19,131	19,131	19,131	19,131	19,131	19,131	19,131	19,131	19,131	19,131	19,131	12,754
MV from plantation in year 5	875	-	-	-	-	-	-	11,957	15,943	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914
MV from plantation in year 6	875	-	-	-	-	-	-	-	11,957	15,943	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914	23,914
Yearwise Marketable volume in MT		-	-	4,783	11,160	20,726	35,074	53,409	75,729	87,686	95,657	95,657	95,657	95,657	95,657	95,657	95,657	92,469	87,686	82,903	74,931

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Guava		0	0	15	20	30	30	30	30	30	30	30	30	30	30	30	30	20	15	15	15
Yield (MT/ha) *3 x 3 spacing = 1111 trees/ha	1111	-	-	16.67	22.22	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	22.22	16.67	16.67	16.67
Spoilage	13.5%	0.00	0.00	2.25	3.00	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	3.00	2.25	2.25	2.25
Remaining Volume of Produce MT /ha		0.00	0.00	14.42	19.22	28.83	28.83	28.83	28.83	28.83	28.83	28.83	28.83	28.83	28.83	28.83	28.83	19.22	14.42	14.42	14.42
MV from plantation in year 1	300	-	-	4,325	5,766	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	5,766	4,325	4,325	4,325
MV from plantation in year 2	300	-	-	-	4,325	5,766	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	5,766	4,325	4,325
MV from plantation in year 3	300	-	-	-	-	4,325	5,766	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	8,649	5,766	4,325
MV from plantation in year 4	600	-	-	-	-	-	8,649	11,532	17,298	17,298	17,298	17,298	17,298	17,298	17,298	17,298	17,298	17,298	17,298	17,298	11,532
MV from plantation in year 5	750	-	-	-	-	-	-	10,811	14,415	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623
MV from plantation in year 6	750	-	-	-	-	-	-	-	10,811	14,415	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623	21,623
Yearwise Marketable volume in MT		-	-	4,325	10,091	18,740	31,713	48,291	68,472	79,284	86,491	86,491	86,491	86,491	86,491	86,491	86,491	83,608	79,284	74,959	67,752

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Pomegranate		0	0	15	20	30	30	30	30	30	30	30	30	30	30	30	30	20	15	20	30
Yield (MT/ha) *3 x 3 spacing = 1111 trees/ha	1111	-	-	16.67	22.22	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	33.33	22.22	16.67	22.22	33.33
Spoilage	11%	0.00	0.00	1.83	2.44	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	2.44	1.83	2.44	3.67
Remaining Volume of Produce MT /ha		0.00	0.00	14.83	19.78	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	29.66	19.78	14.83	19.78	29.66
MV from plantation in year 1	100	-	-	1,483	1,978	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	1,978	1,483	1,978	2,966
MV from plantation in year 2	100	-	-	-	1,483	1,978	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	1,978	1,483	1,978
MV from plantation in year 3	100	-	-	-	-	1,483	1,978	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	2,966	1,978	1,483
MV from plantation in year 4	200	-	-	-	-	-	2,966	3,955	5,933	5,933	5,933	5,933	5,933	5,933	5,933	5,933	5,933	5,933	5,933	5,933	3,955
MV from plantation in year 5	250	-	-	-	-	-	-	3,708	4,944	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416
MV from plantation in year 6	250	-	-	-	-	-	-	-	3,708	4,944	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416
Yearwise Marketable volume in MT		-	-	1,483	3,461	6,427	10,877	16,562	23,484	27,192	29,664	29,664	29,664	29,664	29,664	29,664	29,664	28,675	27,192	26,203	25,214

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Litchi		0	0	0	0	5	15	25	35	45	65	70	70	70	70	70	70	70	70	70	70
Yield (MT/ha) *4 x 4 spacing =625 trees/ha	625	-	-	-	-	3.13	9.38	15.63	21.88	28.13	40.63	43.75	43.75	43.75	43.75	43.75	43.75	43.75	43.75	43.75	43.75
Spoilage	23.5%	0.00	0.00	0.00	0.00	0.73	2.20	3.67	5.14	6.61	9.55	10.28	10.28	10.28	10.28	10.28	10.28	10.28	10.28	10.28	10.28
Remaining Volume of Produce MT /ha		0.00	0.00	0.00	0.00	2.39	7.17	11.95	16.73	21.52	31.08	33.47	33.47	33.47	33.47	33.47	33.47	33.47	33.47	33.47	33.47
MV from plantation in year 1	150	-	-	-	-	359	1,076	1,793	2,510	3,227	4,662	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020
MV from plantation in year 2	150	-	-	-	-	-	359	1,076	1,793	2,510	3,227	4,662	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020
MV from plantation in year 3	150	-	-	-	-	-	-	359	1,076	1,793	2,510	3,227	4,662	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020
MV from plantation in year 4	300	-	-	-	-	-	-	-	717	2,152	3,586	5,020	6,455	9,323	10,041	10,041	10,041	10,041	10,041	10,041	10,041
MV from plantation in year 5	375	-	-	-	-	-	-	-	-	896	2,689	4,482	6,275	8,068	11,654	12,551	12,551	12,551	12,551	12,551	12,551
MV from plantation in year 6	375	-	-	-	-	-	-	-	-	-	896	2,689	4,482	6,275	8,068	11,654	12,551	12,551	12,551	12,551	12,551
Yearwise Marketable volume in MT		-	-	-	-	359	1,434	3,227	6,096	10,579	17,571	25,102	31,915	38,728	44,824	49,307	50,203	50,203	50,203	50,203	50,203

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Persimmon		0	0	15	20	30	30	30	30	30	30	30	30	30	30	30	30	20	15	15	15
Yield (MT/ha) *4 x 4 spacing =625 trees/ha	625	-	-	9.38	12.50	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	12.50	9.38	9.38	9.38
Spoilage	23.5%	0.00	0.00	2.20	2.94	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	2.94	2.20	2.20	2.20
Remaining Volume of Produce MT /ha		0.00	0.00	7.17	9.56	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	14.34	9.56	7.17	7.17	7.17
MV from plantation in year 1	25	-	-	179	239	359	359	359	359	359	359	359	359	359	359	359	359	239	179	179	179
MV from plantation in year 2	25	-	-	-	179	239	359	359	359	359	359	359	359	359	359	359	359	359	239	179	179
MV from plantation in year 3	25	-	-	-	-	179	239	359	359	359	359	359	359	359	359	359	359	359	239	179	179
MV from plantation in year 4	50	-	-	-	-	-	359	478	717	717	717	717	717	717	717	717	717	717	717	717	478
MV from plantation in year 5	62.5	-	-	-	-	-	-	448	598	896	896	896	896	896	896	896	896	896	896	896	896
MV from plantation in year 6	62.5	-	-	-	-	-	-	-	448	598	896	896	896	896	896	896	896	896	896	896	896
Yearwise Marketable volume in MT		-	-	179	418	777	1,315	2,002	2,839	3,287	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,466	3,287	3,108	2,809

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Plum		0	0	0	5	10	20	30	40	50	60	70	75	75	75	75	75	75	75	75	75
Yield (MT/ha) *4 x 4 spacing =625 trees/ha	625	-	-	-	3.13	6.25	12.50	18.75	25.00	31.25	37.50	43.75	46.88	46.88	46.88	46.88	46.88	46.88	46.88	46.88	46.88
Spoilage	13.5%	0.00	0.00	0.00	0.42	0.84	1.69	2.53	3.38	4.22	5.06	5.91	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33	6.33
Remaining Volume of Produce MT /ha		0.00	0.00	0.00	2.70	5.41	10.81	16.22	21.63	27.03	32.44	37.84	40.55	40.55	40.55	40.55	40.55	40.55	40.55	40.55	40.55
MV from plantation in year 1	25	-	-	-	68	135	270	405	541	676	811	946	1,014	1,014	1,014	1,014	1,014	1,014	1,014	1,014	1,014
MV from plantation in year 2	25	-	-	-	-	68	135	270	405	541	676	811	946	1,014	1,014	1,014	1,014	1,014	1,014	1,014	1,014
MV from plantation in year 3	25	-	-	-	-	-	68	135	270	405	541	676	811	946	1,014	1,014	1,014	1,014	1,014	1,014	1,014
MV from plantation in year 4	50	-	-	-	-	-	-	135	270	541	811	1,081	1,352	1,622	1,892	2,027	2,027	2,027	2,027	2,027	2,027
MV from plantation in year 5	62.5	-	-	-	-	-	-	-	169	338	676	1,014	1,352	1,689	2,027	2,365	2,534	2,534	2,534	2,534	2,534
MV from plantation in year 6	62.5	-	-	-	-	-	-	-	-	169	338	676	1,014	1,352	1,689	2,027	2,365	2,534	2,534	2,534	2,534
Yearwise Marketable volume in MT		-	-	-	68	203	473	946	1,656	2,669	3,852	5,204	6,488	7,636	8,650	9,461	9,968	10,137	10,137	10,137	10,137

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Mango		0	0	0	10	15	20	25	30	35	35	35	35	35	35	35	35	35	35	35	35
Yield (MT/ha) *3 x 3 spacing = 1111 trees/ha	1111	-	-	-	11.11	16.67	22.22	27.78	33.33	38.89	38.89	38.89	38.89	38.89	38.89	38.89	38.89	38.89	38.89	38.89	38.89
Spoilage	13%	0.00	0.00	0.00	1.44	2.17	2.89	3.61	4.33	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06
Remaining Volume of Produce MT /ha		0.00	0.00	0.00	9.67	14.50	19.33	24.16	29.00	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83	33.83
MV from plantation in year 1	25	-	-	-	242	362	483	604	725	846	846	846	846	846	846	846	846	846	846	846	846
MV from plantation in year 2	25		-	-	-	242	362	483	604	725	846	846	846	846	846	846	846	846	846	846	846
MV from plantation in year 3	25			-	-	-	242	362	483	604	725	846	846	846	846	846	846	846	846	846	846
MV from plantation in year 4	50				-	-	-	483	725	967	1,208	1,450	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691	1,691
MV from plantation in year 5	62.5					-	-	-	604	906	1,208	1,510	1,812	2,114	2,114	2,114	2,114	2,114	2,114	2,114	2,114
MV from plantation in year 6	62.5						-	-	-	604	906	1,208	1,510	1,812	2,114	2,114	2,114	2,114	2,114	2,114	2,114
Yearwise Marketable volume in MT		-	-	-	242	604	1,087	1,933	3,141	4,652	5,739	6,706	7,551	8,155	8,457	8,457	8,457	8,457	8,457	8,457	8,457

Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Yield (kg/tree)- Pecan nut		0	0	0	0	5	10	15	20	25	25	25	25	25	25	25	25	25	25	25	25
Yield (MT/ha) *6 x6 spacing = 278 trees/ha	278	-	-	-	-	1.39	2.78	4.17	5.56	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95	6.95
Spoilage	11%	0.00	0.00	0.00	0.00	0.15	0.31	0.46	0.61	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Remaining Volume of Produce MT /ha		0.00	0.00	0.00	0.00	1.24	2.47	3.71	4.95	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19
MV from plantation in year 1	25	-	-	-	-	31	62	93	124	155	155	155	155	155	155	155	155	155	155	155	155
MV from plantation in year 2	25		-	-	-	-	31	62	93	124	155	155	155	155	155	155	155	155	155	155	155
MV from plantation in year 3	25			-	-	-	-	31	62	93	124	155	155	155	155	155	155	155	155	155	155
MV from plantation in year 4	50				-	-	-	-	62	124	186	247	309	309	309	309	309	309	309	309	309
MV from plantation in year 5	62.5					-	-	-	-	77	155	232	309	387	387	387	387	387	387	387	387
MV from plantation in year 6	62.5						-	-	-	-	77	155	232	309	387	387	387	387	387	387	387
Yearwise Marketable volume in MT		-	-	-	-	31	93	186	340	572	851	1,098	1,314	1,469	1,546	1,546	1,546	1,546	1,546	1,546	1,546

Annexure VIII: Details of Agro climatic zones of Himachal Pradesh

The table below describes the specific fruits and regions under specific zones.

Table 128: Agro climatic zones of Himachal Pradesh

Zone	Elevation (meter)	Horticultural crops	District/area covered
Sub-tropical, Submountain, Low Hill	365- 914	Mango, Litchi, Citrus, Aonla, Guava, Pomegranate, low chilling varieties of Peach, Plum and Pear, Strawberry	Una & Hamirpur District and parts of Bilaspur, Kangra, Chamba, Sirmour and Solan
Sub-tropical, Sub-humid, Mid Hills	915-1523	Stone fruits (Peach, Plum, Apricot, Almond), Pear, Pomegranate, Pecan nut, Walnut, Kiwi fruit, Strawberry	Mid hill area of Solan, Sirmour, Shimla, Chamba, Mandi, Kullu and Kangra
Wet Temperate High Hills	1524- 2742	Apple, Pear, Cherry, Almond, Walnut, Chestnut, Hazelnut, Strawberry.	High reaches of Shimla, Mandi, Kullu, Sirmour, Chamba
Dry Temperate High Hills & Cold Desert	Above 2742	Apple, Grapes, Prunes, Drying type Apricot, Almond, Chilgoza, Pistachionut, Walnut, Hazelnut	Lahaul Spiti, Kinnaur, and Bharmour and Pangti area of Chamba district

Source: Envis Center in Himachal Pradesh

at http://www.hpemis.nic.in/Database/Horticulture_4022.aspx

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