

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

CS03: Nursery Development Action Plan





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List of Abbreviations

CEC	Cation Exchange Capacity
CHF	College of Horticulture and Forestry
CHPMA	Community Horticulture Production and Marketing Associations
CIHNER	Central Institute of Horticulture North East Region
CISH	Central Institute of Subtropical Horticulture
CoE	Centre for Excellence
CSK HPKV	Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya
DNA	Deoxyribonucleic acid
DoH	Department of Horticulture
EA	Executing Agency
ELISA	enzyme-linked immunoassay
EoI	Expression of Interest
EY	Ernst & Young
FLD	Front Line demonstrations
FYM	Farm Yard Manure
GAP	Good Agricultural Practice
GoHP	Government of Himachal Pradesh
HP	Himachal Pradesh
HPSHIVA	Himachal Pradesh Subtropical Horticulture, Irrigation and Value Addition
HSDSIP	Horticulture Sector Development Strategy and Investment Plan
IA	Implementing Agencies
IA	Inspection Authority
IBA	Indole-3-Butyric Acid
INM	Integrated Nutrient Management
INR	Indian Rupee
IPM	Integrated Pest Management
IRR	Internal Rate of Return
KCC	Kisan Credit Card
MIDH	Mission for Integrated Development of Horticulture
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MP	Mother Plant
NHB	National Horticulture Board
NPV	Net Present Value
NRC	National Research Center
NSDC	National Skill Development Corporation
PBP	Pay Back Period
PCDO	Progeny cum Demonstration Orchard
PCR	Polymerase Chain Reaction
PEQ	Post-Entry Quarantine
PMU	Project Management Unit
PoP	Package of Practices
PPM	Parts Per Million
PPP	Public Private Partnership
PRF	Project Readiness Financing

RBS	River Bed Sand
RFP	Request for Proposals
SQ	Service Quality
ToR	Terms of Reference
UHF	University of Horticulture & Forestry
VCA	Value Chain Analysis

Executive Summary

The HPSHIVA project is going to invest in the high-density plantation of Sweet Orange, Guava, Litchi, Pomegranate, Persimmon, Plum, Mango, and Pecan nut. The first step to this is procurement of high-quality, true to type with genetic fidelity, disease-free planting material and simultaneously establishment of quality nurseries which will cater to production of high-quality disease-free planting material. While conceiving the HPSHIVA project and to make it successful, the Horticulture department has established various Front-Line Demonstration (FLD) clusters in seven districts of the state and 17 PRF clusters in four districts of the state. The success of the sub-tropical crops has been established and demonstrated in the region. The project envisages that in the coming years there will a substantial increase in area of the cultivation of sub-tropical horticultural crops.

This report presents the strategy for plantation till 2030 covering an area of 10,000 hectare spread over 1000 clusters/ villages across 28 blocks in 7 districts to benefit ~25,000 households. The plantation work of 8 subtropical fruits for plantation phased out as 10% in Year 1, 10% in Year 2, 10% Year 3, 20 % in year 4 and 25% each in year 5 and year 6. In the initial year plantation percentage has been kept low and increased gradually taking into considerations time for the establishment of nurseries.

It is suggested to procure 100% of planting material required from Year 1 to Year 3 covering 30 % of the proposed area through procurement only. Simultaneously, it is proposed that 10 nurseries may be established to start production from year 4 onwards which can subsequently phase out the planting material procurement and supply quality planting material to upcoming areas also. It is suggested that procurement should be done through open tendering process keeping technical and financial evaluations. The bidders can be reputed registered nurseries/agencies within/outside the state/ country, those who meet the eligibility criteria in terms of years of operation, quality of planting material, safe logistics and timely supply. During procurement, certification that planting material is insect pest & disease free is also a necessity and few samples should also be tested in accredited laboratory for the same.

The proposed procurement of planting material also taking into consideration maximum mortality rate comes to 93.58 lakhs out of which 10.62 lakhs planting material are required in Year 1, 2 and 3 each, 19.32 lakhs in Year 4, 22.62 lakhs in year 5, 19.62 lakhs after factoring in extra 5 to 7% for mortality and transportation losses. It is assumed that planting material production from proposed nurseries will start from Year 4 onwards and the established nurseries can substitute planting material requirement by 7 % In Sweet Orange, 8 % in Guava, 9% in Litchi, 8% in Pomegranate, 42% in Persimmon, 57% in Plum 6% in Mango and 38% in Pecan nut in Year 4 and subsequently increase supply. 100 % planting material requirement for Persimmon and Plum can be met in Year 6 with surplus production.

Taking into consideration the spacing and planting material requirement, it is proposed to establish two nurseries each for Sweet Orange and Guava and one nursery each for Litchi, Persimmon, Plum, Mango and Pecan nut fruit and one Tissue culture Lab for Pomegranate. The locations for fruit crops have been suggested based on the altitude of the region. It is suggested to establish the nurseries of Sweet Orange, Guava, Litchi, Mango and Pomegranate in altitude ranging between 600-800 m whereas nurseries of Plum, Pecan nut and Persimmon are suited for the higher altitude 800- 1200 m.

In these nurseries mother block is proposed to be maintained along with facilities of mist chamber, fan and pad green house, naturally ventilated poly house, shade net, electricity and water facilities depending on the crop. Facilities for hardening of planting material, storage and general administrative requirements will also be maintained. The pomegranate planting material is to be raised through Tissue culture whereas virus indexing is the major requirement for the sweet orange which is further propagated through micrografting. Depending upon the crop different propagating methodology has been proposed for different crops as patch budding for Guava, air layering for

Litchi, chip budding for Persimmon, T budding for plum and veneer and whip grafting for Mango and Pecan nut respectively.

For small and medium enterprise financing for developing the state of Himachal Pradesh's internal capacity, the project is focused on developing nursery models for 10 fruit plant nurseries, of which one is a Tissue Culture Lab cum nursery for Pomegranate. For establishment of nurseries, it is proposed to develop separate block for mother plant of a single fruit crop variety, production of plants will start from second year or third year depending on the crop/variety. The target increase in production for each target fruit crop may be achieved by extending the facilities and also provide production linked incentives for incremental sales. The investment cost of different nursery models ranges between 1.01 crore to 3.15 crores depending on the variable facilities across the crops. It is proposed that the financing models for all nurseries is proposed as 50:50 taking into consideration many existing schemes in other states. Quality planting material production and supply will be further strengthened by training programs and exposure visits for different stakeholders along with diligent maintenance of the records.

The nursery development plan if implemented conscientiously may serve to supply quality planting materials to the project and act as a commercial venture for the young entrepreneurs of the state, thus boosting further economic growth in the state.

1. Introduction

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 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 the Jal Shakti Vibhag. The PRF project has four outputs:

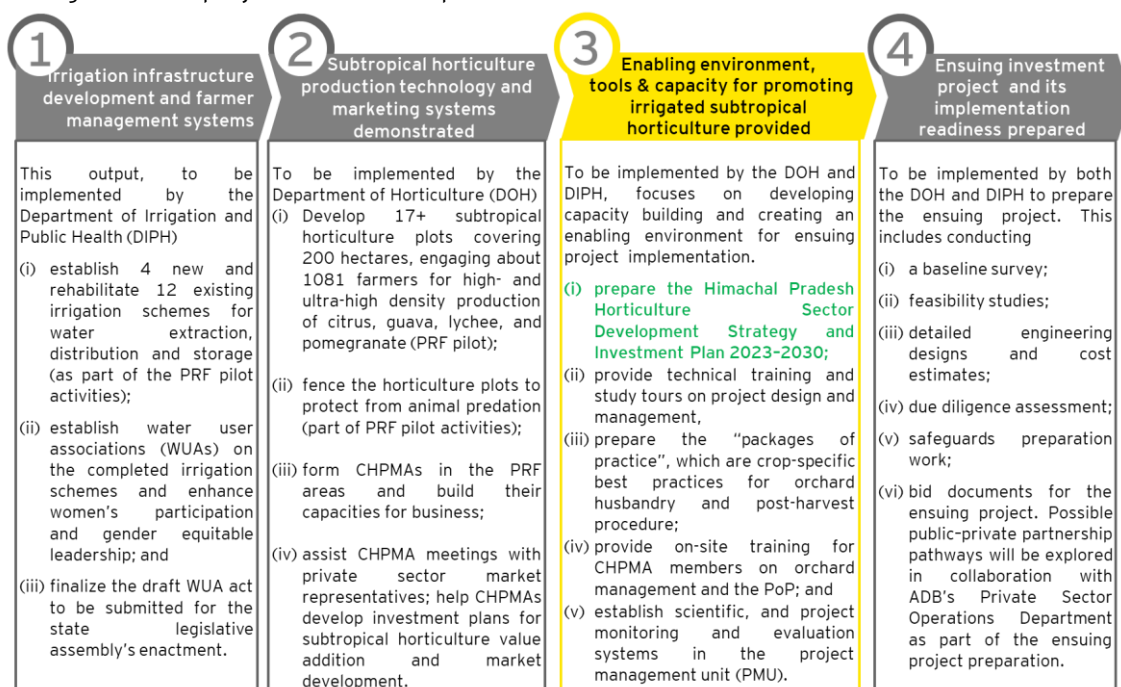


Figure 1: Outputs from PRF

This assignment, CS 03 Himachal Pradesh Horticulture Sector Development Strategy and Investment Plan (HSDSIP) 2023-2030 falls under PRF- Output 3. The HSDSIP 2023-2030 will guide the overall future development of the HP horticulture sector and the HP-SHIVA project design. The present report- the Nursery development action plan under this will guide nursery development pertaining to the selected subtropical fruit crops.

In the country, Himachal Pradesh is known as important horticulture state, but the focus has been mostly on temperate fruits. The sub -tropical horticulture crops have not gained sufficient attention. The ensuing project, HPSHIVA aims to increase livelihoods of rural households in Himachal Pradesh, especially to increase income of subtropical farmers in Himachal Pradesh. So, the project focusses on sub-tropical regions of the state covering 7 districts of Hamirpur, Bilaspur, Solan, Sirmaur, Una, Kangra and Mandi in the subtropical low hills zone and some in the mid hills sub-humid zone of the state, which aims to

- 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 2: Target Districts

The altitude of these districts ranges from 600 m to 3656 m which makes it suitable for cultivation of sub- tropical fruits and low chilling cultivars of some temperate fruits like Plum, Persimmon. The estimated percentage distribution of crops that will be considered in the project are as follows:

Table 1: Percentage distribution of selected Crops

S. No	Name of Crops	Percentage
1	Sweet Orange	35%
2	Guava	30%
3	Litchi	15%
4	Pomegranate	10%
Others		10%
5	Persimmon	2.5%
6	Plum	2.5%
7	Mango	2.5%
8	Pecan nut	2.5%

Source: PMU HPSHIVA, DoH 2021

The above fruit crop selection is based on the PRF document prepared by HPSHIVA ADB team and as per discussion with Department of Horticulture at Inception meeting. It is reverified and strengthened by crop prioritization study (through elimination procedure) based on agro- climatic conditions, area and production of different fruit crops in Himachal Pradesh. The project is focused to increase farmers' income in the sub-tropical zones and to attract migrant farmers/youths back to the state. In the recent two decades, most of the farmers are abandoning their farmland due to various problems including monkey and wild animals menace on fruit crops, migration of youth to big cities for better job prospects.

In 2019, Department of horticulture initiated Front Line demonstrations (FLDs) in 9 locations across 4 districts namely Bilaspur, Mandi, Hamirpur and Kangra for Sweet Orange, Guava, Litchi, Pomegranate, covering ~1 hectare at each location. The plantation as part of PRF project was done in 17 clusters across these 4 districts. The snapshot of these PRF clusters has been provided below:

Table 2: Snapshot of PRF clusters

Districts	No. of Clusters	Crops	Net area under Plantation (Ha)	Total Area under Plantation (Ha)
Bilaspur	4	Sweet Orange, Guava, Litchi	52.52	59.29
Mandi	6	Pomegranate, Sweet Orange, Guava, Litchi	53.88	65.98
Hamirpur	2	Sweet Orange, Guava	16.55	20.00
Kangra	5	Sweet Orange, Guava, Litchi	45.65	54.40
Total	17		168.60	199.67

Source: PMU HPSHIVA, DoH 2021

Further, 198 FLD clusters with approximately 1 hectare each in 28 blocks across 7 districts have been started in 2021 as mentioned below:

Table 3: FLD Clusters in 2021

District	Number of Divisions	Number of Clusters
Bilaspur	4	27
Hamirpur	6	27
Kangra	7	32
Mandi	7	76
Sirmaur	2	12
Solan	2	15
Una	1	9
Total	28	198

Source: PMU HPSHIVA, DoH 2021

Nurseries

The nurseries in Himachal Pradesh need to be registered under “**The Himachal Pradesh Fruit Nurseries Registration Act, 2015**”. No nursery can sell the planting material without registration. The license is valid for a period of 5 years.

There are 40 public nurseries and 212 private nurseries with major public nurseries being in Mandi (10) and Sirmaur (10), followed by Solan (8) and Bilaspur district (7) in sub-tropical districts in Himachal Pradesh. In private sector, the major nurseries are in Mandi district (92) and Sirmaur (53) district.

Table 4: Snapshot of PCDOs and private nurseries

District	Progeny cum demonstration orchard	Private nurseries
Bilaspur	5	14
Hamirpur	4	7
Kangra	2	31
Mandi	10	92
Sirmaur	10	53
Solan	8	9
Una	1	6
Total	40	212

Source: DoH, 2021

There are 10 nurseries accredited by National Horticulture Board in Himachal Pradesh (1- star nurseries: 8 and 2- Star Nurseries: 2). The major crops grown in these nurseries include Apple, Mango, Pear, Lemon, Litchi, Peach, Plum, Pomegranate and Sweet Orange. The details of nurseries with relevant sub- tropical plants are provided in Annexure III. The summary of capacity of NHB accredited nurseries with relevant sub-tropical crops in Himachal Pradesh is as follows:

Table 5: Summary of NHB accredited nurseries in Himachal Pradesh

Name of Crop	Name of Varieties	Total No. of Mother Plants	Total Production Capacity
Citrus	Baramasi	5	4000
Litchi	Calcuttia	5	5000
	Dehradun	20	2000
Mango	Amrapali	1112	5050
	Chausa	6	300
	Dashehari	251	12750
	Langra	24	1100
	Mallika	2	500
Plum	Santa Rosa	4	2000
Pomegranate	Bhagwa	30	2500
	Kabuli Kandhari	70	5000
	Kandhari	70	3000
Grand Total		1599	43200

Source: NHB, 2021

There are no NHB accredited nurseries for Guava, Persimmon crops in Himachal Pradesh. The nurseries have been established under state horticulture act and are registered.

2. Anticipated demand of Planting Material and indicative procurement criteria

DOH is currently procuring through open tender and competitive bidding. The current procurement is done from reputed nurseries/agencies and institutions in the state of Uttar Pradesh, Maharashtra, Punjab and Uttarakhand.

The process for procurement of seedlings is currently underway and the DOH has planned for procurement of planting materials for the year 2022-2023. The plan for the current planting material prepared by DOH is for plantation area of 4,200 hectares in which the focused crops are Guava, Sweet Orange, Pomegranate, Litchi, Plum etc.,

For preparing the strategy till 2030 covering an area of 10,000 hectare spread over 1000 clusters/ villages across 28 blocks in 7 districts to benefit ~25,000 households and considering 8 subtropical fruits, the plantation work from 2023 to 2028 is phased out as 10% each in Year 1, 2 & 3, 20% in Year 4 and 25% each in Year 5 and 6 covering the total planned area. As per the success of the project, the plantation work will continue beyond 2030 as it is expected that other farmers will be attracted to the plantation and thus established nurseries will supply the planting material and can run as business enterprise.

Table 6 : Year wise plantation distribution

Year wise plantation area distribution	Year 1 2023	Year 2 2024	Year 3 2025	Year 4 2026	Year 5 2027	Year 6 2028
% of Plantation	10%	10%	10%	20%	25%	25%
Area in hectares	1000	1000	1000	2000	2500	2500

Source: PMU HPSHIVA, DoH 2021

As per above phasing and proposed distribution of the fruit crops (in Table 1) across different districts and clusters, the area to be covered under each crop in each year is as mentioned below. It is proposed to cover 1000 hectares each in Year 1, 2 & 3, increasing to 2000 ha in Year 4 and subsequently 2500 ha in Year 5 and 6 covering total 10000 ha in the project period.

Table 7: Year wise- Area (ha) to be covered under each crop

Fruit Crop/ Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total area /crop (ha)
Sweet Orange	350	350	350	700	875	875	3500
Guava	300	300	300	600	750	750	3000
Litchi	150	150	150	300	375	375	1500
Pomegranate	100	100	100	200	250	250	1000
Persimmon	25	25	25	50	62.5	62.5	250
Plum	25	25	25	50	62.5	62.5	250
Mango	25	25	25	50	62.5	62.5	250
Pecan nut	25	25	25	50	62.5	62.5	250
Total area every year	1000	1000	1000	2000	2500	2500	10000

Source: PMU HPSHIVA, DoH 2021 and EY analysis

The coverage of the area has been decided based on the nursery established plan. Initial 3 years of the project has been considered as incubation stage as proposed nurseries will take time to be established so only 10 % area each is targeted in the initial three years which is subsequently increased with the establishment of proposed inhouse nurseries. The plantation of each crop is suggested to be done in high density planting. The suggested spacing for Sweet Orange, Guava, Pomegranate and Mango is 3x3, Persimmon, Plum and Litchi is 4x4 m and Pecan nut is 6x6 m. The plant spacing has been decided on the basis of consultations with department of Horticulture and College of Horticulture and Forestry, Neri on January 4, 2022. (Minutes of Meeting attached in Annexure X). Hence the total number of plants per hectare comes to 1,111 for Sweet Orange, Guava, Pomegranate and Mango, 625 for Persimmon, Plum and Litchi and 278 for Pecan nut. Hence, based

on the total requirement of planting material and proposed spacing (in consultation with DOH and College of Horticulture and Forestry, Neri, Hamirpur) for each fruit crop the planting material requirement comes out to be 38.88 lakhs for Sweet Orange, 33.33 lakhs for Guava, 9.37 lakhs for Litchi, 11.11 lakhs for Pomegranate, 2.77 lakhs for Mango, 0.69 lakhs for Pecan nut, and 1.56 lakhs each for Persimmon and Plum as mentioned in Table 8 below.

Table 8: Year wise planting material requirement (in lakhs)

Crop	Spacing (m)	Population/ ha	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Sweet Orange	3x3	1,111	3.889	3.889	3.889	7.777	9.721	9.721	38.885
Guava	3x3	1,111	3.333	3.333	3.333	6.666	8.333	8.333	33.330
Litchi	4x4	625	0.938	0.938	0.938	1.875	2.344	2.344	9.375
Pomegranate	3x3	1,111	1.111	1.111	1.111	2.222	2.778	2.778	11.110
Persimmon	4x4	625	0.156	0.156	0.156	0.313	0.391	0.391	1.563
Plum	4x4	625	0.156	0.156	0.156	0.313	0.391	0.391	1.563
Mango	3x3	1,111	0.278	0.278	0.278	0.556	0.694	0.694	2.778
Pecan nut	6x6	278	0.070	0.070	0.070	0.139	0.174	0.174	0.695
Total			9.930	9.930	9.930	19.860	24.824	24.824	99.298

Source: PMU HPSHIVA, DoH 2021 and EY analysis

As per production plan from the proposed nurseries' establishment as detailed in section 3, the estimated number of plants available for sale every year will be as mentioned below:

Table 9: Estimated production of plants from the proposed nurseries

No. of Nurseries	Crop	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
2	Sweet Orange	0	0	0	52,800	1,05,600	1,58,400
2	Guava	0	0	0	52,800	1,05,600	1,58,400
1	Litchi	0	0	0	17,778	28,444	56,889
1	Pomegranate	0	0	0	17,100	38,000	1,14,000
1	Persimmon	0	0	0	13,200	26,640	53,280
1	Plum	0	0	0	17,760	35,520	53,280
1	Mango	0	0	0	3,555	17,777	53,333
1	Pecan nut	0	0	0	5,333	10,667	16,000

Source: EY analysis

Based on the production from nurseries and considering the trends and mortality percentages, it is proposed that 5- 7% extra plants should be procured to overcome the mortality faced during transportation and establishment of the orchard.

In general mortality rate reported in various nurseries across the country varies from 2-25 % in different fruit crops but with better management practices which are being followed in the state the mortality rate in some of the PCDOs was only noticed 1-2%. The major factors attributed to low mortality rate are:

- ▶ keeping the orchard ready before plantation.
- ▶ better management practices
- ▶ soil is also very rich in organic matter with good physico- chemical properties
- ▶ adequate spatial distribution
- ▶ proper care of plants has been taken right from land preparation till post-natal care of plants.
- ▶ plants planted after one shower of monsoon having good survival
- ▶ timely application of water
- ▶ addition of organic manure 5 to 7 kgs 2-3 times a year

- ▶ maintain weed free condition also improves vegetative growth

The same has been validated and finalised with HPSHIVA, Department of Horticulture in the meeting happened on 4th January 2022 (Refer Annexure X).

Considering the mortality rate and start of production from the proposed nurseries within the states, the year wise planting material to be procured through open tender from reputed registered nurseries is as presented below:

Table 10: Year wise planting material procurement (in lakhs)

Crop/ Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Sweet Orange	4.161	4.161	4.161	7.756	9.272	8.707	38.217
Guava	3.566	3.566	3.566	6.568	7.786	7.221	32.273
Litchi	1.003	1.003	1.003	1.816	2.203	1.899	8.928
Pomegranate	1.189	1.189	1.189	2.195	2.565	1.752	10.078
Mango	0.297	0.297	0.297	0.556	0.553	0.172	2.173
Pecan nut	0.074	0.074	0.074	0.092	0.072	0.015	0.401
Persimmon	0.167	0.167	0.167	0.193	0.133	-	0.828
Plum	0.167	0.167	0.167	0.144	0.038	-	0.684
Total	10.625	10.625	10.625	19.320	22.622	19.766	93.583

Note: The planting spacing suggested for fruit crops are under high density planting on raised beds with nutrition and water requirement being catered through drip irrigation system. For proper growth and profitable fruiting in this type of planting; training and pruning schedule will play the most important role.

The plantation in each year happens in two seasons February - March and July- August. Since majority of plantation happens in July- August period, planting material has been divided in the ration of 30: 70 in February- March and July- August respectively. The varieties that may be considered in each fruit crop are as follows:

- i. **Sweet Orange (8):** Valencia, Hamelin, Natal, Pera, Westin, Jaffa, Blood Red, Mosambi (Andhra)
- ii. **Guava (3):** Lalit, Shwetha, VNR Bihi
- iii. **Pomegranate (1):** Bhagwa
- iv. **Litchi (2):** Dehradun, Calcuttia
- v. **Persimmon (2):** Fuyu, Jiro
- vi. **Plum (2):** Angeleno, Friar
- vii. **Mango (2):** Mallika, Pusa Arunima
- viii. **Pecan Nut (2):** Mahan, Nellis

The planting material requirement between 2 seasons across each variety of fruit crops are provided in detail in Annexure VII (e-g).

There is limited availability of targeted sub- tropical fruits' planting material in nurseries registered under "The Himachal Pradesh Fruit Nurseries Registration Act, 2015" (Refer Annexure VII for information about nurseries visited by EY team). It is also evident from Table 5 that currently, very limited planting material is available in NHB accredited nurseries in Himachal Pradesh.

To understand the availability of quality planting material of targeted crops in other states, EY team has studied the current production capacity of specific varieties of targeted crops in NHB accredited nurseries across India. The snapshot of planting material production capacity is presented below, and detailed tables are attached in Annexure IV.

Table 11: Snapshot of state wise NHB production capacity of targeted plants and varieties

Fruit Crop	Summary
Sweet Orange	NHB accredited nurseries of Sweet Orange have planting material of relevant Valencia and Hemlin. Maharashtra, Punjab, Rajasthan and Haryana which have production capacity of 6 lakh Plants. NHB accredited nurseries in other states have limited production capacity of few thousands.
Guava	NHB accredited nurseries across 14 states in India produce Guava planting material. Out of these the highest production capacity is found in Haryana of Hissar Safeda variety with more than 15 lakhs per annum, followed by Uttar Pradesh with more than 9 lakhs. However, the production capacity is around 50,000- 65,000 in Punjab, West Bengal and Maharashtra. Barfkhana variety from Uttar Pradesh in the initial trail has showed promising potential and hence can be considered for future plantations. In addition, L-49 and Sweta can be taken up, which can be procured from Jain Irrigation Systems, Jalgaon and CISH, Lucknow.
Pomegranate	In Pomegranate, the major recommended variety is Bhagwa. Maharashtra state has the predominant production capacity (100% of total 32.8 production capacity) from NHB accredited nurseries i.e., 26.31 lakh plants per annum, while Andhra Pradesh and Gujarat have production capacity of more than 3.5 lakh plants.
Litchi	The major relevant varieties in Litchi are Dehradun, Rose Scented and Shahi. The highest planting material production capacity from NHB accredited nurseries is reported from Uttarakhand with more than 1.23 lakh seedlings. Other important states for Litchi planting material and respective production capacity are Bihar (1,00,000), Jammu & Kashmir (58,600) and Uttar Pradesh (48,000).
Persimmon	Varieties namely Fuyu, on Amlak rootstock should be preferred for Persimmon. There are no NHB accredited nurseries for Persimmon. However, in North East Persimmon is found in Central Institute of Horticulture North East India (CIHNER) accredited nurseries. Fuyu variety of Persimmon is available in two private nurseries accredited by CIH, one in Nagaland (1 star) and another one in Arunachal Pradesh (2 star).
Plum	The major recommended varieties of Plum are Black Amber, Frontier, Santa Rosa, Kala Amritsari and Satluj Purple. Jammu & Kashmir has the highest production capacity from NHB accredited nurseries of 1.37 lakh followed by Uttarakhand of 37,600.
Mango	The relevant varieties considered for analysis are Mallika and Pusa Arunima. The state wise NHB accredited nurseries' production capacity suggests a wide availability across states with the major production capacity being in Uttar Pradesh, where recommended varieties are available.
Pecan nut	There are no NHB accredited nurseries or CIHNER accredited nurseries for Pecan nut, thus should be locally procured.

Hence, above states can be considered as major sourcing zone for procurement of targeted crops. Apart from NHB accredited nurseries there are many institutes/agencies which also supply certified quality planting material that include:

- ▶ Central Institute of Sub tropical Horticulture, Rehmankhera, Lucknow, UP
- ▶ College of Horticulture and Forestry, Neri, Hamirpur, HP
- ▶ National Research Centre for Litchi, Muzaffarpur, Bihar
- ▶ Centre of Excellence for Citrus, Hoshiarpur, Punjab
- ▶ Citrus Centre of Excellence, Kota, Rajasthan
- ▶ Pomegranate Centre of Excellence, Bassi, Jaipur, Rajasthan
- ▶ Guava Excellence Centre, Tonk, Rajasthan

2.1. Indicative eligibility criteria for procurement

It is suggested that the procurement of planting materials should be based on open tendering process. DOH may appropriately finalize the specifics of the minimum qualification criteria. The general conditions and criteria proposed to be fulfilled are as follows:

2.1.1. General Plant pathological conditions

- ▶ The plants must be free from Insect-pests/ diseases, virus and shall provide necessary certification from registered/competent certifying authority
- ▶ The entire root system of plant must be intact and viable
- ▶ Plants must be supplied by reputed/ registered/ genuine source
- ▶ The plants must be properly packed, tagged and dispatched
- ▶ The fruit plants must be true to type, with a certificate of genuineness from competent authority
- ▶ Pre-tested certificate should be provided

2.1.2. Eligibility criteria

- ▶ Bidder should be reputed organization, agency, nursery having 3 years of experience in the field of production and export (if applicable) of genuine planting material, nursery plants of fruit cultivars for propagation and plantation purpose
- ▶ The bidder should ensure supply of disease-free planting material with certifications for sanitary and phytosanitary standards
- ▶ Bidders should demonstrate experience in raising of fruit plants/ supply of plant material with necessary documents/ brochures of their stocks
- ▶ In case of foreign agencies/bidder's experience in import/export of plants with valid import license.
- ▶ The average annual turnover in last three years may be 1.5 times of estimated contract value which depends on the lot size and the product¹.
- ▶ For foreign agencies, the annual turnover may be 3 times of estimated contract value based on the lot size and product.

¹ User Guide for Prequalification of Bidders Standard Bidding Document December 2021 - 1.5 to 2 times of annualized value of the subject contract

3. Establishment of nursery for planting material multiplication

For area expansion to 10,000 hectare and to cater to the multiplier impact produced by the success of crop in the FLD area and PRF clusters, it is anticipated that success will be replicated in huge numbers and the selected districts will see many farmers/ youths coming for implementation of nurseries and plantation of sub-tropical fruits sensing the potential. For this, quality planting material needs to be produced in the state so that the state becomes self-reliant. The crop wise planting material requirement in the state presented in Table 8 above.

Initial years' requirement can be met through procurement as mentioned in Section 3. It is estimated that the establishment of nurseries and tissue culture unit will take at least 2 years. Some production will start from year 4 as mentioned in Section 4.2. The proposed plan for establishment of nurseries is mentioned below:

Table 12: Establishment of nurseries

S.No	Fruits Crops	Tentative Cost (INR)	Outcome at full capacity (Nos)	No. of Nursery	Altitude
1	Sweet Orange	630 lakhs	2.0 lakh	2	600-800m
2	Pomegranate (Tissue culture lab)	552 lakhs	1.0 lakh	1	600-800 m
3	Guava	226 lakhs	2.0 lakh	2	600-800 m
4	Litchi	101 lakhs	1.4 lakh	1	600-800 m
5	Persimmon	115 lakhs	0.80 lakh	1	800- 1200 m
7	Plum	112 lakhs	1.0 Lakh	1	800-1200 m
7	Mango	128 Lakhs	1.0 Lakh	1	600-800 m
8	Pecan nut	122 Lakhs	0.66 Lakh	1	800- 1200 m

For quality production, it is proposed to establish new mother block in each nursery with insect-pest and disease free, true-to-type mother plants and only then produce variety specific true to type insect-pest & disease-free planting material can be produced. The mother block after establishment will produce shoots which can be grafted/ budded/ layered depending on the crop type.

Note: In Sweet Orange the nursery should be atleast 3-5 km from commercial cultivation to avoid bacterial and viral diseases.

4. Requirements of nurseries

The requirements of nurseries and production schedule of the nurseries are detailed in this chapter. The phasing has been proposed in line with establishment capacity of the mother block and the production of number of bud wood shoots. The recommended type of propagation method for fruit crops is presented below:

Table 13: Recommended propagation method

Crop	Propagation
Sweet Orange	Micrograft
Guava	Patch budding
Pomegranate	Tissue Culture
Litchi	Air layering
Persimmon	Chip budding
Plum	T- budding
Mango	Veneer grafting
Pecan Nut	Whip grafting

The proposed establishment of nurseries meeting the above requirement will require careful site selection, standards for planting material, rootstock, mother block, facilities for day-to-day activities, hardening facilities which are detailed below:

4.1 General requirements of a nursery

For suggested establishment of nursery, some general requirements which need to be taken care are:

- ▶ A well-maintained mother block with proper labelling
- ▶ Maintenance of rootstock block
- ▶ Proper maintenance of nursery records like progeny tree register for mother block, Nursery should maintain the documents of the source of planting material / pedigree, nursery raise register, nursery sale register etc.
- ▶ Proper labelling of grafted/ budded plants like name of variety, date of grafting, rootstock etc.
- ▶ Uniformity in the grafts of a particular variety.
- ▶ Minimum hardening period of three months

4.1.1 Site selection

The establishment of nursery starts with site selection which is the most important step. The major points to be considered during site selection of a nursery are:

- ▶ Nearness of road / easy accessibility
- ▶ Near a habitat
- ▶ Suitable climate as per requirement of the fruit crops to be propagated
- ▶ Neither shady nor exposed area
- ▶ Sufficient sunlight
- ▶ Good irrigation facilities
- ▶ Good soil condition

4.1.2 Mother block

Mother block is the most important part of the nursery as it houses the parent plant from which further plants are developed so it should be well maintained in the nursery or should be from a known

pedigree source. It can be considered as the backbone of the nursery and the health of the planting material depends on it. Successful establishment of a mother block depends upon following factors:-

- ▶ The identity of the plants should be known with verified production potential.
- ▶ Free from insect-pest and diseases assured by indexing for crop specific viruses.
- ▶ Mother plants are very important constituent of a nursery. The success of any nursery depends greatly on the health and vigour of its mother plants. It is therefore necessary to obtain genetically sound mother plants to produce healthy and vigorous offspring.
- ▶ Not only the selection of mother plants is necessary but also proper care and maintenance of these plants are also essential to obtain vigorous and healthy growth. Mother plants should be irrigated regularly.
- ▶ Manures and Fertilizers are given at proper stages. Diseases and pests are controlled by spraying fungicides and insecticides.
- ▶ After care and all operations are carried out to get healthy and vigorous bud sticks. First dose of manures and fertilizers is given in June - July. Second dose is given in September - October.
- ▶ Reproductive growth is strictly avoided. Only vegetative growth is permitted, and maximum bud sticks are produced. Mother plants are kept healthy by regular testing of the planting material for viruses and other organisms. Register record about parents, pedigree and bearing habit shall be kept in office.

4.1.3 Facilities for Nursery

Each nursery should have certain facilities for proper functioning and to carry over the day-to-day activities. These facilities include:

- ▶ Fencing
- ▶ Working platform/ Work shed
- ▶ Net house/shade house / screen house
- ▶ Water source and irrigation facilities
- ▶ Adequate drainage facility
- ▶ Substrate/s
- ▶ Root trainers/grow bags
- ▶ Nursery tools
- ▶ Propagation kits
- ▶ Electricity
- ▶ Storage

The most important material in the nursery is the growing substrate. It should be firm and hard, easy to retain sufficient moisture, porous and have high CEC, free from insect, pest and diseases.

4.1.4 Standards of planting material

Every crop has specific standards for planting material. However, some general standards to be followed for each crop are:

- ▶ Generally, 8-10 months to 1.5 years old
- ▶ Diameter of the shoot should be between 0.50 to 1.25 cm
- ▶ Healthy and vigorous
- ▶ Well-developed root system
- ▶ The root system should not be broken, it should have enough moisture for duration of transport

4.1.5 Environment conditions for hardening

After propagation of the planting material to establish it in the field, gradual acclimatization to the field condition is required otherwise the planting material wither away and die. This process is called hardening. The proper environmental conditions for hardening are:

Table 14: Environment conditions for hardening

S. No.	Steps for hardening	Temperature (°C)	Relative humidity (%)	Light intensity range (Lux)
1	Acclimatization hood made of polycarbonate sheet with ventilation device / Natural ventilated Poly House	25 ± 2	75-95	3000-5000
2	Evaporative cool chamber covered with insect proof net and shaded with agronet with 50 % light intensity	25-30	70-80	5000-10000
3	Polyhouse equipped with intermittent fogging device	25-30	60-80	10000-20000

The media which is used in raising the nursery and is a combination of soil , sand and FYY in a ratio of 3:1:1. Most of the mother plants are being maintained in open field condition except pomegranate and citrus. Mother plants will also be irrigated & fertigated with drip system and should be maintained as per standard POP. Natural ventilated poly house will be used for raising seedling of root stock and grafting on these root stock seedlings and primary hardening. Net house will be used for secondary hardening of the plants till sale or plantation. Fan and Pad controlled green house will be used for maintaining the mother plants of pomegranate and citrus as both are susceptible to many viruses etc. All this infrastructure is equipped with modern irrigation system.

4.1.6 Rootstocks for different crops

It is important to note that Pomegranate is proposed to be multiplied only through Tissue culture. The rootstock for each of the crops is listed below.

Table 15:Crop wise- Root stock

Crop	Rootstock
Sweet Orange	Rangpur Lime/Rough Lemon / carrizo
Guava	Common guava cultivars
Litchi	Common litchi cultivars
Plum	wild apricot / wild peach
Persimmon	Amlok
Mango	Wild mango seedlings
Pecan Nut	Burkett & Nellis

4.2. Specific requirement for each crop Nursery

In addition to above general requirements for fruit crop nursery, each crop nursery has separate requirement which is presented below:

4.2.1. Sweet Orange Nursery

- ▶ Mother plant of identified variety will be planted at a spacing of 3 x 2 m in fan and pad green house.
- ▶ Natural ventilated poly house is selected for raising seedling of root stock, budding and primary hardening
- ▶ Rootstock seeds have to be raised in trays which is transplanted after 60-70 days of seed sowing in poly bags filled with growing media.
- ▶ Micrograft is done on 5 to 6 months old root stock seedling and plants kept under fan and pad controlled green house for 4 to 5 months.
- ▶ Once graft is successful, it is staked and put into shade net house for one to two months for secondary hardening and storage till sale
- ▶ Sweet orange can get infested with large numbers of viruses mainly transmitted through planting material as well as vectors. The major viruses and viroid are:
 - Citrus tristeza virus
 - Citrus yellow mosaic virus
 - Citrus yellow vein clearing virus
 - Citrus greening virus
- ▶ Virus indexing of plant will be done quarterly.



Figure 3: Indexing in nursery plants



Figure 4: Sweet Orange Mother Block

Table 16: Production plan in Sweet Orange Nursery

Sweet Orange Nursery		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	2000										
Plant Spacing (in m)	6										
No of Mother plants maintained / year	333	330	330	330	330	330	330	330	330	330	330
No of micro grafts obtained / plant / year		0	100	200	300	400	400	400	400	400	400
Total No of grafted Plants obtained /year		0	33000	66000	99000	132000	132000	132000	132000	132000	132000
No. of Plants ready for plantation or sale /year (80%)		0	26400	52800	79200	105600	105600	105600	105600	105600	105600

4.2.2. Guava Nursery

- ▶ Seedlings are raised in polyethylene bags of 18x27 cm size during any time of the year.
- ▶ Polyethylene bags are filled with soil, sand and Farm- Yard Manure in 3:1:1 ratio.
- ▶ Vigorously growing plants with 1.25- 2.5 cm in stem diameter, are used as rootstock.
- ▶ Guava rootstocks should be raised in polyethylene bags for better root establishment and to maintain an undisturbed tap root system.
- ▶ One year old, pencil thick, uniform, and active seedlings are selected for budding.
- ▶ The trees from which buds are taken should be highly vegetative with lush succulent growth.
- ▶ Scion is maintained in green house and raising of rootstock, patch budding is also done in greenhouse. After successful budding, plants are hardened.



Table 17: Production plan in Guava Nursery

Guava Nursery		1	2	3	4	5	6	7	8	9	10
Area required to plant MP (in sq.m)	2000										
Plant Spacing (in m)	6										
No of Mother plants maintained / year	333	330	330	330	330	330	330	330	330	330	330
No. Of scion stick/ obtained Plants/year		0	100	200	300	400	400	400	400	400	400
Total no. of grafted plants/ year		0	33000	66000	99000	132000	132000	132000	132000	132000	132000
No. of Plants Ready for Plantation or sale/ year (80%)		0	26400	52800	79200	105600	105600	105600	105600	105600	105600

Fruiting in Guava has been observed at Ghamdhal & Dabrot cluster. It is only in less than two years of plantation. Guava plants are about 2.5 -3.5 ft in height and spreading about 1.5 to 2.0 ft diameter. This means that plants are being maintained with proper and timely application of inputs and T&P by some of the beneficiary. Good vegetative growth can further be enhanced by proper training and pruning of these plants, which is expected in due course of time in targeted clusters.

4.2.3. Pomegranate Nursery

Pomegranate in past has been propagated by cutting or air layering but this method of propagation results in transmission of fungal and bacterial disease leading to high risk of diseases in the orchards. Therefore, tissue culture has been standardised and it is done commercially. The explant is grown in tube and after 6-7 cycle, it is put to rooting Media. Then the plants are primarily hardened, and trading is given in during secondary hardening. The planting material raised is bacterial blight free and timely pruning results in production of sturdy and large canopy to bear more fruits and sustain the load

Table 18: Production plan in Pomegranate Nursery

Pomegranate Nursery		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	200										
Plant Spacing (in m)	9										
No of Mother plants maintained / year	22	22	22	22	22	22	22	22	22	22	22
No. of ex plant per plants/ year		1	600	1000	2000	10000	20000	30000	40000	50000	60000
No. of multiplication rate /plant/year		0	30	40	60	80	200	300	500	500	500
Total No. of plants rooted plants/ year		0	18000	40000	120000	800000	4000000	9000000	20000000	25000000	30000000
No of plants ready for plantaion or sale/ year (95%)		0	17100	38000	114000	114000	114000	114000	114000	114000	114000

4.2.4. Litchi Nursery

- ▶ The most practiced method is air-layering,
- ▶ Air-layering is commercially practiced for large scale multiplication both in public sector and private sector nurseries.
- ▶ Air layering is done during July-August during active growth stage after harvesting. A healthy terminal/peripheral branch receiving good sunshine with a thickness of about 1.2-1.5 cm is selected, with a 2.5 cm ring is made by removing the bark about 45-50 cm below the apical growth. The exposed woody portion is treated with rooting hormone (1000 ppm IBA) is used as paste or powder and covered with a layer of sphagnum moss (20 x 25 cm) of 400-gauge polythene sheet and tied properly at both ends to ensure supply of proper moisture which facilitates the development of roots and the rooting media should be enriched with organic nutrients.
- ▶ The ideal potting mixture standardized by NRC, Muzaffarnagar is 2 parts RBS, 1- part Vermicompost, 1 part coconut pit and 50 g of vermiculite.



Figure 5: Litchi Plant nursery

Root trainer

- ▶ Best root trainer for Litchi is of 500 ml capacity with 12 holes to guide the roots towards base of the cones.
- ▶ The nutrient requirement and pest and disease management is being taken care of.

Table 19: Production plan in Litchi Nursery

Litchi Nursery		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	4000										
Plant Spacing (in m)	9		60	100	200	250	300	300	300	300	300
No of Mother plants maintained / year	444	444	444	444	444	444	444	444	444	444	444
Total no. of Gutti/plant/year		0	50	80	160	300	400	400	400	400	400
Total no. of Air layering plants/year		0	22222	35556	71111	133333	177778	177778	177778	177778	177778
No. of Plants Ready for Plantation or sale /year (80%)		0	17778	28444	56889	106667	142222	142222	142222	142222	142222

The number of gutti/plant is higher is based on the observation that Litchi plants at both Binga & Harabag are of very good health and quality, having uniform vegetative growth and about 2.5 to 3.5 ft in height. This has happened even when irrigated with only water overflown from Bhakra Nagal Dam and timely care of each operation to maintain good growth.

4.2.5. Persimmon nursery

- ▶ Persimmon seedlings are commonly propagated through chip budding
- ▶ Seeds are sown in 6- 7 cm deep containers.
- ▶ When seedlings are 6- 7 cm high, they are transplanted to deep plastic planting bags 15.2 x 45.7 cm or to nursery beds.
- ▶ At that time, the bottom one-fourth of the taproot is pruned to encourage lateral rooting.
- ▶ Budding is done during the dormant season on rootstock stems that are at least 9 mm in diameter.
- ▶ Scions with two to four buds from the previous season's growth are used.
- ▶ After budding, the scion should be enclosed in a plastic bag to maintain high humidity.
- ▶ Cool temperatures not preferable for seed germination.
- ▶ Most suitable time is April
- ▶ The favoured rootstock is Indian Persimmon known as Amlok

Table 20: Production plan in Persimmon Nursery

Persimmon Nursery		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	4000										
Spacing in sq. m	12										
No of Mother plants maintained / year	333	330	330	333	333	333	333	333	333	333	333
No. of bud stick obtained /plant/ year		0	50	100	200	300	300	300	300	300	300
Total No. of grafted plants obtained / year		0	16500	33300	66600	99900	99900	99900	99900	99900	99900
Plants ready for plantation or sale / year (80%)		0	13200	26640	53280	79920	79920	79920	79920	79920	79920

4.2.6. Plum nursery

- ▶ True-to -type and disease free
- ▶ Plums need to be planted where they receive at least 8 hours of full sunlight.
- ▶ Plum is raised on seedling rootstock of wild apricot or sometimes on its own like Kala Amritsari
- ▶ The rootstock is raised through seeds or hardwood cuttings.
- ▶ To improve rooting use 2500 ppm IBA
- ▶ The scion wood is collected from 1-year-old shoots with 0.8-1.2 cm thickness
- ▶ Best time of T-budding in Feb (Lower elevation) and March (Higher elevation)
- ▶ Planting of plum should be done in December-January when plant is in dormant condition
- ▶ Choose a plum tree that has well-developed buds, which are a brownish colour. Cut the branches with the buds off the tree using your gardening shears.
- ▶ Cut the leaves off the branch so that only the buds are left behind.
- ▶ Wrap the branches in moist burlap to keep them from drying out.
- ▶ Cut a small T-shape into the bark of a mature branch where you will graft the bud. Make this cut about 15 inches from the trunk of the plum tree.
- ▶ Gently lift the corners of the bark to loosen it, using the tip of your knife.
- ▶ Repeat the T-shaped cuts for each branch where you plan to graft a bud.
- ▶ Cut the buds you want to graft from the sticks you have wrapped in moist burlap. Make small incisions around the bud and gently cut away using the tip of your knife.
- ▶ Place one bud into each of your T-shaped cuts tightly.
- ▶ Wrap each graft with adhesive tape, such as electrician's tape. Wrap the tape tightly around the T-shaped incision, but don't wrap the bud.
- ▶ Leave the buds wrapped until the following spring but check their progress periodically until then.
- ▶ Once the bud begins to grow, cut away the branch above the bud so your plums will grow.

Table 21: Production plan in Plum Nursery

Plum Nursery		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	4000										
Plant Spacing(in sq. m)	9										
No of Mother plants maintained / year	444		444	444	444	444	444	444	444	444	444
No of scion stick obtained / plant / year			50	100	150	300	300	300	300	300	300
Total No. of grafted plants obtained /year			22200	44400	66600	133200	133200	133200	133200	133200	133200
Total no. of plants ready for plantation or sale/ year			17760	35520	53280	106560	106560	106560	106560	106560	106560

4.2.7. Mango Nursery

- ▶ The most successful method used for mango is veneer grafting.
- ▶ In this method 1-2-year-old (50 mm diameter) rootstock is used.
- ▶ The scion is also selected of similar thickness having 3 to 4 months age, preferably a terminal non-flowering shoot.
- ▶ The selected scions are defoliated on the mother plant about 7 to 10 days prior to detaching, keeping a part of petiole intact on the selected terminal shoot.
- ▶ This helps in forcing the buds to swell and increasing the percentage of success in grafting. This method can be adopted from March to September, preferably from July to September.
- ▶ A slanting downward and inward cut, 2.5 to 4.0 cm long, is made on rootstock 15 cm above the crown portion of stock. At the base of cut, another shorter cut is given to intersect the first, to remove the piece of wood and bark.

- ▶ The base of scion is given a long cut along one side and a very short cut on the opposite side to match the cuts on the stock.
- ▶ The scion is inserted into the stock so that the cambium layers match on the longer side.
- ▶ The graft union is tied lightly with transparent polyethylene (200 gauge thickness) strip.
- ▶ When scion shoot starts growing and produces the vigorous sprout, the rootstock just above the graft union is cut back.
- ▶ Then care and maintenance of graft is done in nursery. The percentage of success is about 96 per cent when done in June and July.

Table 22 Production plan for Mango Nursery

Mango Nursery		1	2	3	4	5	6	7	8	9	10
Area required to plant MP (in sq.m)	4000										
Plant Spacing (in m)	9										
No of Mother plants maintained / year	444	444.444	444	444	444	444	444	444	444	444	444
No. of scion stick/ obtained Plants/year		0	10	50	150	250	400	400	400	400	400
Total no. of grafted plants/ year		0	4444	22222	66667	111111	177778	177778	177778	177778	177778
No. of Plants Ready for Plantation or sale/ year (80%)		0	3556	17778	53333	88889	142222	142222	142222	142222	142222

4.2.9. Pecan nut Nursery

- ▶ Mother block to be planted in open field
- ▶ Mother block varieties should be true to type obtained from reliable source.
- ▶ All the care of mother block should be taken to keep it free from diseases and pest
- ▶ Seed should be sown during the month of Feb. on either raised seed bed or in plastic trays
- ▶ As the seed germinate and plants are of 3-4 leaves pair, then prick out the plants and transplanted in poly bag filled with growing media
- ▶ Scions should be cut from the previous season's growth of a productive tree. Scions should be straight and smooth, measuring ¼ to 5/8 inches in diameter. They should be long enough (6-8 inches) for three to four healthy buds and should be insect and disease free. Water sprouts often work well as scion wood.
- ▶ Graft wood can be used immediately, and storage may not be necessary.
- ▶ Most practised method is whip grafting
- ▶ Immediately after making the graft, wrap it with plastic grafting tape, string or a rubber band so that the scion will be held in proper position with the stock.
- ▶ Bank soil around the scion and stock, leaving one or two buds exposed on the scion.
- ▶ Remove soil after 5 to 8 inches of new growth has developed. For older trees, wax or seal the wrapped cut area with Parafilm.

Table 23: Production Plan for Pecan nut Nursery

Pecan nut Nursery		1	2	3	4	5	6	7	8	9	10
Area required to plant MP (in sq.m)	3000										
Plant Spacing (in sq. m)	9										
No of Mother plants maintained / year	333	333.333	333	333	333	333	333	333	333	333	333
Total no. of Grafts/plant/year		0	20	40	60	80	120	150	250	250	250
Total no. of Grafted / Budded plants/year		0	6667	13333	20000	26667	40000	50000	83333	83333	83333
No. of Plants Ready for Plantation or sale /year (80%)		0	5333	10667	16000	21333	32000	40000	66667	66667	66667

5. Supporting services

The supporting services includes requirements of packaging materials, labels to be included on packaging material, transport requirements, testing facilities for water and soil testing, quarantine facilities for imported rootstocks/planting material. These facilities are detailed below:

5.1. Packaging and Labeling requirements for planting material

The package should be strong enough to maintain the planting material in the best possible condition during storage and transport. It is better if planting material is transported in the same container in which they were developed. Transporting bare rooted material has its drawbacks as it causes damage to the plant.

- ▶ Package should be strong enough to hold handling and transport
- ▶ Tissue culture media to be transported in culture tubes
- ▶ Seedlings to be transported in grow bags, root trainers etc.

The Labels need to be clearly mentioned so that there is no damage to the plant and transporter is aware about the sensitivity of the material they are transporting.

- ▶ "LIVE Plants"-Should not be subjected to extreme heat and cold
- ▶ "THIS WAY UP"-so they are not mishandled
- ▶ Name, Address and Telephone number

5.2. Transport requirements

The utmost requirement is that the planting material from the suppliers should reach the destination at the day of planting/or one day prior. The field should be ready for planting otherwise the quality of the planting material deteriorates. The other precautions to be taken are:

- ▶ Seedlings should not be placed one above the other on the floor of the transporting vehicle, containers, etc. to avoid damage.
- ▶ Plant should be packed for delivery in such a manner as to ensure protection against climatic, seasonal, or other injuries during transit.
- ▶ Special care should be taken for prompt delivery and careful handling in loading and unloading.
- ▶ Plants need to be transported in an enclosed truck or trailer, or they may be moved in an open trailer if sufficient wind protection (netting) is provided to prevent damage to sensitive leaves
- ▶ Precaution should be taken not to disturb soil ball during transportation and storage.
- ▶ Minimize time between transportation and planting of planting material
- ▶ Plants are damaged during transport to the planting site. Therefore, adequate care must be taken to avoid mishandling of plants during loading and unloading from vehicles.
- ▶ It is important that the containers are packed tightly, so that they cannot move as the movement cause damage
- ▶ Special shelves for stacking pots or trays can be added to the vehicle platform
- ▶ Gap between one shelf and other will be about 50 centimetres above the other.
- ▶ Plants should be transported in the planting season on cool, cloudy, or even rainy days to prevent desiccation during transport.
- ▶ Shipping schedules should be planned to avoid delays and to allow proper disposition of the plants immediately upon arrival.
- ▶ Normally, plants should arrive one day ahead of planting; where shade and watering facilities are available, supplies can be brought several days in advance.
- ▶ As soon as the plants arrive at the planting site, they must be watered and, if necessary, heaped-in in a cool, moist, shaded place until they are needed for planting.

5.3. Common possible errors in nursery

Some of the common possible errors noted in the nursery and precautions to be taken care of are mentioned below:

- ▶ Containers are not filled properly
- ▶ Containers are not in upright position
- ▶ Soil or sand used in germination beds not changed after each production cycle.
- ▶ Sowing seed too deep
- ▶ Lifting transplant seedlings individually and wrenching them
- ▶ Exposure of seedlings to air after lifting
- ▶ Bad transplanting and delayed transplant to container beds
- ▶ Leaving air space around the root of the young seedling after transplanting
- ▶ Bad root pruning while transplanting
- ▶ Inadequate attention paid to root pruning in transplanted containers before transporting to field.

5.4. Testing facilities

Testing facilities should be established at University/Research station, Neri.

Soil Testing

The major test to be considered in soil testing are Growing media pH and electrical conductivity (EC) as this will help in selecting appropriate growing medium and fertilizers and help in nutrient management of the nursery.

pH of the grow media

Media pH affects how soluble nutrients supplied by a fertilizer will be in growing media, especially micronutrients such as iron. Soluble nutrients are the only ones available for uptake by roots. As media pH increases, solubility of most of the micronutrients decreases. Therefore, micronutrient toxicity symptoms are common in plants grown at excessively low pH, whereas micronutrient deficiency symptoms can occur at high pH.

Electrical conductivity of the grow media

Media EC is a generic measurement that tells you how much salt is contained in growing media. In most cases, the salt is from fertilizers applied to the crop, but it can be made up of non-fertilizer ions such as sodium or chloride (table salt). A low media EC indicates lack of available nutrients (leading to nutrient deficiency), whereas a high media EC indicates excess nutrients (leading to nutrient toxicities, or damage to sensitive roots).

Instrument needed

- ▶ pH meter
- ▶ EC meter

These are low-cost instruments which can be kept at the each nursery.

Testing of water

Criteria to be considered while determining the source of water are: Level of contaminants and debris, storage capacity to fulfil needs during the most demanding time periods (June-August), reliability of source, environmental and legal limitations which may be placed on natural water source

Water quality is a vital component and testing the water from source prior to nursery site selection is critical. The acceptable value of total soluble salts is between 175-525 ppm, with sodium levels between 20-40 per cent of the total salt (ideal level is less than 175 ppm salts and 35 ppm sodium).

Good water quality is essential for healthy plant development. Saline water should be completely avoided. Treating water with low concentrations of chlorine (1 ppm) helps to control water moulds.

Testing of mother plants

The vegetative propagation of fruit crops makes them vulnerable to transmission of several diseases and pests through the mother plant. Thus, importance of testing of material in the process of its preparation at various stages needs due attentions.

Mother plants are kept healthy by regular testing of the plant material for viruses and other organisms. Register record about parents, pedigree and bearing habit is kept in office.

Testing of planting material

The inspection authorities/laboratories should have following equipment for laboratory diagnosis of pests such as insects/mites; nematodes; fungi & bacteria

Entomology

- ▶ Insect storage cabinets/mounting boards
- ▶ Soft X-ray Scanner & Film Developer to develop insect images. Can also be used for quality evaluation of produce
- ▶ Stereobinocular microscope fitted with Image grabber

Nematology

- ▶ Nematode Extraction Unit
- ▶ Fenwick can
- ▶ Baerman funnel
- ▶ Sieve set
- ▶ Stereo binocular microscope
- ▶ Compound Binocular Microscope
- ▶ Microscope accessories (slides/cover slips; ocular/stage micro meters; camera lucida)

Plant Pathology

- ▶ Laminar flow
- ▶ BOD Incubator
- ▶ Autoclave
- ▶ Hot air oven
- ▶ Digital top pan balance
- ▶ Analytical Balance
- ▶ Hot Plate with Magnetic Stirrer
- ▶ pH meter
- ▶ Haemocytometer
- ▶ Inoculation loop or needle
- ▶ UV fluorescent lamp
- ▶ Distilled Water Unit
- ▶ Deep freezer (-20C)
- ▶ Compound trinocular microscope fitted with Photomicrographic Equipment
- ▶ Vacuum cleaner
- ▶ A set of laboratory chemicals (for preparation of media/stains/reagents etc.)
- ▶ A set of laboratory glassware (beakers, conical flasks, measuring cylinders, pipettes, Petri dishes, test tubes, etc.)
- ▶ Microscope accessories (slides/cover slips; ocular/stage micrometers; camera lucida)

Special Equipment for Molecular Diagnosis of Bacteria/Viruses

- ▶ Tissue grinder
- ▶ Micropipettes (varying volumes)
- ▶ Micro plates (for ELISA Test) / ELISA kit (reader, washer, reagents)
- ▶ Nitrocellulose membrane (for DIBA test)
- ▶ Immuno-diagnostic reagents (Specific Antisera/Enzymes/substrate/buffers)
- ▶ PCR with PCR Tubes
- ▶ Horizontal Gel Electrophoresis Unit with power pack
- ▶ Hybridization Oven
- ▶ Gel Documentation Unit with printer
- ▶ Micro-centrifuge & Eppendorf tubes
- ▶ Nucleic Acid Chemicals (Specific Primers/TAQ DNA Polymerase/buffers/stains etc)
- ▶ Rnase Kit

Nematodes

- ▶ A Laboratory Analysis of Soil, Root, or Shoot System Tissue for Necessary Diagnosis or Long-Term Avoidance of Plant-Parasitic Nematode Problems.

5.5. Certification facilities

The primary objectives of the certification program is to limit pathogen incidence in plant material to minimize losses by growers and prevent movement of harmful pests and pathogens that may harm the environment. For many fruit and nut crops, orchards are expected to remain productive for years or decades; thus, starting with plants of high health status is essential. The components of certification programs aim to facilitate plant movement without increasing trade in plant pathogens. The facilities ensure that:

No consignment of plants and plant products, if found infested or infected with a quarantine pest or contaminated with noxious weed species shall be permitted to be imported.

Every container carrying out planting material shall be inspected on board by an officer duly authorized by Plant Protection Adviser before the same accorded permission to off-load it at the notified port of entry.

On inspection, if found free from quarantine pests and noxious weed species, permission shall be accorded to off-load at the port or provide fumigation treatment order fumigation/treatment immediately upon unloading at the port before such permission is granted for movement outside the port and subject to such conditions as imposed thereon.

Every effort must be made to prevent the entry into India of exotic pests, diseases and weeds that are detrimental to the interests of the farmers.

Phytosanitary certificate

Every consignment of plant species shall be accompanied by an original Phytosanitary Certificate issued by the authorized officer at country of origin.

6. Nursery models for targeted fruit crops

This section presents the financial analysis for the Public-Private Nursery Models for the respective fruit tree crops demonstrating the on-farm income generating activities by group of farmers or a rural entrepreneur in partnership with the Department of Horticulture, Government of Himachal Pradesh. The financial analysis shows that nurseries are profitable and sustainable. Upgrading of the public nurseries has not been suggested considering the financial viability and business proposition. The financial analysis aims at demonstrating that, from a financial benefits perspective, all the nursery development project is viable, considering, all quantifiable and additional costs and benefits within the project situation.

6.1. Data Sources and General Assumption

a. Sources:

The data used in this analysis have been collected from various sources. This includes nurseries visited by the Mission members, discussions with the Department of Horticulture, Government of Himachal Pradesh. Data were collected from Solan University Officials, private nurseries in Kotla and Solan, KVK, Research Centre at Kandhaghat, College of Horticulture and Forestry Neri, Hamirpur, Research Centre at Jachh, CSKHPKV Hill Agricultural Research & Extension Centre at Dhaulakuan, and Jain Irrigation, Jalgaon. Additional data were collected through interviews with farmers and entrepreneurs during the field visits. Information was collected on labour and inputs requirements for various nursery operations, capital costs, prevailing wages, and nursery gate price of saplings and market prices of saplings from out of the state. In addition, studies were used as source of technical information related to nursery development and tissue culture labs currently being run in the country. The other assumptions are:

- 1) All the nurseries will be owned and run by the Promoter/ entrepreneur or a group of entrepreneurs.
- 2) The Government may provide a grant / subsidy for project viability (attract private partners to create demonstration project).
- 3) In the case of the Tissue Culture Lab cum Pomegranate nursery, the enterprise will be a Public-Private Partnership, which will be run and managed by the promoter/s with advice from the DoH.

b. Prices:

Input and output prices are of January 2021 and expressed in constant terms. Financial prices have been collected in the project area during the field visit. For other commodities, given the general lack of distortion in the economy, the opportunity cost of traded items is equal to their market price, hence the market price is a fair measure of the willingness to pay and is the best estimate for the opportunity cost. Therefore, financial prices are found to be reliable approximations of their economic value for most of the items used in the analysis of the nursery model, although in this case we have limited the models to only financial analysis. The financial prices have been subsumed in the cost assumptions made in each of the models.

c. Cost of Labour:

The standard salary for nursery Manager, Assistant Manager and Supervisors in the project area were taken as prevailing salaries in 2021. These salaries are impacted by inflation rate prevailing in the state of Himachal Pradesh. Both semi-skilled and unskilled labour rates are around INR 350 to INR400 in the project area. It is noticed that even at peak periods the demand for unskilled labour is met because of the MGNREGA program of the Government, it would be the same under with project situation.

d. Valuation of Family Labour:

As these nurseries will be run in the public-private mode, it is assumed that no family labour will be used and instead, unskilled, and semi-skilled labour from the labour market of the project area will be used. The models present the results without counting family labour. This has been done to make sure that the partnership is able to cover the cost of labour needed in the model from the labour market in the project area

e. Nursery plants production Model and the Tissue Culture Lab:

In the present case, the production models represent the best practice models, which have been established after benchmarking the best nurseries in northern and western India. These models are income generating activities for an entrepreneur or a group of entrepreneurs (Farmer Associations), which will also generate employment in the rural areas, while these nursery models represent enterprise and existing business that would benefit from loans to be organized through institutional finance linkage in HPSHIVA. These loans will be small or medium enterprise finance. The models show the incremental revenues and costs generated by the new investment which would be partly 70% grant in the form of back ended subsidy. EY team has analysed various schemes supporting establishment of nurseries. It is understood that NHB provides a subsidy component of 40% for general area and 50% for Hilly areas³ subject to a ceiling. However, some of the states like Maharashtra provides 75% subsidy component whereas Haryana provides 90% of credit linked subsidy⁴. Hence, it is proposed to have a model of 50:50 (Grant: Promoter & Lenders) to attract the private entrepreneurs.

Table 24 Price of saplings collected during nursery surveys

EY team established the selling price of saplings for revenue calculations by considering the following factors:

a) surveying the public sector and private sector selling price locally and nationally. The price shared by the nurseries is as shown, which gives a fair idea of the range of prices².

Crop	Min price (INR)	Max price (INR)
Citrus	60	250
Guava	60	100
Litchi	60	80
Pomegranate	50	60
Mango	70	100
Plum	100	130
Persimmon	100	150
Pecan nut	250	400

b) Other factors which have been considered are:

- ▶ simulating to arrive at a minimum viable price where the IRR will be above the cost of capital and NPV remain positive.
- ▶ Additionally, considered selling price by ensuring that the payback period is within the project horizon (10 years)

f. Financial analysis was carried out based on:

a) representative of nursery costs and activity model of production of saplings/seedlings using prevailing production patterns and looking at incremental costs and benefits due to the project intervention, and

b) representative income generating enterprise models related to HPSHIVA.

² Information collected from Department of Horticulture, CISH Lucknow and private nursery- Kamal nursery

³ Commercial Horticulture Scheme, Cost Norms. National Horticulture Board,

⁴ Horticulture Establishment and Strengthening Scheme. Government of Maharashtra

6.2. Nursery Development Project Benefits

6.2.1. Quantified Benefits

The nurseries are essentially rural enterprises, which are an important node in the sub-tropical horticultural value chains of the target crops. Out of the selected target crops Pomegranate planting material will be developed with Tissue culture technology. Since the nurseries will have the comparative advantage of commercial production of saplings and seedlings catering to the prevailing demand for sapling/seedlings in the state, the major benefits derived from the project's component on nursery development will consist of the following:

- ▶ Increased benefits with improved production technologies, and enhanced access to markets through the project HPSHIVA value chain activities
- ▶ Access to timely and high-quality seedlings/saplings coupled with the improved techniques for propagation used
- ▶ Better management of saplings from high quality plant management information to be provided as after sales service by the nurseries; and
- ▶ High possibility of improved production and yield from plants that are disease free and healthy

Whilst farmers will have the above benefits, the entrepreneurs who will be partnering with the Department of Horticulture will have the following benefits from the project:

- ▶ Improved remunerative business opportunities and wage employment creation in the rural areas; and
- ▶ Better access to specially tailored financial services (loans, and insurance), coupled with technical assistance from the Department of Horticulture

6.2.2. Non-quantified Benefits

By supporting rural entrepreneurs in nursery development through a public-private mode, the HPSHIVA would reach the primary beneficiary groups in terms of knowledge transfer and high-quality planting material. It is envisaged that better financing would be provided through various government schemes and through the Kisan Credit Card instrument loans with soft interest rates for establishing necessary back ward linkage with the nurseries and forward linkage with the market for all the selected value chains, where the fruit tree nurseries are a critical node in the value chain.

In addition, the nursery development component of the project is expected to generate non-quantified benefits in terms of capacity building and empowerment of the farmers and youth involved in the cluster orchards.

- ▶ Increased understanding of and competence in the technical, and financial aspects of running a nursery production unit who then become leaders in dissemination of technology and knowledge to farmers and rural youth.
- ▶ Enhanced capacity for business and financial planning to enable direct investment in the nursery business and improve services to fruit tree growing farmers
- ▶ Entrepreneurs enhanced capacity for business and financial planning to enable direct investment in the sub-tropical fruits sub-sector; and
- ▶ For women in particular, the capacity and opportunity and confidence to move from unskilled to skilled labour

India is an emerging market with a large fruits consuming population. Most fruits are sold in the retail markets, grocery stores, supermarkets and by street vendors. Our study has shown that the trend in the sub-tropical fruit's consumption is increasing. With the increase in domestic demand for sub-tropical fruits there is a natural pressure to increase production. Currently the demand for fruit tree saplings is high in the state, and most of the demand is met by procuring from outside the state. The

production of saplings within the state will gradually phase out a certain portion of what it is currently being procured from outside the state.

6.2.3 Production linked incentives

Production linked incentive scheme may be introduced where incentives shall be provided on incremental sales over base year from targeted crops' nurseries, like the existing New Central Sector Scheme "Production Linked Incentives Scheme for Food Processing Industry" (PLISFPI)¹. This will encourage entrepreneurs to invest in nurseries establishment and thus both existing and new nurseries will strive to increase the planting material sales to meet the planting material demand.

6.3. Fruit Tree Nurseries and the Subtropical Value Chains

The HPSHIVA project is going to invest in the development of the value chains of Sweet Orange, Guava, Pomegranate, Litchi, Plum, Persimmon, Mango and Pecan nut. Presently these fruits have a growing demand to be consumed fresh as well as for processed and value added. The growing domestic demand of these fruits have been met through domestic production and through imports. As an emerging economy, the country has been exporting as well as importing fruits, having an overall growth in export and a positive balance of trade position. To meet with this growing domestic and export demand for sub-tropical fruits the domestic production in a fruit growing state like Himachal Pradesh will have to be in terms of increase in production through increased yield and increased cropped area. Hence developing nurseries in the state to cater to high-quality disease-free planting material is an important step in meeting both the objective of quality planting material and to expand production area.

6.4. Financial Analysis

The project is promoting value chains of all the selected fruit tree crop and commercial nursery models are developed for this purpose. Only pomegranate will be produced in a Tissue culture laboratory. The nine models including the tissue culture lab illustrates the mode of public - private partnership and the need for small and medium enterprise credit that will be required along with grant financing or provision of Government subsidies.

The present analysis looks at the financing that will be required and that could be availed as grant financing for participating in a public -private mode in the project- after allowing for loan receipts and debt service including interest payments and repayment of principal, which together gives the net financing - to reach the net benefit after financing.

The following assumptions cut across all the fruit nursery models:

- ▶ Separate block for mother plant of a single variety is to be maintained
- ▶ Production schedule is based on number of mother plants maintained. The schedule is provided in Annexure V.
- ▶ It is also the basis of number of grafts/explant/buds/scion stick obtained per plan of targeted fruits crops
- ▶ Production of plants will start from fourth year. Hence, it is required to establish all facilities and its pre-requisite in the first year of the project.
- ▶ Production of Tissue Culture plants of pomegranate is proposed to maximum capacity of one lakh plants.

¹ Production linked incentive for Food Processing Industry. Central Sector Scheme. Ministry of Food Processing Industries. Government of India.

- ▶ Around 7.32 lakhs plants on an average will be produced per year. The number of plants for each target plants are presented in Annexure V.

- ▶ There is possibility of increasing production for each target fruit tree crop by extending the facilities
- ▶ Minimum selling price per sapling/rooted plant is considered for assessing the viability of the model as an enterprise. If selling price is increased, then the net worth of the model will increase and reduce the payback period. All nursery models are viable covering all the likely scenario and facilities.

For small and medium enterprise financing for developing the state of Himachal Pradesh's internal capacity, we are focusing on nursery models for 8 fruit saplings, of which one is a Tissue Culture Lab cum nursery. The analysis carried out is based on the models showing the "with" project situation. Table 25 shows the financial benefits from target fruit tree nurseries.

Table 25: Summary of Financial Benefits from target fruit tree models in INR

Model Nursery	Total Investment (INR lakhs)	Grant / Project Assistance in Lakhs	Promoter (Debt) in lakhs	NPV	IRR (%)	PBP (Year) [#]
Sweet Orange	3,15,08,933	1,57,54,467	1,57,54,467	62,59,190	13	9
Guava	97,33,680	48,66,840	48,66,840	70,48,759	22	7
TC Lab cum Pomogranate	2,46,45,908	1,23,22,954	1,23,22,954	74,33,169	17	8
Litchi	1,01,37,441	50,68,720.5	50,68,720.5	37,84,118	16	9
Persimmon	1,19,60,641	59,80,320	59,80,320	26,66,109	15	9
Plum	1,40,39,471	70,19,735	70,19,735	32,46,156	16	9
Mango	1,28,04,733	64,02,367	64,02,367	47,49,671	17	9
Pecan nut	1,22,07,505	61,03,752	61,03,752	7,68,760	13	10

Note: Grant/ Project assistance to Promoter (Debt) is considered as 50 :50 for fruit crop nurseries establishment.

#- Years after establishment of nursery (excluding first 2 years- 2023, 2024 for preparatory work/ site selection/ construction/ establishment of nursery).

The sale prices of plants in nurseries have been fixed based on following points:

- ▶ the nurseries will start minimal production in 2026 after establishment and thereafter substantial production will start as mentioned in Table 26. Hence, by considering the inflation rate, the prices of plants will be higher.
- ▶ the prices were adjusted with the cash flow and IRR so that the price of sapling is at a rate that the nursery enterprise remains viable in terms of the NPV and IRR.
- ▶ the price considered also reflects quality of product, in these nurseries which will produce disease free and healthy saplings and of better quality which will sell at a higher rate.

6.5. Fruit Tree Nursery Models for upgradation / establishment of new nurseries

The existing public nurseries in sub- tropical districts have limited production capacity of selected fruit crops' planting material. However, some of the PCDOs/ public nurseries have land and basic facilities (water supply, accessibility, open ventilated greenhouses) available. Under this project, these PCDOs/ public nurseries can be upgraded in terms of infrastructure facilities and enhance production of planting material of the sub- tropical fruits in line with agro- climatic suitability as proposed in Section 3.

Some of the public nurseries which may be considered for upgradation as discussed with Deputy Director of Horticulture based on availability of land are Hara bagh in Mandi, Jhullar (Shahpur) in Kangra, Bhumpal (Nadaun) in Hamirpur districts. As the upgradation of existing nurseries may require almost all the facilities, the nursery models for establishment of new nurseries as discussed in detail below, may be applicable for upgradation as well.

The production plan considered for each of the nurseries, as also discussed in section 3 and 4 is mentioned below:

Table 26: Production schedule from proposed fruit crop nurseries

Particulars			Production Schedule									
Nursery wise production plan	2023	2024	2025 Year 1	2026 Year 2	2027 Year 3	2028 Year 4	2029 Year 5	2030 Year 6	2031 Year 7	2032 Year 8	2033 Year 9	2034 Year 10
Sweet Orange Nursery	Preparatory phase		-	26,400	52,800	79,200	1,05,600	1,05,600	1,05,600	1,05,600	1,05,600	1,05,600
Guava Nursery			-	26,400	52,800	79,200	1,05,600	1,05,600	1,05,600	1,05,600	1,05,600	1,05,600
Pomegranate Nursery			-	17,100	38,000	1,14,000	1,14,000	1,14,000	1,14,000	1,14,000	1,14,000	1,14,000
Litchi Nursery			-	17,778	28,444	56,889	1,06,667	1,42,222	1,42,222	1,42,222	1,42,222	1,42,222
Parsimmon Nursery			-	13,200	26,640	53,280	79,920	79,920	79,920	79,920	79,920	79,920
Plum Nursery			-	17,760	35,520	53,280	1,06,560	1,06,560	1,06,560	1,06,560	1,06,560	1,06,560
Mango Nursery			-	3,556	17,778	53,333	88,889	1,42,222	1,42,222	1,42,222	1,42,222	1,42,222
Pecan nut Nursery			-	5,333	10,667	16,000	21,333	32,000	40,000	66,667	66,667	66,667

It is important to note that the first two years 2023, 2024 are considered for the preparatory work for establishment of nurseries. The respective years mentioned in the below narrative is after the preparatory stage and the same reference has been used for revenue calculations in each nursery model.

Nursery Model of Sweet Orange

The proposed nursery model for sweet orange is based on latest technique of micrografting which will be used to produce saplings in poly house supported by drip irrigation leading to developing high quality disease free, healthy sweet orange saplings. The details of propagation technology and specific requirement of sweet orange is discussed in Section 4.

The proposed nursery model illustrates a typical Sweet Orange nursery of with 333 mother plants raised in 4,000 square meter area. With the project, the mother plants will be irrigated for 365 days of the year. The entrepreneur is going undertake seed bed preparation, seed sowing, quality analysis and maintenance. Likewise, preparing poly bags with growing media, filling, planting, and pest and disease management. This model is to produce around 1Lakh saplings. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

The fixed cost will be invested to establish the nursery in year 1 after preparatory phase. In this case, production of saplings will begin form second year after establishment of nursery. It is assumed that the nursery will produce 26,400 saplings in the second year, 52,800 in the third year, 79,200 the fourth year, 1,05,600 the fifth year onward after establishment. The price of saplings is INR 200 per sapling is based on survey of saplings locally as well as rationally so that entrepreneur gets enough value in the first year of production, the future price will be adjusted with inflation rate of 5.6%. The project horizon for producing the saplings is 10 years. The full development of the project will start from second year onward. The total investment is divided into fixed costs and variable costs. Replacement costs include mainly shade-net house nets, fan and pad controlled green house and natural ventilated polyhouse, and poly tunnel plastics (every two to four years) which will be easily covered from the revenue from sales. It is assumed in this case 5% shade net would be damaged and replaced every 4 years, and similarly 25% of the plastics in the polyhouses.

The model is proposed to have a total investment cost of INR 3.15 Cr, which would be finance up to 50% by the Government as Grant/Subsidy and the rest of the investment (50%) would be financed by promoter, who would borrow from a commercial bank, or other institutional finance instruments for small and medium enterprises. The total amount of the loan amounts to INR 1.57 Cr, which would have no grace period. The model shows that the principal of the loan would be repaid in 5 equal

annual installments of INR 31.5 lakhs over a 5-year period at a simple interest of 12%. The total amount that would be repaid after 6 years is INR 2.3 Cr.

A positive cash flow seen from the 4th year and repayment of the principal from year-2 onward. The entrepreneur would be able to repay the loan, but there would be a drop in the cash flow for two consecutive years. A discount rate of 12% was used for the calculation. Project revenue was calculated based on the total annual production of saplings and the price of sapling in the first year at INR 185 per sapling with change in price over the period of the project based on an inflation rate of 5.6%. The model is viable with a positive NPV of INR 62.6 lakhs and an internal rate of return of 13% where the project can pay back by the 9th year.

Nursery Model of Guava

This guava nursery model shows an improved nursery for developing healthy disease-free Guava seedlings with patch budding technique. With project investment, the model shows the raising of 333 mother plants in an area of 2000-square meters, which will be using shade net houses and naturally ventilated polyhouse, to raise 1,00,000 saplings annually. The details of propagation technology and specific requirement of Guava is discussed in Section 4.

After preparatory phase, the nursery would produce 26,400 saplings in the second year, 52,800 saplings in the third year, 79,200 saplings in the fourth year and 1,05,600 saplings annually thereafter. The Guava saplings would be sold at the rate of INR 150 per sapling, which in later years would increase because of inflation which is estimated to be 5.6% for this model for Himachal Pradesh. A project horizon of 10 years is considered. The full development of the project would start from first year onward. The total investment is divided into fixed costs and variable costs, where the variable cost is spread over the rest of the project period. Replacement costs include mainly shadenet of shade net house, and plastics of polyhouses, which will be easily covered from the revenue from sales. It is assumed that 5% shade net would be damaged and replaced every 4 years along with 25% of plastics of polyhouse. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

The model is proposed to have a total investment cost of INR 97.33 lakhs, which would be financed up to 50% by the Government as a Grant/Subsidy and 50% by a promoter, who would take a loan from a commercial bank, or other institutional finance product for small and medium enterprises. The total loan amounts to INR 48.66 lakhs, which would have no grace period. The debt is serviced by repaying the principal amount in 5 equal installments over a period of the project at a simple interest of 12%. The total amount to be repaid after a period of 6 years would be INR 72.02 lakhs. It shows that the entrepreneur would be able to repay the loan without any drop in the cash flow. A discount rate of 12% was used for the calculation. Project revenue was calculated based on the total annual production of saplings and the price of saplings. In the first year of sale the price is INR 150 per sapling with change in price over the period of the project based on an inflation rate of 5.6%. The model is viable with a positive NPV of INR 70.49 lakhs and an internal rate of return of 22% where the project would be able to pay back by the 7th year.

Model for Tissue Culture Lab cum nursery for propagation of Pomegranate

A Tissue Culture Lab cum pomegranate nursery is proposed for the propagation of 100,000 rooted seedlings of pomegranate each year. This would be established as a Public- Private model with a total investment of INR 2.46 crores, where 50% of this investment would be a public grant, or a subsidy from the government and the remaining 50% (INR 1.23Cr) would be a loan taken by the Promoter, or by a group of entrepreneurs from a commercial bank, or other institutional finance instruments for small and medium enterprises. The details of propagation technology and specific requirement of Pomegranate is discussed in Section 4.

The Lab would be established in a land measuring one hectare either provided by the state government or taken on lease from private owner. In either case land lease rent will be paid from the business. These positions would be financed from the revenue of the Lab. The Lab would be

equipped with all the necessary devices and equipment and facilities, the details of which are not given in the model. The detailed nursery model including other fixed and variable costs, revenue, etc., is attached in Annexure VI.

The Lab-cum nursery would generate revenue by selling rooted seedlings at INR 190 per rooted sapling in the first production year and subsequently at a higher price based on the rate of inflation. The capital borrowed would be INR 1.23 Cr paid in five equal annual installments of INR 24.64 lakhs and interest payment at the rate of 12% will begin from the first year of the project, wherein the loan will have no grace period. The promoter will complete servicing the debt at the end of 6 years and pay the bank a total of INR 1.83 Cr. This project is viable, as the project has a positive cash flow from 4th year on ward and a NPV of INR 74.33 lakhs and an IRR of 17% and would payback by the 8th year.

Nursery Model of Litchi

The model shows how improved nursery air layering production technique will be used to produce saplings in poly house supported by drip irrigation leading to developing high quality disease free, healthy Litchi saplings. The details of propagation technology and specific requirement of Litchi is discussed in Section 4.

The model illustrates a typical Litchi nursery with 444 mother plants raised in 4000 square meter area. With the project, the mother plants will be irrigated for 365 days of the year. The entrepreneur is going to undertake seed bed preparation, seed sowing, quality analysis and maintenance. Likewise, preparing poly bags with growing media, filling, planting, and pest and disease management. This model is to produce around 1.4 lakh Litchi saplings. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

The fixed cost will be invested to establish the nursery from the first year after preparatory phase. In this case production of saplings will begin from second year. It is assumed that in the second year the nursery would produce 17,779 saplings, 28,444 in the third year, 56,889 the fourth year, 1,06,667 the fifth year and 1,42,222 from the sixth year onward. The price of saplings in the first year is INR 100 per sapling, the future price would be adjusted with the inflation rate. The project horizon for producing the saplings is 10 years. The full development of the project would start from second year. The total investment is divided into fixed costs and variable costs. Replacement costs include mainly nets of shade net house and plastics of naturally ventilated polyhouse (every two to four years), the cost would be easily covered from the revenue from sales. It is assumed that 5% shade net would be damaged and replaced every 4 years, and 25% plastics of polyhouse.

The model is proposed to have a total investment cost of INR 1.014 crores which would be finance up to 50% a Government Grant/Subsidy and through promoter contribution including debt component (50%) where the promoter/s would borrow from a commercial bank, or other institutional finance instrument for small and medium enterprises. The total amount of the loan would be INR 50.69 lakhs, which would have no grace period. The loan principal would be paid in 5 equal installments of INR 10.14 lakhs over a 5-year period at a simple interest of 12%. The total amount to be repaid is INR 75.12 lakhs after a period of 6 years. The model shows a positive cash flow from year 5 on ward and repayment of the loan principal from year-2 onward. The entrepreneur would repay the loan, but with a drop in the cash flow for two consecutive year. A discount rate of 12% was used for the calculation. Project revenue was calculated based on the total annual production of saplings and the price of sapling in the first year at INR100 per sapling with change in price over the period of the project based on the inflation rate. The model is viable with a positive NPV of INR 37.84 lakhs and an internal rate of return of 16% where the project would be able to pay back by the 9 th year.

Nursery Model of Persimmon

The model shows how improved nursery chip budding production technique will be used to produce saplings in poly house, poly tunnel cultivation with mist chambers and drip irrigation leading to

developing high quality disease free, healthy persimmon saplings. The details of propagation technology and specific requirement of Persimmon is discussed in Section 4.

The model illustrates a typical persimmon nursery with 333 mother plants raised in 4000 square meter area. With the project, the mother plants will be irrigated for 365 days of the year. The entrepreneur is going undertake seed bed preparation, seed sowing, quality analysis and maintenance for 9 months. Likewise, preparing 25% poly bags with growing media, filling, planting, and pest and disease management. This model is to produce 80,000 saplings. In the first year the fixed cost would be invested for establishing the nursery -and no production will take place that year. In this case production of saplings will begin form second year.

The price of saplings is INR 110 per sapling and the future price would be adjusted with the rate of inflation. The project horizon for producing the saplings is 10 years. The full development of the project will start from second year onward. There would be 13,200 saplings produced in the second year, 26,640 saplings the third year, 53,280 the fourth year, and 79,920 the fifth year onwards. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

The total investment is divided into fixed costs and variable costs. Replacement costs include mainly shade net house nets, and naturally ventilated polyhouse, which will be easily covered from the revenue from sales. It is assumed in this case that 5% shade net would be damaged and replaced every 4 years, and 25% polyhouse and of similar infrastructure.

The model is proposed to have a total investment cost of INR 1.19 crores, which would be financed up to 50% by a Grant/Subsidy and the remaining 50% by a promoter contribution who would borrow from a commercial bank, or through other means of institutional finance for small and medium enterprises. The total amount of the loan would be INR 59.80 lakhs, which would have no grace period. To service the debt, the principal amount would be repaid in 5 equal installments of INR 11.96 lakhs over a period of 5 years with a simple interest of 12%. The total amount to be repaid is INR 88.50 lakhs after a period of 6 years.

The model shows a positive cash flow from year 5 and repayment of the principal from year-2 onward. It shows that the entrepreneur would be able to repay the loan, but with a drop in the cash flow for two consecutive years. A discount rate of 12% was used for the calculation. Project revenue was calculated based on the total annual production of saplings and the price of sapling. In the first production year the saplings are priced at INR 110 per sapling. The price would change in the future years of the project based on the inflation rate. The model is viable with a positive NPV of INR 26.66 lakhs and an internal rate of return of 15% where the project can pay back by 9th year.

Nursery Model of Plum

The model shows how improved nursery production techniques/structure (T- budding) can be used such as Fan and Pad controlled green house, Natural ventilated poly house poly house, and shade net house with mist chambers and drip irrigation leading to developing high quality disease free, healthy saplings of Plum. The model illustrates a typical plum nursery with 444 mother plants in 4000 square meter area. With the project, the entrepreneur is going to adopt advanced techniques maintaining the mother block with fertilizer, pest and disease management and irrigation. Likewise, the root stock will be developed, and seed beds will be maintained with seeds treated with fungicides and irrigated the entire year. This model is to produce 100,000 saplings. The details of propagation technology and specific requirement of Plum is discussed in Section 4.

The fixed cost will be invested to establish the nursery in the first year of the project. Production of saplings will begin from the second year. With the project, the nursery will produce 17,760 saplings in the 2nd year, 35,520 saplings in the 3rd year, 53, 280 in the 4th year, and thereafter 1,08,560 saplings annually. The saplings are priced at INR 80 per sapling in the first year of production, this is the minimum price at which the project will be viable. If we increase the price, then the project will have a higher net worth/NPV and will be able to pay back earlier. We have considered 10 years to be the project horizon for nursery development plan implementation. The full development of the

project will start from third year onward. The total investment is divided into fixed costs and variable costs. Replacement costs include shade net house and polyhouse (every two to four years) and drip irrigation pipes, which will be easily covered from the revenue from sales. It is assumed that 5% shade net would be damaged and replaced every 4 years. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

The model is proposed to have a total investment cost of INR 1.40 crores which would comprise of 50% Government Grant/Subsidy and the rest as promoter contribution (50%), which would be debt financed by a commercial loan through banks, or other institutional finance instrument for small and medium enterprises. The total loan amounts to INR 70.19 lakhs, which we assume would be taken by the Promoter from a commercial bank. The debt will be serviced by paying the principal amount in 5 equal installments (INR 14.04 lakhs) at a simple interest of 12%. The total amount would be repaid is INR 55.38 lakhs after a period of 6 years. A positive cash flow is seen in year 5 with repayment of the principal being made from year 2. It appears that the entrepreneur will repay the loan without any drop in the cash flow. A discount rate of 12% was used for the calculation.

Project revenue was calculated based on the total annual production of saplings and the price of sapling will change based on the inflation rate which is taken to be 5.6% for the model specific to Himachal Pradesh. The model is viable with a positive NPV of INR 32.46 lakhs and an internal rate of return of 16% where the project can pay back by the 9th year.

Nursery Model of Mango

The model shows how improved nursery production techniques (Veneer grafting) such as drip irrigation, naturally ventilated poly house, and shade net houses are used to develop high quality disease free, healthy Mango saplings. The model illustrates a typical Mango nursery with 444 mother plants in 4000 square meter area. With the project, the entrepreneur is going to adopt advanced techniques for maintaining the mother block with fertilizer, pest and disease management and irrigation. Likewise, seeds, seed trays, seed sowing, watering and maintenance including insecticide, fungicide, and irrigation for one year. This model is to produce 100,000 saplings. The details of propagation technology and specific requirement of Mango is discussed in Section 4. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

A fixed cost will be invested to establish the nursery in the first year of the project. Production of saplings will begin from the second year. With the project, the nursery will produce 3,556 saplings in the 2nd year, 17,778 saplings in the 3rd year, 53,333 in the 4th year, 88889 the 5th year, and 1,42,222 5th year onward. The saplings are priced at INR 100 per sapling in the first year of production, this is the minimum price at which the project will be viable. If we increase the price, then the project will have a higher net worth/NPV and will be able to pay back earlier. We have considered 10 years to be the project horizon for nursery development plan implementation. The full development of the project will start from second year onward. The total investment is divided into fixed costs and variable costs. Replacement costs include damaged shade nets of shade net house and damaged plastics of polyhouse every two to four years respectively at the rate of 5%, which will be easily covered from the revenue from sales.

The model is proposed to have a total investment cost of INR 1.280 crores which would comprise of 50% Government Grant/Subsidy and the rest as promoter contribution (50%), which would be a loan from a commercial bank, or other institutional finance instrument for small and medium enterprises. The total loan amount would be INR 64.02 lakhs, which we assume would be taken by the Promoter from a commercial bank. The debt will be serviced by paying the principal amount in 5 equal installments of INR 12.80 lakhs at a simple interest of 12%. The total amount that would be repaid is INR 56.85 lakhs after a period of 6 years. A positive cash flow is seen in year 4 with repayment of the principal being made from year 2. It appears that the entrepreneur will repay the loan without any drop in the cash flow.

Project revenue was calculated based on the total annual production of saplings and the price of sapling, which will change based on the inflation rate of 5.6% for the model specific to Himachal Pradesh. A discount rate of 12% was used for the calculation and a residual value of 10%. The model is viable with a positive NPV of INR 47.50 lakhs and an internal rate of return of 17% where the project can pay back by the 9th year.

Nursery Model of Pecan nut

The model shows how improved nursery production techniques (Whip grafting) such as drip irrigation, naturally ventilated poly house, mist chamber, and shade net houses are used to develop high quality disease free, healthy Pecan nut saplings. The model illustrates a typical Pecan nut nursery with 333 mother plants in 4000 square meter area. With the project, the entrepreneur is going to adopt advanced techniques for maintaining the mother block with fertilizer, pest and disease management and irrigation. Likewise, seeds, seed trays, seed sowing, watering and maintenance including insecticide, fungicide and irrigation for one year. This model is to produce 100,000 saplings. The details of propagation technology and specific requirement of Pecan nut is discussed in Section 4. The detailed nursery model including fixed and variable costs, revenue, etc., is attached in Annexure VI.

A fixed cost will be invested to establish the nursery in the first year of the project. Production of saplings will begin from the second year. With the project, the nursery will produce 5333 saplings in the 2nd year, 10667 saplings in the 3rd year, 16000 in the 4th year, 21333 the 5th year, 32000 6th year, 40000 the 7th year and 66667 8th year onward. The saplings are priced at INR 250 per sapling in the first year of production, at this price the project will be viable. If we increase the price, then the project will have a higher net worth/NPV and will be able to pay back earlier. We have considered 10 years to be the project horizon for nursery development plan implementation. The full development of the project will start from second year onward. The total investment is divided into fixed costs and variable costs. Replacement costs include damaged shade nets of shade net house and damaged plastics of polyhouse and the mist chamber every two to four years respectively at the rate of 5%, which will be easily covered from the revenue from sales.

The model is proposed to have a total investment cost of INR 1.22 crores which would comprise of 50% Government Grant/Subsidy and the rest as promoter contribution (50%), which would be a loan from a commercial bank, or other institutional finance instrument for small and medium enterprises. The total loan amount would be INR 61.03 lakhs, which we assume would be taken by the Promoter from a commercial bank. The debt will be serviced by paying the principal amount in 5 equal installments of INR 12.21 lakhs at a simple interest of 12%. The total amount that would be repaid is INR 90.34 lakhs after a period of 6 years. A positive cash flow is seen in year 4 with repayment of the principal being made from year 2. It appears that the entrepreneur will repay the loan without any drop in the cash flow.

Project revenue was calculated based on the total annual production of saplings and the price of sapling, which will change based on the inflation rate of 5.6% for the model specific to Himachal Pradesh. A discount rate of 12% was used for the calculation and a residual value of 10%. The model is viable with a positive NPV of INR 7.69 lakhs and an internal rate of return of 13% where the project can pay back by the 10th year.

7. Roles and responsibilities

7.1. Department of Horticulture and Project Monitoring Unit

For nursery development plan, the department of horticulture will be responsible for the below mentioned points:

- ▶ Preparation, release, and evaluation of tender bids for procurement of planting material
- ▶ Scouting to select best nurseries for purchase of mother plants and initial years planting material
- ▶ Selection of sites for establishment of new nurseries
- ▶ Monitoring of quality standards during and after establishment of private nursery
- ▶ Lay down the conditions for appointment and management
- ▶ Monitoring of the nursery plants

7.2. Research Universities/Institutions

The institution will play a very active role in the implementation of the nurseries and the roles will be focused on:

- ▶ Establishment and functioning of certification facilities for planting material
- ▶ Conducting soil testing and water testing and providing recommendations
- ▶ Providing package of practices
- ▶ Conducting capacity building and training program

7.3 Private Sector

The responsibility for the private sector in this plan will be:

- ▶ Establishment, licensing and registration of the nursery
- ▶ Procuring of mother plants, root stocks, tool and implements
- ▶ Preparing the nursery calendar
- ▶ Selection and appointment of the nursery staff
- ▶ Ensuring the supply of irrigation water, nutrients, electricity
- ▶ Day to day monitoring of the nursery activities
- ▶ Developing and implementing the business plan

7.4 Himachal Pradesh Nursery Management Society

The society can specifically look at:

- ▶ Rehabilitation of PCDO
- ▶ Post entry quarantine
- ▶ Establishment of bud wood bank
- ▶ Establishment of demonstration orchards

8. Capacity building program

Production of quality planting material as well as building the institutional capacity is the key for success of a program for this scale. The program implementation will require training at various levels which will include empowering departmental personnel, entrepreneurs, and farmers.

8.1. For department officials

The trainings should be provided to department officers at district and cluster level for effective management of saplings during procurement and distribution. Two training programs for 2- days to be organized in year 1 followed by a refresher course in Year 2 for department officials in coordination with universities/ research institutes. The cost for each program will be INR 5000/person/day amounting to INR 2.8 lacs for training program and 0.7 lac for the refresher course. The topics that can be covered during these trainings include:

- ▶ Nursery establishment and Layout
- ▶ IPM in nursery management
- ▶ Symptoms of nutrient deficiency and their management
- ▶ Monitoring and Evaluation Training

Exposure visits:

In addition to trainings, it is also suggested to conduct exposure visits once in a year for department officials to gather latest technology information. In this along with district horticulture officers few officials from department of horticulture will also be designated for the exposure visit. The cost of visit per person/per day has been estimated as INR 10000/- total amounting to INR 5.60 lakhs. The tentative list of nurseries/ institutions are as follows:

- ▶ Jain Irrigation Private Limited, Gurgaon
- ▶ Central Institute of Sub tropical Horticulture, Lucknow
- ▶ Central Institute of Horticulture, Medziphema, Nagaland
- ▶ Indian Institute of Horticulture Research, Bangalore
- ▶ Centres of Excellence
- ▶ National Research Centres

For training program all the districts growing horticulture crops are considered, not only sub-tropical districts so the total number of officials @2 officials per district comes to 24. For exposure visits 2 more officials can be included.

8.2. For entrepreneurs

The trainings for entrepreneurs should be conducted by DoH in coordination with University of Horticulture and Forestry, Neri at least once in a quarter to enable them exploring opportunities in nursery development. A total number of 50 entrepreneurs can be trained in nursery development activities. The topics for training shall include the following:

- ▶ Types of nurseries and industry profile
- ▶ Determining cost of production, business types and establishment
- ▶ Laws, regulations, and codes for nurseries
- ▶ Introduction to personnel and business management
- ▶ Site selection and layout
- ▶ Water management and quality
- ▶ Soil and substrate qualities
- ▶ Winter protection
- ▶ Nursery pest management
- ▶ Containers and structures for propagation
- ▶ Technical and business training

8.3. For gardeners

The training for gardeners is important to maintain the quality of planting material. It is proposed to train 4 gardeners per nursery along with 2 lab technicians for tissue culture unit. Hence, it is suggested to conduct training of gardeners in the nurseries by NSDC in coordination with DOH at least twice in a year.

- ▶ Soil sampling and soil sterilization/
- ▶ Media preparation
- ▶ Bud wood collection
- ▶ Budding & grafting operations
- ▶ Seed bed preparation
- ▶ Seed sowing/planting
- ▶ Techniques in transplanting of nursery plants
- ▶ Propagation techniques: specialized parts, cutting, layering, budding, and grafting.
- ▶ Use of bio fertilizers, growth regulators etc.
- ▶ Various intercultural operations.
- ▶ Inventory management

The total budget for capacity building of nursery development program comes to INR 25.82 lacks.

Table 27: Training programs details

Category	Number of Officials	No. of days per training	No. of training in year	Number of Years	Cost / Person/ training	Total amount (INR lakhs)
Capacity building for DoH officials (Year 1-2 days training)	24	2	2	1	5000	2.80
Capacity building for DoH officials (Year 2-1 day refresher training)	24	1	1	1	5000	0.70
Exposure visits for DoH officials	26	2	1	2	10000	5.60
Capacity building of entrepreneurs	25	2	4	2	2500	10.00
Training for Gardeners	42	2	2	2	2000	6.72
Total						25.82

*While deciding the capacity building program officials from other districts apart from sub tropical districts are also covered.

9. Book keeping and record maintenance

Record keeping is an essential activity for growing plants as well as nursery. The important details that should be captured for efficient record keeping are listed below:

Mother Block

- Source of Mother plants,
- Pattern of growth,
- Occurrence of diseases and pests
- Indexing for viruses in Sweet Orange
- Nutrient application

Root stock:

- Record of Root stock
- Date of sowing of seeds
- Number of seed germination
- Speed of germination (weekly)
- Percentage of germination
- Occurrence of diseases, if any,
- Control of diseases, any other matter.

Scion:

- Collection date
- Time of grafting/ budding/ layering
- Number of plants grafted/ budded/ layered
- Media in which plants have been grown
- Survival of graft
- Percentage of success
- Pattern of plants
- Removal of water suckers
- Date of staking

Hardening:

- Date of Primary hardening
- Date of secondary hardening

Planning nursery operations

There are four main tools for planning nursery operations:

Nursery Calendar

A nursery calendar to help plan necessary actions and purchases of seed, supplies and equipment

Plant development register

A plant development register for collecting species-specific information about seed treatment, germination requirements and duration, plant development, special requirements for potting substrate, watering, shading or disease control.

Nursery inventory

A nursery inventory to keep track of the species and number of seedlings in different stages of development.

10. Conclusion and Way Forward

India is an emerging market with a large fruit consuming population. Most fruits are sold in the retail markets, grocery stores, supermarkets and by street vendors. Our study has shown that the trend in the sub-tropical fruits consumption is increasing. With the increase in domestic demand for sub-tropical fruit there is a natural pressure to increase production. Currently the demand for fruit tree saplings is high in the state, and most of the demand is met by procuring from outside the state. The production of saplings within the state will gradually phase out a certain portion of what it is currently procured from outside the state.

The HPSHIVA project came at the most opportune time and ensures to bring the farmers/youth of the state back into profitable farming to prevent migration and give them a viable business option within the state. The project assumes to cover an area of 10,000 ha with production of major sub-tropical fruits viz. Sweet Orange, Guava, Pomegranate, Litchi, Persimmon, Plum, Mango and Pecan nut in the lower sub-tropical regions of Himachal Pradesh covering seven districts: i.e. Bilaspur, Hamirpur, Una, Mandi, Solan, Sirmour and Kangra.

This report presents the strategy for plantation covering an area of 10,000 hectare spread over 1000 clusters/ villages across 28 blocks in 7 districts to benefit ~25,000 households. The plantation work of 7 subtropical fruits is phased out as 10% in Year 1, 2 and 3 each, 20% in year 4, and 25 % in year 5 and 6 covering total planned area, as suggested by DoH.

For fruitful implementation of this plan the suggested recommendations are:

- ▶ Procurement of 100% planting material requirement for Year 1, 2 and 3 (30.62 lakh) to cover 30% of 10,000 hectares through open tender process whereas in subsequent years required quantity will be met both by in house planting material and procurement.
- ▶ Simultaneously, it is proposed that 10 nurseries may be established/upgraded based on the crop and climatic suitability, to start production from year 4 onwards. Initial two years will be considered as establishment phase.
- ▶ The proposed nurseries for Litchi, Guava, Mango, Pecan nut, Persimmon and Plum are suggested to be established with private sector participation (with government support in the form of back ended subsidy / incentive). Tissue culture lab for nursery and Virus indexed Nursery for Sweet Orange may be set up public private partnership or on similar models as others with higher back end subsidies.
- ▶ The proposed procurement of planting material comes to 93.58 lakhs out of which 10.62 lakhs planting material are required in Year 1, 2 and 3 each, 27.75 lakhs in Year 4, 19.32 lakhs in year 5, 22.62 lakhs in Year 6 and 19.76 lakhs in Year 7, after factoring in extra 7% for mortality and transportation losses and production of planting material from nurseries.
- ▶ It is proposed to establish 2 nurseries each for Sweet Orange and Guava and 1 nursery each for Litchi, Persimmon, Plum, Mango, Pecan nut and 1 Tissue culture Lab for Pomegranate. The Sweet Orange, Guava, Mango, Litchi nursery is proposed to be established in lower altitudes 600-800 m while Plum, Persimmon and Pecan nut nursery for the higher altitudes of 800-1200m.
- ▶ To build the capacity of the state 2 training programs in Year 1 followed by a refresher course in Year 2, 1 exposure visit, training of 50 entrepreneurs and 42 gardener/technicians is suggested.

Considering all these facts the next steps for establishment of nursery development plan is:

- ▶ Setting up the process for prompt and timely procurement of planting material starting from February 2023
- ▶ Creating the provision and release of the subsidy amount in timely manner
- ▶ Selection of the sites in each district for establishment of the nursery
- ▶ Ensuring that quality standards and recommended procedures are followed both for procurement of planting material and establishment of the nursery

- ▶ Implementation of the capacity building training calendar and inventory management in the nursery

The nursery enterprise once developed will result in very beneficial proposition for the entrepreneurs. It will result in production of improved quality planting material, with state of art production technology, better business opportunities with increased job creation, capacity enhancement and farmers empowerment.

This report will form a base towards value chain report for supply of quality planting material and serve as a strategic component of Horticulture Sector Strategy Planning and Investment Report 2023-2030 thereby forming a valuable component of Horticulture Policy Document.

Annexures



11. Annexures

Annexure I: Benchmarking studies

a. Jain Irrigation (Jalgaon)

Our team visited Jain Irrigation System to see their model of Nursery and tissue culture. Jain Irrigation Systems Limited, Head Quartered at Jalgaon, Maharashtra, India, is a diversified agriculture conglomerate with a turnover, in excess of 1.2 million USD. They have global presence with 33 manufacturing plants, spread over 4 continents, with over 5 decades have presence in marketplace. They have reached 10 million farmers in making them prosperous. They are accredited by both National Horticulture Board and National Certification System for Tissue Culture Raised Plants (NCS-TCP) by Department of Biotechnology (DBT) and one of the best private nurseries in India.

Some of the key observations or best practices identified during the visit are as follows:

- ▶ Mother block is maintained under protected conditions and they also have modern technique of propagation.
- ▶ They grow plants under soilless media and use root trainer for growing plant and ensures freedom from diseases
- ▶ They have in house Indexing facilities
- ▶ Manufacturer of both natural ventilated and Fan and Pad Green House and shed house
- ▶ Using latest drip system with automation facilities
- ▶ Have very good facilities for primary and secondary hardening for each crop
- ▶ Involved in vertical farming of leafy vegetables
- ▶ Experts in hydroponic. Involved in the business of producing and selling early generation high vigor seed potato (Techni tuber-Seed Potato).
- ▶ Using Q-vertical Drone for plant protection.
- ▶ Very good network in about 126 countries. Hence, there is no problem of importing QPM.
- ▶ They are the largest producer of tissue culture plant of Banana and Pomegranate in the world.
- ▶ Present capacity of Tissue Culture lab is to produce 24.0 crore plants.
- ▶ Producing 12.0 crores plants of banana and Pomegranate (75.0 lakhs) on demand /annum (with advance Booking).
- ▶ Currently, producing 13.0 lakhs plants of different cultivar guava, particularly L-49.
- ▶ Also producing 20 lakhs of Sweet Orange plants annually.
- ▶ They are maintaining true to type mother plants of some of the targeted fruits (HPSHIVA) i.e., guava, Sweet Orange and pomegranate.
- ▶ One more mother plant nursery for Sweet Orange in 2000 sq. m area of polyhouse has been inaugurated recently. Therefore, there is no problem to produce 4-5 lakhs extra plants of Sweet Orange in phases.
- ▶ Replace poly bags with plastic tubes for development of grafts/budded plants.
- ▶ Producing plants with soilless media.

The crop wise nursery practices followed in Jain Irrigation Systems:

- ▶ The **pomegranate plants** are producing largest through tissue culture to avoid diseases transmission especially bacterial and fungal diseases. The explants are collected from plus trees of Bhagwa varieties. When the explants grow, it is transplanted and kept in culture. Once rooting takes place, they are transplanted in soilless media and kept under primary nursery. From primary



Figure 6: EY team visit to Jain Irrigation

nursery, plants are taken to secondary nursery and are grown on soilless media. Training and pruning are done to give a shape to plants.

- ▶ **Guava** is multiplied through tissue culture and diseases free planting of true to type. Besides the tissue culture, L-49 Allahabad Safedaare also propagated through convention grafting method, assuring that they are free from diseases and true to type. These plants are also grown in soil less media in special plots, which ensure 100% establishment on planting.
- ▶ The **Sweet Orange mother plants** are produced under protected condition and indexed from time to time to ensure that plants are free from virus diseases. The bud sticks (scions) are only collected from the protected mother plants and can be used in the farm or Volkemeriana (citrus janchari) and Rajpur lane (citrus limon). Micro- chip grafting technique as used for propagation. The plants are primary hardened in the green house and are grown on soil less media in root trainer pots. The plants can be transported in trucks and planted directly in the field with no mortality reported.



Figure 7: Guava Plantation



Figure 8: Sweet Orange Mother Nursery



Figure 9: Sweet Orange Mother plants



Figure 10: Sweet orange grafted plants in 4.5 acres in controlled condition



Figure 11: Pomegranate saplings in primary hardening in 2.5 acres having ~2 lakh plants

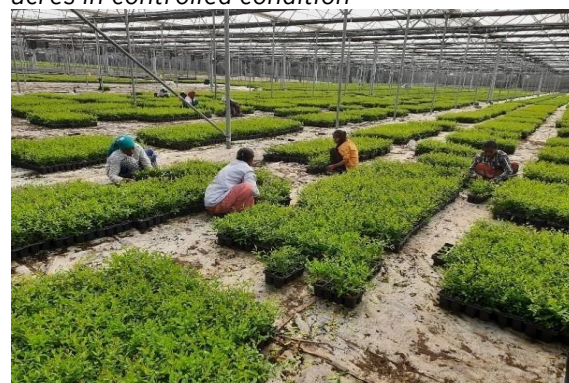


Figure 12: Pomegranate saplings in secondary hardening house in 7.5 acres

b. Central Institute of Subtropical Horticulture, Lucknow

The Central Institute of Subtropical Horticulture (CISH) which was started in 1972 under the Indian Council Agricultural Research is committed to the development of Sub tropical horticulture. The institute has two centres, one at Rehmarkhera, approximate 25 km away from the city and other at Raibareilly road in the city of Lucknow. The farms at Rehmarkhera have an area of 125 ha. Raibareilly road is approximately 8 Km. away from the CISH. The Institute takes various programs for the promotion of Mango, Guava and other Sub-tropical fruits. The CISH has excellent nursery for the production of quality planting material of guava and mango. They also organize the program to train human resource on production of planting material as well as growing of the plants. This center can provide the quality material of Guava especially of variety Shweta, after placing the order.

CISH at Rehmarkhera is producing 75,000 to 80,000 plants of Guava, 60,000 plants of mango, 10,000 of Aonla and 10,000 of Beal. Out of 75,000 plants of guava, 40,000 plants are produced especially of Sweta. They have planted their mother block at the spacing of 2.5 x 2.5 and also on 3 x 2 meters. They reported that in 1st year they get 50 sticks and at 5th year, 400 scion per plant.

CISH at R.B. Road, Lucknow has sufficient mother plants of different fruits. The orchards of mango, bael, guava and other fruits have been maintained organically. The CISH is also producing biological agents at this center.



Figure 13: Lalit Scion Block



Figure 14: Polyhouse in 500 sq.m and can accommodate 30,000 saplings



Figure 15: Guava root stock



c. Other private nurseries

► Key findings from Yadava Nursery and Kisan Nursery at Malihabad:

Kisan Nursery is one Star NHB accredited nursery and Yadava Nursery is rated 2 stars by NHB and they both are located in Lucknow, Uttar Pradesh.

The plants are raised by enhancing as well as wedge grafting and enhancing. They maintain the mother block of desired varieties. Growing of Root Stock is done by the farmers, who sell the plants @ Rs.2-3. Then it is potted and brought it to nursery. In about two months, these root stocks become graft able.

Grafting is done in February and the plants are made available in the month of June and July. These Nurseries can provide 2-3 lakh plants, provided a firm order is placed 6 to 8 months in advance. It was informed that “Barfaw Khan” is a local high demand Guava variety it is suggested to also adopt this variety due to high quality and long shelf life.

► Key findings from A1high-Tech nursery:

A1 High-tech nursery located in Abohar, Punjab is one of the high-tech well-maintained nursery of the region providing high quality planting materials of Malta Red blood, Jaffa, Guava- Hisar Safeda, Pomegranates to the farmers. This well-known establishment spread over an area of more than 4000 sq. meters raises planting materials for different sub-tropical fruits. This business has established a firm foothold in its industry. They have separate mother blocks for propagation of mother plants of different varieties of Sweet Orange, Pomegranate and Guava. They have different propagation structure and hardening area. The total planting material capacity in around 2.5 lakh plants annually.

Annexure II: Summary of Nursery Visits

Table 28: Summary of nursery field visits

Name of Nursery	Type of Nursery	District	Date of Visit	Team members
Kamal Nursery	Private	Bilaspur, HP	10 November 2021	ShaheelRafique, AryaVinayakam
PCDO-Bhumpal	Public	Hamirpur, HP	12 November 2021	ShaheelRafique, JitendraSinha, AryaVinayakam, BhavithaVigrahala
PCDO Palampur	Public	Kangra, HP	17 November 2021	ShaheelRafique, Jitendra Sinha, BhavithaVigrahala
PCDO Madan	Public	Mandi, HP	17 November 2021	Arun Kumar Johri, Harishchandra Prasad Singh, Ruchir Kant Pareek
PCDO Hara Bagh	Public	Mandi, HP	17 November 2021	Arun Kumar Johri, Harishchandra Prasad Singh, Ruchir Kant Pareek
PCDO Dualakaun	Public	Sirmaur, HP	18 November 2021	Mohit Kumar
Karan fruit plants nursery	Private	Solan HP	20 November 2021	Arun Kumar Johri, Harishchandra Prasad Singh
Fruit nursery, Kandahaghat	Private	Solan, HP	20 November 2021	Arun Kumar Johri, Harishchandra Prasad Singh
PCDO Arki	Public	Solan, HP	22 November 2021	Mohit Kumar
PCDO Dhang	Public	Solan, HP	23 November 2021	Mohit Kumar
Jain Irrigation Systems	Private	Jalgaon, Maharashtra	9-11 December 2021	Arun Kumar Johri, Harishchandra Prasad Singh
Central Institute of Subtropical Horticulture, Lucknow	Public	Lucknow, Uttar Pradesh	23- 24 December 2021	Arun Kumar Johri, Harishchandra Prasad Singh
Yadav Nursery	Private	Lucknow, Uttar Pradesh	23 December 2021	Arun Kumar Johri, Harishchandra Prasad Singh
Kisan Nursery	Private	Lucknow, Uttar Pradesh	24 December 2021	Arun Kumar Johri, Harishchandra Prasad Singh

Annexure III: Details of NHB accredited nurseries in Himachal Pradesh for targeted crops

Table 29: NHB accredited nurseries in Himachal Pradesh for targeted crops

Sr No.	Nursery Name	District	NHB Star Rating	Name of Crop	Name of Variety	No.of Mother Plants	Production Capacity
1	Fruit Nursery, Deot	Hamirpur	1	Mango	Amrapali	1	50
					Chausa	4	200
					Dashehari	51	5000
					Langra	22	1000
					Mallika	2	500
2	Fruit Nursery, DEOT, Sidh	Hamirpur	1	Mango	Dashehari	55	2500
3	Fruit Plant Nursery, Badiana	Hamirpur	1	Litchi	Calcuttia	5	5000
					Dehradun	20	2000
				Mango	Amrapali	1111	5000
					Chausa	2	100
					Dashehari	5	250
					Langra	2	100
				Plum	Santa Rosa	4	2000
				Pomegranate	Kabuli Kandhari	50	2000
4	Kamal Nursery	Bilaspur	1	Cirtus	Baramasi	5	4000
				Mango	Dashehari	140	5000
				Pomegranate	Bhagwa	30	2500
					Kabuli Kandhari	20	3000
5	Progeny Cum Demonstration Orchard, Bhumpal	Hamirpur	1	Pomegranate	Kandhari	70	3000

Source: NHB, 2021

Annexure IV: Details of NHB accredited nurseries for targeted crops and varieties

Table 30: State wise cumulative production capacity of Sweet Orange varieties in NHB Accredited nurseries

State/Varieties	Hamlin	Jaffa	Mosambi	Natal	Valentia	Total
West Bengal	-	-	638000	-	-	638000
Maharashtra	40000	-	29000	50000	30000	149000
Punjab	-	58000	-	-	-	58000
Rajasthan	-	42600	47200	-	-	89800
Haryana	-	23000	24700	-	-	47700
Jammu & Kashmir	-	-	12000	-	-	12000
Uttarakhand	-	-	8000	-	-	8000
Madhya Pradesh	-	-	2000	-	-	2000
Total	40000	123600	760900	50000	30000	1004500

Source: NHB, 2021

Table 31: State wise cumulative production capacity of Guava varieties in NHB Accredited nurseries

State/Varieties	HisarSafeda	Lalit	Shweta	Grand Total
Bihar	-	2100	-	2100
Chhattisgarh	-	6650	1500	8150
Gujarat	-	5000	-	5000
Haryana	1566500	2000	-	15,68,500
Jharkhand	-	9900	-	9900
Jammu & Kashmir	-	3500	1200	4700
Karnataka	-	2100	-	2100
Maharashtra	-	52000	-	52000
Madhya Pradesh	-	11000	700	11700
Punjab	65000	-	-	65000
Rajasthan	4500	1500	2300	8300
Uttarakhand	-	10500	7000	17500
Uttar Pradesh	25000	624000	285550	9,34,550
West Bengal	-	60000	-	60000
Total	1661000	790250	298250	2749500

Source: NHB, 2021

Table 32: State wise cumulative production capacity of Litchi varieties in NHB Accredited nurseries

State/Varieties	Dehradun	Rose Scented	Shahi	Total
Bihar	-	-	56500	56500
Chhattisgarh	-	3500	13850	17350
Himachal Pradesh	2000	-	-	2000
Haryana	2000	-	-	2000
Jharkhand	-	-	40600	40600
Jammu & Kashmir	58600	-	-	58600
Kerala	-	-	1000	1000
Madhya Pradesh	-	2500	-	2500
Odisha	-	-	25000	25000
Punjab	500	-	-	500
Uttarakhand	-	123000	-	123000
Uttar Pradesh	3000	12800	33000	48800
Total	66100	141800	169950	377850

Source: NHB, 2021

Table 33: State wise cumulative production capacity of Bhagwa variety in NHB Accredited nurseries

State/ Varieties	Bhagwa
Andhra Pradesh	350000
Bihar	600
Chhattisgarh	16150
Gujarat	366000
Himachal Pradesh	2500
Haryana	24700
Maharashtra	2631500
Madhya Pradesh	8000
Rajasthan	35800
Uttarakhand	3000
Uttar Pradesh	2000
West Bengal	49000
Total	3285250

Source: NHB, 2021

Table 34: State wise cumulative production capacity of Plum relevant varieties in NHB Accredited nurseries

State / Varieties	Black Amber	Frontier	Kala Amritsari	Santa Rosa	Satulej Purple	Total
Himachal Pradesh	-	-	-	2000	-	2000
Haryana	-	-	-	-	15000	15000
Jammu & Kashmir	14075	2877	2000	117135	1000	137087
Punjab	-	-	-	-	4000	4000
Uttarakhand	1000	-	-	32100	4500	37600
Total	15075	2877	2000	151235	24500	195687

Source: NHB, 2021

Table 35: State wise cumulative production capacity of Mango varieties in NHB Accredited nurseries

State /Varieties	Chausa	Mallika	Total
Bihar	-	10000	10000
Chhattisgarh	19725	65900	85625
Gujarat	1050	300	1350
Himachal Pradesh	300	500	800
Haryana	6000	1000	7000
Jharkhand	28300	715100	743400
Jammu & Kashmir	8000	22000	30000
Karnataka	-	75300	75300
Kerala	-	32000	32000
Maharashtra	-	24500	24500
Madhya Pradesh	11500	33900	45400
Odisha	-	492000	492000
Uttarakhand	72500	20500	93000
Uttar Pradesh	198790	5250	204040
West Bengal	-	948500	948500
Total	346165	2446750	2792915

Source: NHB, 2021

Annexure V: Production Schedule of Targeted Fruits Crops during Ten Years

Particulars		Production Schedule											
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Sweet Orange Nursery				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	2000												
Plant Spacing (in m)	6												
No of Mother plants maintained / year	333			330	330	330	330	330	330	330	330	330	330
No of micro grafts obtained / plant / year				0	100	200	300	400	400	400	400	400	400
Total No of grafted Plants obtained /year				0	33000	66000	99000	132000	132000	132000	132000	132000	132000
No. of Plants ready for plantation or sale /year (80%)				0	26400	52800	79200	105600	105600	105600	105600	105600	105600
Guava Nursery				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	2000												
Plant Spacing (in m)	6												
No of Mother plants maintained / year	333			330	330	330	330	330	330	330	330	330	330
No. Of scion stick/ obtained Plants/year				0	100	200	300	400	400	400	400	400	400
Total no. of grafted plants/ year				0	33000	66000	99000	132000	132000	132000	132000	132000	132000
No. of Plants Ready for Plantation or sale/ year (80%)				0	26400	52800	79200	105600	105600	105600	105600	105600	105600
Pomegranate Nursery				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	200												
Plant Spacing (in m)	9												
No of Mother plants maintained / year	22			22	22	22	22	22	22	22	22	22	22
No. of ex plant per plants/ year				1	600	1000	2000	10000	20000	30000	40000	50000	60000
No. of multiplication rate /plant/year				0	30	40	60	80	200	300	500	500	500
Total No. of plants rooted plants/ year				0	18000	40000	120000	800000	4000000	9000000	20000000	25000000	30000000
No of plants ready for plantaion or sale/ year (95%)				0	17100	38000	114000	114000	114000	114000	114000	114000	114000
Litchi Nursery				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	4000												
Plant Spacing (in m)	9				60	100	200	250	300	300	300	300	300
No of Mother plants maintained / year	444			444	444	444	444	444	444	444	444	444	444
Total no. of Gutti/plant/year				0	50	80	160	300	400	400	400	400	400
Total no. of Air layering plants/year				0	22222	35556	71111	133333	177778	177778	177778	177778	177778
No. of Plants Ready for Plantation or sale /year (80%)				0	17778	28444	56889	106667	142222	142222	142222	142222	142222
Parsimmon Nursery				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	4000												
Spacing in sq. m	12												
No of Mother plants maintained / year	333			330	330	333	333	333	333	333	333	333	333
No of bud stick obtained /plant/ year				0	50	100	200	300	300	300	300	300	300
Toat No. of grafted plants obtained / year				0	16500	33300	66600	99900	99900	99900	99900	99900	99900
Planrs ready for plantation or sale / year (80%)				0	13200	26640	53280	79920	79920	79920	79920	79920	79920
Plum Nursery				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Area required to plant MP (in sq.m)	4000												
Plant Spacing(in sq. m)	9												
No of Mother plants maintained / year	444				444	444	444	444	444	444	444	444	444
No of scion stick obtained / plant / year					50	100	150	300	300	300	300	300	300
Total No. of grafted plantsobtained /year					22200	44400	66600	133200	133200	133200	133200	133200	133200
Total no. of plants ready for plantation or sale/ year					17760	35520	53280	106560	106560	106560	106560	106560	106560
Mango Nursery				1	2	3	4	5	6	7	8	9	10
Area required to plant MP (in sq.m)	4000												
Plant Spacing (in m)	9												
No of Mother plants maintained / year	444			444	444	444	444	444	444	444	444	444	444
No. of scion stick/ obtained Plants/year				0	10	50	150	250	400	400	400	400	400
Total no. of grafted plants/ year				0	4444	22222	66667	111111	177778	177778	177778	177778	177778
No. of Plants Ready for Plantation or sale/ year (80%)				0	3556	17778	53333	88889	142222	142222	142222	142222	142222
Pecan nut Nursery				1	2	3	4	5	6	7	8	9	10
Area required to plant MP (in sq.m)	3000												
Plant Spacing (in sq. m)	9												
No of Mother plants maintained / year	333			333	333	333	333	333	333	333	333	333	333
Total no. of Grafts/plant/year				0	20	40	60	80	120	150	250	250	250
Total no. of Grafted / Budded plants/year				0	6667	13333	20000	26667	40000	50000	83333	83333	83333
No. of Plants Ready for Plantation or sale /year (80%)				0	5333	10667	16000	21333	32000	40000	66667	66667	66667

Annexure VI: Detailed Nursery Models

a. Sweet Orange Nursery Model

Specification				
Total Investment		100%	31508933	
Grant component		50%	15754467	
Promoters' contribution		50%	15754467	
Inflation		5.56%		
Discount Rate		12%		
Residual value		10%		
Replacement of plastic of the poly house by			20%	evert 4 years
Replacement of material from the Mist house			5%	evert 4 years
Replacement of damaged drip lines		2%	every 4 years	
Electricity connection and repairs by		5%	every 4 years	
Replacement of sheet of Green house		5%	every 4 years	
Mother Block - Natural Ventilated Poly House	sq.m	2000		
Plant spacing	sq.m	6		
Total no of mother Plants	No's	333		

Benefits		
Year -2	26400	saplings
Year- 3	52800	saplings
Year - 4	79200	saplings
Year -5 on ward	105600	saplings
Price per sapling	185	INR

Costs				
Particular	Inputs	Unit Area	Unit Cost (INR)	Total
Fixed Costs				
Plant virus diagnostic lab				11003000.00
Fencing - Wire Chain link - 8 ft height	Running Meter	400	600.00	240000
Work shed	sq.m	100	3500.00	350000
Office - 200 Sq.m out of which 100 sq.m building area	sq.m	100	15000.00	1500000
Mother Plant Block- Natural Ventilated Poly House	sq.m	2000	1500.00	3000000
Fan & Ped Green House Controlled conditions for raising rootstock & micro grafting & primary Hardening	sq.m	3000	2600.00	7800000
Natural Ventilated for Secondary Hardening	sq.m	2000	1500.00	3000000
Shadenet House	sq.m	0	0.00	
Mist Chamber	sq.m	0.00	0.00	
Drip irrigation with one lateral with 2 drippers @4lph	sq.m	8000.0	18.75	150000
Land preparation, nursery beds, internal roads, pathways, potting yard	sq.m	10000	10.00	100000
Water Storage	ltr	20000	5.00	100000
Electricity connection	KVA	5	5000.00	25000
Genset	KVA	5	10000.00	50000
Storage	sq.m	100	15000.00	1500000
Office furniture	units	1	50000.00	50000
Variable Costs				
Cost of Mother Plants	Rs	333	250.00	83333.33333
Installation of Drip System with fertigation	sq.m	2000	18.75	37500
Pit digging, Growing media, Chemicals Insecticide, Fungicide	Rs	333	108.00	36000
Maintenance for one year	M-days	365	200.00	73000
Fan & Pad Green House for	sq.m	3000	0.00	
Root stock- Rangpur Lime & Rough Lime				

Costs				
Particular	Inputs	Unit Area	Unit Cost (INR)	Total
Cost of Raising Root Stock & Maintenance	No.	33000	3.50	115500
Micro Grafting for raising the grafted plants & maintenance for nine Months		26400	14.50	382800
Maintenance cost of plants		26400	2.00	52800
Land Rent	Months	12	35000.00	420000
Manager	Months	12	75000	900000
Technical Assistant	Months	12	50000	600000
Executive	Months	12	30000	360000
Insurance	Months	12	10000	120000

Year		1	2	3	4	5	6	7	8	9	10
Cash Inflow											
Revenue			4884000	11489571	18192586	25605458	27029122	28531941	30118317	31792895	33560580
Residual value											2886800
TOTAL REVENUE		0	4884000	4884000	11489571	18192586	25605458	27029122	28531941	30118317	34679695
Cash Outflow											
FIXED COSTS											
Plant virus diagnostic lab		11003000									
Fencing - Wire Chain link - 8 ft height		240000									
Workshed		350000									
Office - 200 Sq.m out of which 100 sq.m building area		1500000									
Mother Plant Block- Natural Ventilated Poly House		3000000					600000				
Fan & Ped Green House Controlled conditions for raising rootstock & micro grafting & primary Hardening		7800000					390000				
Natural Ventilated for Secondary Hardening		3000000									
Drip irrigation with one lateral with 2 drippers @4lph		150000					3000				
Land preparation, nursery beds, internal roads, pathways, potting yard		100000									
Water Storage		100000									
Electricity connection		25000									
Genset		50000									
Storage		1500000									
Office furniture		50000									
Sub-Total		28868000	0	0	0	0	993000	0	0	0	0

Year		1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS											
Cost of Mother Plants			83333								
Installation of Drip System with fertigation			37500								
Pit digging, Growing media, Chemicals Insecticide, Fungicide			36000								
Maintenece for one year			73000	73000	73000	73000	73000	73000	73000	73000	73000
Cost of Raising Root Stock & Maintenece			115500	231000.00	346500.00	462000.00	639202.21	933542	1439226	2342197	4023623
Micro Grafting for raising the grated plants & maintenece for nine Months			382800	957000	1435500	1914000	2648123	3867532	5962508	9703388	16669294
Maintenance- cost of plants			52800	105600	158400	211200	292207	426762	657932	1070719	1839370
Sub-Total			780933	1366600	2013400	2660200	3652532	5300836	8132665	13189303	22605286
OVERHEADS, GENERAL & FIXED COSTS											
Land Rent		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
Insurance		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
Manager		900000	950040	1002862	1058621	1117481	1179613	1245199	1314432	1387515	1464660
Technical Assitant		600000	633360	633360	633360	633360	633360	633360	633360	633360	633360
Executive		360000	380016	401145	423449	446992	471845	498080	525773	555006	585864
Sub-Total		2400000	2503416	2577367	2655430	2737833	2824818	2916639	3013565	3115880	3223885
Repayment of Principal			3150893	3150893	3150893	3150893	3150893				
Interest		1890536	1890536	1512429	1134322	756214	378107				
Debt Service		1890536	5041429	4663322	4285215	3907108	3529001				
TOTAL COST		33158536	8325779	8607289	8954045	9305141	10999351	8217475	11146230	16305184	25829171
Total Benefits		-33158536	-3441779	-3723289	2535526	8887445	14606108	18811647	17385711	13813133	8850524
Discounted Total Benefits /Cashflow		-29605836	-3073017	-2968183	1804737	5648132	8287898	9530566	7864413	5578893	3191588
Net Present Value at 12% (NPV)	6259190										
Internal Rate of Return (IRR)	13%										
Payback period (Year -9)		-29605836	-32678852	-35647036	-33842299	-28194167	-19906269	-10375703	-2511290	3067602	6259190

b. Guava Nursery Model

Specifications	
Total area of 4000 sqm of land will be used	
Plant Spacing (3X2m)	6 sqm
Area for plantation of Mother plant	2000sqm
No. of mother plants	333
Kissan Credit Card interest rate	4%
Discount rate	12%
Inflation	5.60%

Benefits			
Price of sapling Rs	150	per sapling	
Total Investment	9733680		
Grant/Subsity	50%	4866840	
Promoter Contribution	50%	4866840	borrowed from Financial institution
Principal Payment in five equal instalments			
Residual Value	10%		
Replacement			
Shade net	5% net replaced every 2 years		
Poly house	25% plastic replaced every 2 years		
Polytunnel	5% plastic replaced every 2 years		
Mist house	5% materials replaced every 4 years		
Year -2	26400	saplings	
Year -3	52800	saplings	
Year -4	79200	saplings	
Year - 5 onward	105600	saplings	

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total Amount (Rs)
Fixed costs				
Fencing - Wire Chain link * ft height	sq.m	400	600.00	240000
Workshed	sq.m	100	3500.00	350000
Office 200sqm out of which 100sqm building area	sq.m	100	15000.00	1500000
Shadenet House	sq.m	2000	1000.00	2000000
Naturally ventilated Polyhouse	sq.m	2500	1500.00	3750000
Drip irrigation with one lateral with 2 drippers @4lph	sq.m	2000	17.50	35000
Land preparation, nursery beds, internal roads, pathways, potting yard	sq.m	10000	10.00	100000
Mother Plant Block	sq.m	2000	5.00	10000
Water Storage	ltr	20000	5.00	100000
Electricity connection	KVA	5	5000.00	25000
Genset	KVA	100	15000.00	1500000
Plant or Fruit storage	sq.m	50	3000.00	150000
Office furniture	units	1	50000.00	50000
Variable Costs				
Maintenance of mother plants for 365 day including irrigation, fertilizer, fungicide, insecticide & weeding.	Rs	333.00	221.00	73593
Root Stock				
Area required for rootstock development	sq.m	200.00	5.00	1000
Seed	No's	130000.00	0.10	13000
Raising of the seeds & growing of the root stock		3000 sqm		
Seed bed, Seed, Sowing, watering & maintenance including insecticide, fungicide and irrigation till 70 days	No's	33000	2.00	66000
Poly bags, Growing media, filling, Transplantation and Maintenance including watering, fertilizer, Insecticide, fungicide for one year	Rs	33000	8.32	274560
Maintenance of plants		33000	2.00	66000

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total Amount (Rs)
Cost of mother plant		333	60.00	19980
Net House				
Budding		100000	0.00	
Budding work and maintenance, trimming, water & nutrient management & Plant Protection for one year	Months	100000	12.00	1200000
Manager	Months	12	60000	720000
Nursery supervisor	Months	12	30000	360000
Insurance	Months	12	10,000	120000
Rent	Months	12	35,000	420000

Year		1	2	3	4	5	6	7	8	9	10
Cash Inflow											
REVENUE			3960000	9326462	14773116	20800548	21965378	23195439	24494384	25866070	27314569
Residual value											1127600
TOTAL REVENUE			3960000	9360000	9326462	14773116	20800548	21965378	23195439	24494384	26993670
Cash Outflow											
INVESTMENT COSTS											
Fencing - Chain link- 8 ft height		240000									
Workshed		350000									
Office cum Store		1500000									
Shadenet House		2000000			112500			112500			112500
Naturally ventilated Polyhouse		3750000			3000			3000			3000
Drip irrigation with one lateral with 2 drippers @4lph		35000									
Land preparation, nursery beds, internal roads, pathways, potting yard		100000									
Water Storage		100000									
Area required for rootstock development		1000									
Electricity connection		1500000									
Genset		1500000									
Storage		150000									
Office furniture		50000									
Sub Total		11276000	0	0	115500	0	0	115500	0	0	115500

Year		1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS											
Maintenanc of mother plants for 365 day includin g irrigation, fertilizer, fungicide, insecticide & weeding.		0	73593	86662	107767	141515	196240	287365	444371	725640	1251297
Root Stock											
Seed		0	13000	15309	19037	24998	34665	50762	78497	128182	221038
Cost of Mother plant			19980								
Maintenanc of mother plants for 365 day includin g irrigation, fertilizer, fungicide, insecticide & weeding.			73593								
Raising of seeds & growing of the plant for root stock											
Seed bed, Seed seed trays, seed,Sowing, watering & maintenance including insecticide, fungicide and irrigation till 70 days		0	66000		198000	264000	264000	386591	597809	976198	1683361
Poly bags, Growing media,filling,Transplantaion and Maintenance including watering, fertilizer, Insecticide, fungicide for one year		0	274560	549120	823680	1098240	1098240	1608217	2486887	4060984	7002780
Maintenance of plants			66000	132000	198000	264000	264000	386591	597809	976198	1683361
Net House		0									
Budding		0									
Budding work and maintenace, trimming, water & nutrient management & Plant Protection for one year		0	1200000	1413100	1757230	2307535	3199866	4685751	7245870	11832208	20403515
Sub Total		0	1786726	2196191	3103713	4100288	5057011	7405277	11451244	18699411	32245351
OVER HEADS, GENERAL &FIXED COSTS											
Land Rent		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
Insurance		1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000
Staffing											
Manager		720000	760320	802898	847860	895340	945479	998426	1054338	1113381	1175730
Nursery Supervisor		360000	380160	401449	423930	447670	472740	499213	527169	556691	587865
Sub Total		16,20,000	16,80,480	17,44,347	18,11,790	18,83,011	19,58,219	20,37,639	21,21,507	22,10,072	23,03,596
Debt servicing											
Principal Payment			9,73,368	9,73,368	9,73,368	9,73,368	9,73,368				
Interest Payment		5,84,021	5,84,021	4,67,217	3,50,412	2,33,608	1,16,804				
Debt repayment		5,84,021	15,57,389	14,40,585	13,23,780	12,06,976	10,90,172				
TOTAL COSTS		1,34,80,021	50,24,595	53,81,122	63,54,784	71,90,275	81,05,402	95,58,417	1,35,72,751	2,09,09,482	3,46,64,446
Net Benefits /Cashflow		-1,34,80,021	-10,64,595	-14,21,122	29,71,678	75,82,841	1,26,95,145	1,24,06,962	96,22,688	35,84,902	-76,70,777
Discounted Net Benefits		-12035733	-848688	-1011527	1888555	4302708	6431756	5612279	3886442	1292751	-2469785
Net Present Value (NPV) at 12%	₹ 70,48,759										
Internal Rate of Return	22%										
Pay back period	Year 7	-12035733	-12884421	-13895948	-12007393	-7704686	-1272930	4339350	8225792	9518544	7048759

c. Pomegranate Nursery Model

Specifications			
Total investment	24645908.33		
Subsidy	50%	12322954	
Promoters' contribution	50%	12322954	Loan
Mother Block - Natural Ventilated Poly House	sq.m	200	
Plant spacing	sq.m	9	
Total no of mother Plants	No's	22	
Inflation		5.60%	
Discount rate		12%	
Residual value		10%	
Replacement of plastic from green house		5%	every 4 years
Polyhouse material replaced		5%	every 4 years
Fan & Pad Controlled Green House		sq.m	2000
Natural Ventilated Poly House for Secondary		sq. m	2000

Benefits		
Selling price of rooted plant	190	INR per rooted sapling

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total Amount (Rs)
Fixed Cost				
Lab cost				
Technical equipment cost			8332570	
Construction cost of lab area	3000/sqf		4620000	
Fencing - Wire Chain link - 8 ft height	Running Meter	400	600	240000
Workshed	sq.m	100	3500	350000
Office - 200 Sq.m out of which 100 sq.m building area	sq.m	100	15000	1500000
Mother Plant Block- Natural Ventilated PH	sq.m	200	1500	300000
Fan & Ped Controlled Green House	sq.m	2000	2600	5200000
Natural Ventilated Poly house for primary hardening	sq.m	2000	1500	3000000
Shadenet House for secondary House	sq.m	0	0	
Drip irrigation with fertigation	sq.m	0	0	
Land preparation, nursery beds, internal roads, pathways, potting yard	sq.m	8000	10	80000
Water Storage	ltr	20000	5	100000
Electricity connection	KVA	5	5000	25000
Genset	KVA	5	10000	50000
Storage	sq.m	100	3000	300000
Office furniture	units	1	50000	50000
Variable costs				
Cost of Mother Plants	Rs	22	60	1333.333
Maintenance cost for one year	Rs	22	903.38	20075
Fan & Pad Controlled Green House	sq.m	2000	0	
Growing of ex-plant after multiplying the plants till rooting media & transfer to primary hardening for six to eight weeks		18000	4.5	81000
Natural Ventilated Poly House for Secondary	sq. m	2000	0.00	2000
Pruning and Training & secondary hardening for two months		18000	7.25	130500
Insurance		annual	60000	
Land lease	months	12	30000	360000
Manager	1		1800000	1800000
Assistant Manager	1		1200000	1200000
Supervisor	2		1200000	1200000

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total Amount (Rs)
Semi-Skilled worker	13		2340000	2340000
Chemicals			88000	88000
Consumables			95000	95000
Media			125000	125000
Laboratory running cost			250000	250000
Land lease	monthly	12	35000	420000
Insurance	annually	12	10,000	120000

Year		1	2	3	4	5	6	7	8	9	10
Total No. of plants rooted plants/ year		0	18000	40000	120000	800000	4000000	9000000	20000000	25000000	30000000
No of plants ready for plantaion or sale/ year (95%)		0	17100	38000	114000	114000	114000	114000	114000	114000	114000
Cash Inflow											
Revenue			3249000	8502154	26934823	28443173	30035991	31718006	33494215	35369891	37350604
Residual value											2417257
TOTAL REVENUE			3249000	8502154	26934823	28443173	30035991	31718006	33494215	35369891	39767861
INVESTMENT COSTS											
Technical equipment cost		8332570									
Construction cost of lab area		4620000									
Fencing - Wire Chain link - 8 ft height		240000									
Workshed		350000									
Office - 200 Sq.m out of which 100 sq.m building arae		1500000									
Mother Plant Block- Natural Ventilated PH		300000									
Fan & Ped Controlled Green House		5200000				260000				260000	
Natural Ventilated Poly house for primary hardening		3000000				150000				150000	
Land preparation, nursery beds, internal roads, pathways, potting yard		80000									
Water Storage		100000									
Electricity connection		50000									
Genset		50000									
Storage		300000									
Office furniture		50000									
Subtotal		24172570	0	0	0	410000	0	0	0	410000	0

Year		1	2	3	4	5	6	7	8	9	10
Variable Costs											
Cost of Mother Plants			1333								
Maintenance cost for one year			20075	23640.0	23640.0	23640.0	23640.0	23640.0	23640.0	23640.0	23640.0
Fan & Pad Controlled Green House											
Growing of ex-plant after multiplying the plants till rooting media & transfer to primary hardening for six to eight weeks			81000	95384	118613	155759	215991	316288	489096	798674	1377237
Natural Ventilated Poly House for Secondary											
Pruning and Training & secondary hardening for two months			130500	130500							
Chemicals			88000	103627	128864	169219	234657	343622	531364	867695	1496258
Consumables			95000	111870	139114	182680	253323	370955	573631	936716	1615278
Media			125000	147198	173338	204120	240368	283054	333319	392511	462215
Laboratory running cost			250000	294396	346676	408240	480736	566107	666639	785023	924430
Sub-Total			790908	906616	930244	1143657	1448715	1903666	2617690	3804260	5899058
OVERHEAD, GENERAL & FIXED COSTS											
Insurance			120000	120000	120000	120000	120000	120000	120000	120000	120000
Land lease			420000	420000	420000	420000	420000	420000	420000	420000	420000
Manager			1800000	2119651	2496066	2939326	3461302	4075973	4799799	5652164	6655896
Assistant Manager			1200000	1413100	1664044	1959551	2307535	2717315	3199866	3768110	4437264
Supervisor			1200000	1413100	1664044	1959551	2307535	2717315	3199866	3768110	4437264
Semi-Skilled worker			2340000	2755546	3244885	3821124	4499693	5298765	6239738	7347814	8652665
Sub-Total		0	7080000	8241397	9609039	11219551	13116065	15349368	17979269	21076197	24723090
Payment of Principal			2464591	2464591	2464591	2464591	2464591				
Interest Payment		1478755	1478755	1183004	887253	591502	295751				
Debt Service		1478755	3943345	3647594	3351844	3056093	2760342	0			
Total Cost		25651325	11814254	12795607	13891127	15829301	17325122	17253034	20596958	25290458	30622148
Total Benefit		-25651325	-8565254	-4293453	13043696	12613872	12710869	14464972	12897256	10079433	9145713
Discounted Net Benefit		-22902968.3	-6828168	-3055995	8289505	7157450	6439722	6543219	5208985	3634745	2944675
Net Present Value (NPV)	7431169										
Internal Rate of Return (IRR)	17%										
Payback period	Year -8	-22902968.3	-29731136	-32787131	-24497627	-17340177	-10900455	-4357236	851749	4486494	7431169

d. Litchi Nursery Model

Specifications		
Inflation rate	5.60%	
Discount rate	12%	
Total Investment		10137441.44
Grant/ Subsidy	50%	5068720.72
Promoter's contribution	50%	5068720.72
Residual value	10%	
Area required to plant MP (in sq. m)	4000	
Plant Spacing (in m)	9	
No of Mother plants maintained / year	444	
Replacement of polyhouse plastic	25%	every 4 years
Replacement of shade net	5%	every 3 years
Replacement of damaged pipes	5%	every 3 years

Benefits		
Selling price of saplings (INR)		100
Year -2	17778	saplings
Year -3	28444	saplings
Year -4	56889	saplings
Year -5	106667	saplings
Year -6 onward	142222	saplings

Costs				
Particulars	Inputs	Unit Area	Unit Cost (in Rs)	Total (in Rs)
Fixed Costs				
Fencing - Wire Chain link - 8 ft height Fencing - Wire Chain link - 8 ft height	Meter	400	600.00	240000
Workshed	sq.m	100	3500.00	350000
Office - 200 Sq.m out of which 100 sq.m building area	sq.m	100	15000.00	1500000
Mother Plant Block- Open Field	sq.m	4000	0.00	
Poly House with Fan & Ped Controlled conditions	sq.m	2000	0.00	

Costs				
Particulars	Inputs	Unit Area	Unit Cost (in Rs)	Total (in Rs)
Polyhouse -Natural Ventilated Poly house for primary hardening	sq.m	3000	1500.00	4500000
Shadenet House for secondary House	sq.m	1500	1000.00	1500000
Drip irrigation with fertigation	sq.m	4000.0	17.50	70000
Land preparation, nursery beds, internal roads, pathways, potting yard	sq.m	8000	10.00	80000
Water Storage	ltr	20000	5.00	100000
Electricity connection	KVA	5	5000.00	25000
Genset	KVA	5	10000.00	50000
Storage	sq.m	100	3000.00	300000
Office furniture	units	1	50000.00	50000
Variable Costs				
Cost of Mother Plants	Rs	0	125	
Installation of Drip System with fertigation	Sq.m	4000	17.5	70000
Maintenance cost	Rs	444	182.00	80808
Natural Ventilated G.H for detaching and Primary Hardening	sq.m	3000	0	
Air layering of plants on trees	Nos	22222	5.50	122221
Removal of gutti putting in primary hardening, Potting, Polythene bags and Maintenance for six months		22222	6.00	133332
Net House - Secondary Hardening and sale	sq.m	1000	0	
Maintenance cost of plants for three months		17778	2.5	44444
Insurance	Months	12	10000	120000
Land Lease rent	Months	12	35000	420000
Manager	Months	12	60000	720000
Executive	Months	12	35000	420000
Utilities	Months	12	2000	24000

Year	1	2	3	4	5	6	7	8	9	10
<i>Cash Inflow</i>										
Revenue		1777800	3349519	7074308	14007147	19721970	20826400	21992679	23224269	24524828
Residual value										1441500
TOTAL REVENUE	0	1777800	3349518.8	7074308	14007147	19721970	20826400	21992679	23224269	25966328
<i>Cash Outflow</i>										
INVESTMENT COSTS										
Fencing - Wire Chain link - 8 ft heightFencing - Wire Chain link - 8 ft height	240000									
Workshed	350000									
Office - 200 Sq.m out of whch 100 sq.m building arae	1500000									
Polyhouse -Natural Ventilated Poly house for primary hardening	4500000					1125000				
Shadenet House for secondary House	1500000				75000				75000	
Drip irrigation with fertigation	4500000				225000				225000	
Land preparation, nursery beds, internal roads, pathways, potting yard	1500000									
Water Storage	70000									
Installation of Drip irrigation system with fertigation		70000								
Electricity connection	80000									
Genset	100000									
Storage	25000									
Office furniture	50000									
Sub-Total	14415000	70000	0	0	300000	1125000	0	0	300000	0

Year	1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS										
Cost of Mother Plants		55556								
Maintenance cost		80808	90112	106114	131956	173280	253745	392381	640742	1104899
Air layering of plants on trees		122221	195558	391111	733331.5	977779	1431819	2214111	3615553	6234677
Removal of gutti putting in primary hardening, Potting , Poly there bags and Maintenance for six months		133332	213336	426666	799998	1066668	1561984	2415394	3944240	6801465
Maintenance cost of plants for three months		44444	71112	142222	266666	355556	520661	805131	1314747	2267155
Sub-total		436361	570118	1066113	1931952	2573283	3768209	5827018	9515281	16408195
OVERHEAD, GENERAL & FIXED COSTS										
Insurance		120000	120000	120000	120000	120000	120000	120000	120000	120000
Land Lease rent		420000	420000	420000	420000	420000	420000	420000	420000	420000
Manager		720000	760320	802898	847860	895340	945479	998426	1054338	1113381
Executive		420000	443520	468357	494585	522282	551530	582415	615031	649472
Utilities		24000	26763	31516	39191	51464	71366	104505	161603	263890
Sub-total	0	1704000	1770603	1842771	1921636	2009087	2108375	2225347	2370971	2566744
Repayment of Principal		1013744	1013744	1013744	1013744	1013744				
Interest payment	608246	608246	486597	364948	243299	121649				
Debt Servicing	608246	1621991	1500341	1378692	1257043	1135393				
TOTAL COSTS	15023246	3832351	3841063	4287576	5410631	6842763	5876584	8052365	12186253	18974939
Total Benefits/Cashflow	-15023246.5	-2054551	-2063263	-938057	1663677	7164383	13845386	12774035	9806426	4249329
Discounted Net Benefits at 12%	-13413612.9	-1637875.63	-1468589.50	-596152.20	944015.24	3629699.50	6262949.32	5159218.63	3536295.44	1368170.30
Net Present Value (NPV)	3784118									
Internal Rate of Return (IRR)	16%									
Payback period (Year-9)	-13413612.9	-15051488.56	-16520078	-17116230	-16172215	-12542516	-6279566	-1120348	2415948	3784118

e. Persimmon Nursery Model

Specifications			
Total number of plants per annum			50,000
Mother Plants- Open Area			
Plant Spacing (3X2m)	12 sqm		
Area for plantation of Mother plant	4000sqm		
No. of mother plants	333		
Annual land lease rent for 4400 sqm	INR	30,000	

Benefits			
Total sales annually = 50,000 saplings			
Price of sampling INR		110	per sampling
Year 2	13,200	saplings	
Year 3	26,640	saplings	
Year-4	53280	saplings	
Year-5	79920	saplings	

Interest and Inflation rates			
Kisan Credit card		4%	
Commercial Bank		12%	
Inflation		5.60%	
Residual value		10.00%	
Investment	50%	Grant/Subsidy	5980320.28
	50%	Promoter contribution	
Total Investment		11960641	
Promoter's Share		5980320.28	KCC Loan
Replacement			
Shade net	5%	nets replaced every 2 years	
Polyhouse	25%	plastic replaced every 2 years	
Poly tunnel	50%	plastics replaced every 2 years	
Mist Chamber	5%	materials replaced every 4years	

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total (in Rs.)
Fixed Costs				
Fencing - Chain link- 8 ft height		400	600	240000
Workshed	sq.m	100	3500.00	350000
Office with building area 100 sqm	sq.m	100	15000.00	1500000
Shadenet House	sq.m	1500	1000.00	1500000
Naturally ventilated Polyhouse	sq.m	3000	1500.00	4500000
Drip irrigation with one lateral with 2 drippers @4lph	sq.m	4000	17.50	70000
Land preparation, nursery beds, internal roads, pathways & yard	sq.m	10000	10.00	100000
Mother Plant Block	sq.m	4000		
Water Storage	ltr	20000	5.00	100000
Electricity connection	KVA	5	5000.00	25000
Genset	KVA	5	10000.00	50000
Storage	sq.m	100	15000.00	1500000
Office furniture	units	1	50000.00	50000
Variable costs				
Cost of mother plants	Rs	333	150.00	49950
Maintenance of mother plants for 356 days including irrigation	Rs	333.00	163.00	54279
Root Stock - Amlook				
Seed bed, Seed sowing, quality analysis & maintenance till 9 months	No's	16500	2.000	33000
Poly bags, Growing media, filling, planting, etc.	Rs	16500	8.00	132000
Net House				
Net House Area	sq.m	1500	0.00	
Maintenance, trimming, water & nutrient management & Plant Protection for one year	Months	16500	2.00	33000
Land Rent	months	12	35000.00	420000
Electricity and water	months	12	2500.00	30000
Manager	Months	12	50000	600000

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total (in Rs.)
Assistant Manager	Months	12	30000	360000
Supervisor	Months	12	20000	240000
Insurance	Months	12	10000.00	120000

Year	1	2	3	4	5	6	7	8	9	10
<i>Cash Inflow</i>										
REVENUE		1452000	3450791	7288071	11544304	12190785	12873469	13594383	14355669	15159586
Residual Value										998500
TOTAL REVENUE	0	2	1452000	3450791.028	7288070.7	11544304	12190785	12873469	13594383	15354169
<i>Cash Outflow</i>										
INVESTMENT COSTS										
Fencing - Chain link- 8 ft height	240000									
Workshed	350000									
Office with building area 100 sqm	1500000									
Shadenet House	1500000			112500			112500			112500
Naturally ventillated Polyhouse	4500000			3000			3000			3000
Drip irrigation with one latreal with 2 drippers @4lph	70000									
Land preparation, nursery beds, internal roads, pathways & yard	100000									
Water Storage	100000									
Electricity connection	25000									
Storage	1500000									
Genset	50000									
Office furniture	50000									
Sub Total	9985000	0	0	115500	0	0	115500	0	0	115500

Year		1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS											
Cost of mother plants			49950								
Maintenance of mother plants for 356 days including irrigation			54279	63918	79484	104376	144738	211948	327749	535200	922902
Root Stocm - Amlook											
Seed bed, Seed sowing, quality analysis & maintenance till 9 months			33000	66600.00	133200.00	199800.00	199800.00	292579	452433	738804	1273998
Poly bags, Growing media,filling, planting, etc.			132000	155441	193295	253829	351985	515433	797046	1301543	2244387
Net House											
Net House Area											
Maintenace, trimming, water &			33000	66600	133200	199800	199800	292579	452433	738804	1273998
Sub-Total			302229	352559	539179	757804	896323	1312539	2029661	3314352	5715284
OVERHEADS GENERAL & FIXED COSTS											
Eletricity and water			30000	35328	41601	51732	67933	94203	137947	213315	348335
Land rent			420000	420000	420000	420000	420000	420000	420000	420000	420000
Manager			600000	633600	669082	706550	746117	787900	832022	878615	927818
Assistant Manager			360000	380160	401449	423930	447670	472740	499213	527169	556691
Supervisor			240000	253440	267633	282620	298447	315160	332809	351446	371127
Insurance			1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000	1,20,000
Sub-Total			1770000	1842528	1919764	2004832	2100167	2210002	2341990	2510546	2743971
Debt service											
Repayment of Capital			1196064	1196064	1196064	1196064	1196064				
Interest payment		717638	717638	574111	430583	287055	143528				
Debt payment to Commercial Bank		717638	1913702	1770175	1626647	1483119	1339592		0	0	0
TOTAL COST		10702638	3985931	3965261	4201091	4245756	4336082	3638040	4371651	5824898	8574755
Net Benefit/Cash flow		-10702638	-3985929	-2513261	-750300	3042314	7208222	8552745	8501818	7769485	6779414
Discounted Net Benefit at 12%		-9555927	-3177559	-1788890	-476829	1726291	3651910	3868827	3433742	2801754	2182790
Net Present Value (NPV) 12%	₹ 26,66,109										
Internal Rate of Return (IRR)	15%										
Payback Period	Year -9	-9555927	-12733486	-14522376	-14999205	-13272914	-9621004	-5752177	-2318435	483319	2666109

f. Plum Nursery Model

Specifications		
Total number of plants per annum		1,00,000
Plant Spacing	9 sqm	
Area for plantation of Mother plant	4000sqm	
No. of mother plants	444	
Area required for rootstock development	2925sqm	
Net house area	1500 sqm	

Benefits			
Total sales annually = 100,000 saplings			
Price of sampling INR		80	per sampling
Year -2	17,760		
Year -3 onward	35,520		
Year -5 onward	1,06,560	Year -4	53280
Replacement	Shadenets	5%	replaced every 4 years
	Polyhouse plastics	25%	replaced every 2 years
	Mist chamber material	5%	replaced every 4 years
	Polytunnel	30%	replaced every 2 years

Interest and Inflation rates		
Kisan Credit card		4%
Discount Rate		12%
Inflation		5.60%
Residual value		10.00%
Total Investment		14039471
Grant /Subsidy	50%	7019735
Promoter's contribution	50%	7019735
1+r	1.12	

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total (in Rs.)
Fixed costs				
Fencing - Chain link- 8 ft height		400	600	240000
Workshed	sq.m	100	3500.00	350000
Office	sq.m	100	15000.00	1500000
Shadenet House	sq.m	2000	1000.00	2000000
Naturally ventilated Polyhouse	sq.m	3000	1500.00	4500000
Mist Chamber	sq.m	200	900.00	180000
Drip irrigation with one lateral with 2 drippers @4lph	sq.m	4000	19.25	77000
Land preparation, nursery beds, internal roads, pathways & yard	sq.m	10000	10.00	100000
Mother Plant Block	sq.m	3000	5.00	15000
Water Storage	ltr	20000	5.00	100000
Electricity connection	KVA	5	5000.00	25000
Genset	KVA	5	10000.00	50000
Storage	sq.m	100	3000.00	300000
Office furniture	units	1	50000.00	50000
Cost of Mother Plants	Rs	444	163.00	72372
Variable costs				
Cost of Mother Plants	Rs	444	125.00	55500
Maintenance of mother plants for one year including irrigation, fertilizer, fungicide, insecticide & weeding.	Rs	444	163.00	72372
Area required for rootstock development	sq.m	2925.00	0.00	0
Seed bed, Seed, Sowing, watering & maintenance including fungicide and irrigation till 70 days	No's	22200.00	1.50	33300
Poly bags, Growing media, filling, Transplantaion and Maintenance including watering, Insecticide & fungicide for 70 days	Rs	22200	8.90	197580
Net House Area	sq.m	1500	0.00	

Costs				
Particulars	Measure	Unit	Unit Cost (in Rs)	Total (in Rs.)
Grafting work		22200	7.00	155400
Maintenance, trimming, water & nutrient management & Plant Protection for one year	Months	22200	2.00	44400
Manager	Months	12	60,000	720000
Assistant Manager	Months	12	40000	480000
Supervisor	Months	12	25000	300000
Land rent	Months	12	35000	420000
Insurance	months	12	10,000	120000

Year	1	2	3	4	5	6	7	8	9	10
Cash Inflows										
REVENUE		1584385	3346222	5300415	11194477	11821367	12483364	13182432	13920648	14700205
Residual Value										930700
TOTAL REVENUE		1584385	3346222	5300415	11194477	11821367	12483364	13182432	13920648	15630905
Cash Outflows										
INVESTMENT COSTS										
Fencing - Chain link- 8 ft height	240000									
Workshed	350000									
Office	1500000									
Shadenet House	2000000			1,50,000			1,50,000			1,50,000
Polyhouse	4500000			1200000			1200000			1200000
Drip irrigation with one latreal with 2 drippers @4lph	77000	28,875	19250							
Land preparation, nursery beds, internal roads, pathways & yard	100000									
Mother Plant Block	15000									
Water Storage	100000									
Electricity connection	25000									
Genset	50000									
Storage	300000									
Office furniture	50000									
Sub Total	9307000	28875	19250	1350000	0	0	1350000	0	0	1350000

Year		1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS											
Cost of Mother plant			55500								
Maintenanc of mother plants for one year includin g irrigation, fertilizer, fungicide, insecticide & weeding.			72372	85224.1	105978.6	139167.4	192983.9	282597.6	436998.4	713600.5	#####
Seed bed, Seed,Sowing, watering & maintenance including fungicide and irrigation till 70 days			33300	39214	48763	64034	88796	130030	201073	328344	566198
Poly bags, Growing media,filling,Transplantaion and Maintenance including, graftingwatering, Insecticide & fungicide for one year			197580	232667	289328	379936	526858	771509	1193033	1948173	3359439
Net House											
Maintenace, trimming, water & nutrient management & Plant Protection for one year			44400	52285	65018	85379	118395	173373	268097	437792	754930
Sub-Total			403152	409389	509087	668516	927033	1357509	2099201	3427909	5911102
OVERHEADS GENERAL & FIXED COSTS											
Land lease		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
Insurance		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
Staff											
Manager		720000	760320	802898	847860	895340	945479	998426	1054338	1113381	1175730
Assistant Manager		480000	506880	535265	565240	596894	630320	665618	702892	742254	783820
Supervisor		300000	316800	334541	353275	373058	393950	416011	439308	463909	489888
Sub Total		2040000	2124000	2212704	2306375	2405292	2509749	2620055	2736538	2859544	2989438
Debt service											
Repayment of Capital			1403947	1403947	1403947	1403947	1403947				
Interest payment		842368	842368	673895	505421	336947	168474				
Debt payment		842368	2246315	2077842	1909368	1740894	1572421	0	0	0	0
TOTAL COST		12189368	4802342	4719185	6074831	4814703	5009203	5327564	4835739	6287453	10250541
Net Benefits/Cashflow		-12189368	-3217957	-1372963	-774416	6379774	6812165	7155800	8346693	7633195	5380364
Discounted Net Benefits		-10883364.5	-2565336	-977248	-492155	3620055	3451255	3236921	3371089	2752607	1732333
Net Present Value (NPV) at 12%		₹ 32,46,156									
Financial Internal Rate of Return (FIRR)		16%									
Payback Period	Year -9	-10883365	-13448700	-14425948	-14918104	-11298049	-7846794	-4609873	-1238784	1513823	3246156

g. Mango Nursery Model

Specifications			
Area required to plant MP (in sq.m)		4000	sqm
Plant Spacing (in m)		9	
Plant Spacing (in m)			
Plant Spacing (in m)		444	plants
Mother Plant Block- Open		4000	
Total Investment		1,28,04,733	
Grant/Subsidy	50%	64,02,367	
Promoters contribution	50%	64,02,367	Loan
Discounting factor	12%		
Inflation rate	5.60%		
Residual value	10%		
Price of sapling INR	100		
Polyhouse damaged plastic replaced every 4 years @5%			
Shade net house damaged shade nets replaced every 2 years @5%			

Benefits		
No . of scion stick/ obtained Plants/year	Year-1	0
	Year-2	10
	Year-3	50
	Year-4	150
	Year -5	250
	Year -6 onward	400
Total no. of grafted plants/ year	Year-1	0
	Year-2	4444.4
	Year-3	22222
	Year-4	66667
	Year -5	111111
	Year -6 onward	177778
No. of Plants Ready for Plantation or sale/ year	Year-1	0

Benefits		
	Year-2	3556
	Year-3	17778
	Year -4	53333
	Year -5	88889
	Year -6 onward	142222

Costs			
Particular	Unit	Unit cost (INR)	Total Amount (INR)
Fixed cost			
Fencing - Wire Chain link - 8 ft height in meters	400	600	240000
Workshed in sqm	100	3500	350000
Office - 200 Sq.m out of which 100 sq.m building arae	100	15000	1500000
Land preparation, nursery beds, internal roads, pathways, potting yard	10000	10	100000
Drip irrigation with fertigation	4000	17.5	70000
Natural Ventilated Poly house	3000	1500	4500000
Shadenet House	3000	1000	3000000
Water Storage in Litres	20000	5	100000
Electricity connection KVA	5	5000	25000
Genset KVA	5	10000	50000
Storage in sqm	100	15000	1500000
Office furniture	1	50000	50000
Variable Costs			
Mother Plants - Open Field			
Area for plantation of Mother plant			
Cost of Mother Plants	444	60	26640
Maintenance of mother plants up to 5 years	444	221.21	98217.24
Seeds, Seed Trays, Seed,Sowing, watering & maintenance including insecticide, fungicide and irrigation for one year.	4444	2	8888

Costs			
Particular	Unit	Unit cost (INR)	Total Amount (INR)
Poly bags, Growing media, filling, Transplantation, Grafting and Maintenance including watering, fertilizer, Insecticide, fungicide for one year	4444	8.32	36974.08
Maintenance cost of Plants in INR	4444	2.00	8888
Overheads, General & Fixed Costs			
Land Lease rent	12	35000.00	420000
Water & Electricity (months)	12	5000.00	60000
Farm Manager	12	60000	720000
Supervisor - skilled	12	30000	360000
Insurance	12	10000.00	120000

Year	1	2	3	4	5	6	7	8	9	10
<i>Cash Inflow</i>										
Revenue	0	355600	2093508	6632109.47	11672600	12326266	13016537	13745463	14515209	15328060
Residual Value										1148500
TOTAL REVENUE	0	355600	2093508	6632109	11672600	12326266	13016537	13745463	14515209	16476560
<i>Cash Outflow</i>										
INVESTMENT COSTS										
Fencing - Wire Chain link - 8 ft height in meters	240000									
Workshed in sqm	350000									
Office - 200 Sq.m out of whch 100 sq.m buliting arae	1500000									
Land preparation, nursery beds, internal roads, pathways, potting yard	100000									
Drip irrigation with fertigation	70000									
Natural Ventilated Poly house	4500000				225000					225000
Shadenet House	3000000			150000			150000			150000
Water Storage in Litres	100000									
Electricity connection KVA	25000									
Genset KVA	50000									
Storage in sqm	1500000									
Office furniture	50000									
Sub-Total	11485000	0	0	150000	225000	0	150000	0	0	375000

Year		1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS											
Cost of Mother Plants		26640									
Maintenanc of mother plants		98217.24	98217.24	98217.24	98217.24	98217.24	98217.24	98217.24	98217.24	98217.24	98217.24
		8888.00	44444.00	133334.00	222222.00	355556.00	355556.00	355556.00	355556.00	355556.00	355556.00
Poly bags, Growing media,filling,Transplantaion, Grafting and Maintenance including watering, fertilizer, Insecticide, fungicide for one year		36974.08	184887.04	554669.44	924443.52	1479112.96	1479112.96	1479112.96	1479112.96	1479113	1479112.96
Maintenece cost of Plants in INR		8888.00	44444.00	133334.00	222222.00	355556.00	355556.00	355556.00	355556.00	355556.00	355556.00
Sub Total		179607.32	371992	919555	1467105	2288442	2288442	2288442	2288442	2288442	2288442
OVERHEAD, GENERAL& FIXED COSTS											
Insurance		120000.00	120000.00	120000.00	120000.00	120000.00	120000.00	120000.00	120000.00	120000.00	120000.00
Land rent		420000.00	420000.00	420000.00	420000.00	420000.00	420000.00	420000.00	420000.00	420000.00	420000.00
Water & Electricity (months)		60000	66908	70655	74612	78790	83202	87862	92782	97978	103464
Farm Manager		720000	760320	802898	847860	895340	945479	998426	1054338	1113381	1175730
Supervisor - (skilled)		360000	380160	401449	423930	447670	472740	499213	527169	556691	587865
Sub-Total		1680000	1747388	1815002	1886402	1961801	2041421	2125501	2214289	2308049	2407060
Payment of Principal			1280473	1280473	1280473	1280473	1280473				
Interest Payment		768284	768284	614627	460970	307314	153657				
Debt servicing		768284	2048757	1895101	1741444	1587787	1434130	0	0	0	0
TOTAL COST		14112891	4168138	4629657	5244950	6063030	5763994	4563943	4502731	4596491	5070502
NET BENEFIT /Cashflow		-14112891	-3812538	-2536149	1387159	5609571	6562272	8452594	9242732	9918717	11406058
DISCOUNTED NET BENEFIT		-12600796	-3039331.76	-1805180.72	881564.616	3183021	3324651.3	3823524.073	3732984.27	3576788.9	3672445.49
Net Present Value at 12%	4749671										
Internal Rate of Return (IRR)	17%										
Pay back period	Year-9	-12600796	-15640127.58	-17445308.3	-16563744	-13380723	-10056071	-6232547.31	-2499563.04	1077225.9	4749671.344

h. Pecan nut Nursery Model

Specifications				
Area required to plant MP (in sq.m)			3000	sqm
Plant Spacing (in m)			9	
Plant Spacing (in m)				
Number of mother plants maintained per year			333	plants
Mother Plant Block- Open			4000	
Natural Ventilated Poly House for raising root stock & Grafting	sq.m		2500	
Net House for hardening & Sale	sq.m	2500		
Total Investment			12207505	
Grant/Subsidy		50%	6103752	
Promoters' contribution		50%	6103752	Loan
Discounting factor		12%		
Inflation rate		5.60%		
Residual value		10%		
Price of seedling INR		230	per sapling	
Replacement of damaged plastics of polyhouse every 4 years @5%				
Replacement of damaged plastics of Mist chamber every 4years@5%				
Replacement of damaged nets of Shadenet houses every 2years@5%				

Benefits		
No . of grafted plants per year	Year-2	20
	Year-3	40
	Year-4	60
	Year-5	80
	Year -6	120
	Year -7	150
	Year-8 onward	250
Total no. of budded/grafteted/plants/year	Year-2	6667
	Year-3	13333
	Year-4	20000

Benefits		
	Year-5	50000
	Year -6 onward	83333
No. of Plants Ready for Plantation or sale/ year	Year-2	5333
	Year-3	10667
	Year-4	16000
	Year-5	21333
	Year -6	32000
	Year -7	40000
	Year-8 on ward	66667

Costs			
Particulars	Unit	Unit cost (INR)	Total (INR)
Fixed Costs			
Fencing - Wire Chain link - 8 ft height in meters	400	600	240000
Workshed in sqm	100	3500	350000
Office - 200 Sq.m out of which 100 sq.m building area	100	15000	1500000
Land preparation, nursery beds, internal roads, pathways, potting yard	10000	10	100000
Drip irrigation with fertigation	3000	17.5	52500
Natural Ventilated Poly house	2500	1500	3750000
Mist Chamber	200	2000	400000
Shadenet House	2500	1000	2500000
Water Storage in Litres	20000	5	100000
Electricity connection KVA	5	5000	25000
Genset KVA	5	10000	50000
Storage in sqm	100	15000	1500000
Office furniture	1	50000	50000
Variable Costs			
Mother Plants - Open Field			
Cost of Mother Plants	333	150	49950
Maintenance of mother plants	333	188	62604

Costs			
Particulars	Unit	Unit cost (INR)	Total (INR)
Seeds, Seed Trays, Seed, Sowing, watering & maintenance including insecticide, fungicide and irrigation for one year.	6667	2.000	13334
Poly bags, Growing media,filling, Transplantation, Grafting and Maintenance including watering, fertilizer, Insecticide, fungicide for one year	6667	9.90	66003.3
Maintenance cost of Plants in INR	6667	2.7	18000.9
Water & Electricity (months)	12	5000.00	60000
Manager	12	60000	720000
Supervisor	12	20000	240000
Land Lease rent	12	35000	420000
Insurance	12	10000	120000

Year		1	2	3	4	5	6	7	8	9	10
Cash Inflow											
Revenue			1226590	2453410	3680000	4906590	7360000	9200000	15333410	15333410	15333410
Residual Value											1061750
TOTAL REVENUE			1226590	2453410	3680000	4906590	7360000	9200000	15333410	15333410	16395160
Cash Outflow											
INVESTMENT COSTS											
Fencing - Wire Chain link - 8 ft height in meters		240000									
Workshed in sqm		350000									
Office - 200 Sq.m out of which 100 sq.m building arae		1500000									
Land preparation, nursery beds, internal roads, pathways, potting yard		100000									
Drip irrigation with fertigation		52500									
Natural Ventilated Poly house		3750000				187500					187500
Mist Chamber		400000				20000					20000
Shadenet House		2500000		125000			125000			125000	
Water Storage in Litres		100000									
Electricity connection KVA		25000									
Genset KVA		50000									
Storage in sqm		1500000									
Office furniture		50000									
Sub-Total		10617500	0	125000	0	207500	125000	0	0	125000	207500

Year		1	2	3	4	5	6	7	8	9	10
VARIABLE COSTS											
Cost of Mother Plants		49950									
Maintenanc of mother plants f.		62604.0	62604	62604	62604	62604	62604	62604	62604	62604	62604
Seeds, Seed Trays, Seed,Sowing, watering & maintenance including		13334	26666	40000	53334	80000	110936	162450	251207	410211	707370
Poly bags, Growing media,filling,Transplantaion, Grafting and Maintenance including watering, fertilizer, Insecticide, fungicide for		66003	131997	198000	264003.30	396000	549134	804130	1243476	2030546	3501482
Maintenece cost of Plants in INR		18001	35999	54000	72001	108000	149764	219308	339130	553785	954950
Sub-Total		209892	257266	354604	451942	646604	872439	1248492	1896417	3057146	5226406
OVERHEADS, GENERAL &FIXED COSTS											
Insurance		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
Land rent		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
Water & Electricity (months)		60000	36000	36000	36000	36000	49921	73103	113043	184595	318317
Manager		720000	760320	802898	847860	895340	945479	998426	1054338	1113381	1175730
Supervisor		240000	253440	267633	282620	298447	315160	332809	351446	371127	391910
Subtotal		1560000	1589760	1646531	1706480	1769787	1850561	1944338	2058827	2209103	2425957
Payment of Principal			1220750	1220750	1220750	1220750	1220750				
Interest Payment		732450	732450	585960	439470	292980	146490				
Debt servicing		732450	1953201	1806711	1660221	1513731	1367241	0	0	0	0
TOTAL COST		13119842	3800227	3932845	3818643	4137622	4215240	3192830	3955245	5391249	7859863
NET BENEFIT /Cashflow		-13119842	-2573637	-1479435	-138643	768968	3144760	6007170	11378165	9942161	8535297
DISCOUNTED NET BENEFIT		-11714145	-2051687	-1053033	-88110	436333	1593233	2717339	4595450	3585243	2748137
Net Present Value at 12%	768760										
Internal Rate of Return (IRR)	13%										
Pay back period	Year -10	-11714145.08	-13765832.41	-14818865.22	-14906975.43	-14470642	-12877409	-10160070	-5564620	-1979377	768760

Annexure VII: Details of nurseries

a. Infrastructure details of nurseries visited

S. No.	Name of Nursery	Year of Establishment	Total Area sq.m	Land Cost (Rs)	Fencing/Bo undary walls	Developm ent cost (Rs)	Name of Plant	Variety of plant	Capacity (in Nos)	Mortalit y Of Plants (%)	Quality Testing facilities
1	Kamal Nursery, Bilaspur	Since 2000 However, registere d in 2015	2.0 hectare- 1.0 ha under Mother Plants & 1.0 ha area is under nursery	Ancestral property	Some of the area is fenced	Varied	Apple, Pomegra nate, Mango Citrus, Persimmo n, Kiwi, Plum, Pecan nut	Apple-Michael Anna, Dorset Golden, Pomegranate-Ganesh, Mirdula, Khandhari & Baghwa, Mango- Langra, Dusheheri and Citrus-Baramasi, Persimmon-FUYU, Kiwi-Monty, Allison & Abbott, Plum-Santa rosa, Black amber, Satluj Purple	>1.0 lacs	10-15%	Do not have any Facilities
2	PCDO Name - Bhumpal, Block - Nadaun, District- Hamirpur .	1972	Total area- >1.82 ha, Demo Area- 1.5, Nursery area-0.500 ha.	Departme nt of Horticultu re, HP	Fenced	Varied year over Year	Pomegra nate, Apple, Peach, Plum, Jamun, Mousambi	Apple- Anna, Michael, Dorset Golden, Pomegranate- Bhagwa, Mirdula& Kandhari, Mousambi- Sweet hamlin	>5000	10%	Do not have any Facilities
3	PCDO Name- Palampur, Block- Bhawarna District- Kangra,	1064	Total area- 11.34ha., Demo Area- 3.0, Nursery area-1.0 & Mother Block- 0.740 ha	Departme nt of Horticultu re, HP	Just Fenced	Varied year over Year	Apple, Plum, Sweet Orange ,Walnut, Peach, Pomo,	Apple - Anna, Michael, Dorset Golden, Sweet Orange-PAU-1(Kinnow seedless) & Kiwi- 5 cultivars	>3500	5-10%	Do not have any Facilities

S. No.	Name of Nursery	Year of Establishment	Total Area sq.m	Land Cost (Rs)	Fencing/Bo undary walls	Developm ent cost (Rs)	Name of Plant	Variety of plant	Capacity (in Nos)	Mortalit y Of Plants (%)	Quality Testing facilities
							Persimmon & Kiwi				
4	PCDO Name - Madhan, Block-Sundarnagar District-Mandi	1972	Total area- 2.94 ha., Demo Area- 2.88, Nursery area-0.500	Department of Horticulture, HP	Not Fenced	Varied year over Year	Mango, Litchi & Lime	Mango-Dusheheri, Langra & Chausa, Litchi- Bedana, Dehradun & Shahi	>5000	5-10%	Do not have any Facilities
5	PCDO name- Hara Bagh, Block-Sunder Nagar, District-Mandi	1962	Total area- >3.5 hectare, Demo Area- 3.18 ha and Nursery Area- 0.500 ha	Department of Horticulture, HP	Not Fenced	Varied year over Year	Litchi & Mango	Shahi, Bedana, Rosa Scented Rosa, Dehradun, Mango-Chausa, Dusheri and Langra, Lime-Baramasi & Kagzi lime	21000 imported apple rootstock plants have been planted (Bud9-5000 & geneva 11-16000. Litchi-234 as demo plot. Protected nursery of (200 sq.m) mango and Litchi has been also developed	7-10%	Do not have any Facilities. However, it is PEQ site for imported plants .
6	PCDO name- Dualakaun,	1964	Total area- 1.92 Ha. Demo area-	Department of	Fenced	Varied year over Year	Litchi, Mango, Kinnow,	Litch- Rosa Scented, Dehradun, Kalkattia & Seedless, Mango-	Mother Block is being	5-10%	Do not have any Facilities

S. No.	Name of Nursery	Year of Establishment	Total Area sq.m	Land Cost (Rs)	Fencing/Boundary walls	Development cost (Rs)	Name of Plant	Variety of plant	Capacity (in Nos)	Mortality Of Plants (%)	Quality Testing facilities
	Block-Ponta Sahib, District-Sirmaur		1.14 Ha and Nursery Area-0.400 ha	Horticulture, HP			Pomegranate, Kagzi Lime, Guava	Dusheri & Langra, Guava-Allahabad safeda, Thai Guava & Lalit, Kagzi lime-Seedling & Grafted, Citrus- Kagzi lime, Baramasi, Sweet lime	maintained in 122 bigha area of mentioned fruit crops. Total Plants are >18000		
7	Karan fruit plants nursery, Kotla, Solan	2012	4.0 hectare-1.0 hectare under Maintenance of Mother Plant while 1.0 hectare under nursery management	Ancestral property	Not Fenced		Apple, Plum, Walnut, Peach, Pomegranate, Persimmon & Kiwi	Apple- 20 different cultivars, Plum- Black Amber, Red Beauty, Fronteir, Friar, Mariposa & Santa Rosa, Kiwi- Hayward & Allison, Pomogranate - Bhagwa & Kandhari	Apple-10000, Plum-13000 & Kiwi-6000	12-15%	Do not have any Facilities
8	Fruit nursery, Kandahaghat, Solan	2000- NR	0.5 acre	Ancestral property	Not Fenced	Nominal Year over Year	Plum & Apricot	Plum-Black Amber, Santa Rosa, Meriposa, Red Beauty, Friar & Fortune, Apricot- New Castle, Kesha & Safeda	>7000	10-15%	Do not have any Facilities
	Horticulture Research & Training Station and KVK UHF, Kandaghat Block of	1921	Total area is 6.0 hact, out of which 2.0 hactare is under plantation of mother plant while 2.0 ha is under nursery	Gifted by Maharaja Patiyala	1985	Varied	Apple, Kiwi, Apricot, Plum, Pear, Peach, Persimon, Pomegranate,	Apple-Jeromine, Red Velox, Scartlet spur, Red Chief, Top Red, Gale Gala, Granny Smith & Super Chief, Apricot-New castle, Plum-Black Amber & Red Beaut, Pear-Pekham & Max Red	Apple-4975, Apricot-773, Plum-2186, Pear-849, Peach-1583, Persimmon-224, Pomegranate-500,	10-15%	Main Campus is having TC Lab besides Soil & water analysis lab as well as Biotechnol

S. No.	Name of Nursery	Year of Establishment	Total Area sq.m	Land Cost (Rs)	Fencing/Bo undary walls	Developm ent cost (Rs)	Name of Plant	Variety of plant	Capacity (in Nos)	Mortalit y Of Plants (%)	Quality Testing facilities
	District Solan						Walnut, Bell Pepper & Ornamental plants	Bartlet, Peach-July Elberta, Sun Crest & Glow Haven, Persimmon- Haechia, Jiro & FUYU, Pomegranate-Sindhuri & Kandhari, & Kiwi-Hayward & Allison	Walnut-240 Bell Peer-38500 & Ornamental -195800		ogy Lab and 97ccredited PQ center of the state.
9	PCDO Name -Arki, Block-Kunihar, District - Solan	1964	Cultivable area-1.13 ha, Demo Area-0.480 ha and Nursery area-0.400 ha	Department of Horticulture, HP			Plum, Apricot, Pomegranate, Persimmon, Mango Mosambi, Aonla Guava & Mango etc	Plum-Santa Rosa, Apricot-New Castle, Pomegranate-Kandhari, Persimmon-FUYU, Mago -Dusheri, Citrus- Kinnow & Mosambi	Plum-419 Apricot -900, Pomegranate-800, Persimmon -65, Mago-110, Aonla-20 Kinnow-37, Guava-	5-10%	Do not have any Facilities
10	PCDO name-Dhang, Block-Dhrampur, District-Solan	Govt. Land	Total area-1.68 ha, Demo area-1.60 ha and Nursery area-0.500 ha	Department of Horticulture, HP	NA	NA	NA	NA	NA	NA	Do not have any Facilities
11	Jain Irrigation Systems Limited Jain Plastic Park, PO Box No 72,	1970	900 acres	Current rate is not computed as sector rate varying	Fenced	Varied	Citrus, Mango, Guava, Pomegranate, Leafy vegetable	Guava-Shweta, Allahabad & Lalit, Pomegranate-Bhagwa, Sweet Orange-Hamlin, Westin. Natal Orange, Para & Valencia	>24 crores	10%	Having soil and water analysis lab besides Virology & TC lab accredited

S. No.	Name of Nursery	Year of Establishment	Total Area sq.m	Land Cost (Rs)	Fencing/Bo undary walls	Developm ent cost (Rs)	Name of Plant	Variety of plant	Capacity (in Nos)	Mortalit y Of Plants (%)	Quality Testing facilities
	NH No-6, Bambhori, Jalgaon-425001 Maharashtra, India**			year over year			s, Tuber crops etc				by both NHB and DBT.
12	Central Institute of Subtropical Horticulture, Lucknow			Govt. Land	Fenced	Fenced	Guava, Mango, Plum, Sweet orange, Bael, Jamun	Guava, Mango, Aonla, Bael, Citrus, Plum & Jamun etc	Aonla- 7 Cultivars, Mango-6 Variant, Bael-Five & Jamun-three Varieties	12-18%	Yes
13	Yadav Nursery, Front Malihabad Petrol Pump, Malihabad, Lucknow**	1995 However, registered in 1996	>5.0 hectare in 2-3 places	Current rate is not computed as sector rate change year over year	Fenced both with barbed wire and brick boundary wall	15.0 lacs in 1995-96	Guava and Mango	Guava-Allahabad Safeda, Sardar (L-49), Lalit & Shweta, Mango-Dusheri, Langra, Amarpali and Chausa	>4.5 lacs Guava & Mango-1.0 lak	1%-20%	Do not have any facilities However, organized from CISH, Rehmankh era, Lucknow
14	Kisan Nursery, Mahmood Nagar, Malihabad Lucknow **	Ancestral business since 1950	>6.0 hectare in 4-5 places	Current rate is not computed as sector rate change year over year	Not Fenced	0	Guava	Guava-Allahabad Safeda, Sardar (L-49), Barafkhana, Lalit, Shweta	>7.5 lacs	15-20%	Do not have any facilities However, organized from CISH, Rehmankh era, Lucknow

b. Irrigation Infrastructure and sale details of nurseries visited

S. No.	Name of Nursery	Source of Irrigation (perennial/ ground water)	irrigation facility (Drip/Sprinkler/others)	Open area(in Sq.m)	Covered area (in Sq. m) Poly house/shade net house/others)	Total number of plants sale in last three years			Total sale value in last three year		
						2019	2020	2021	2019	2020	2021
1	Kamal Nursery, Bilaspur	Borewell	All	5.0 acres	NA	0	40000	10000	0	15.0 lacs	7-8 lacs
2	PCDO Name - Bhumpal, Block - Nadaun, District- Hamirpur.	Borewell	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	PCDO Name- Palampur, Block- Bhawarna District- Kangra,	Borewell	All	11.34 Ha	1950 sq meter	3500	3900	4200	NA	NA	NA
4	PCDO Name - Madhan, Block-Sundar Nagar District-Mandi	Borewell	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	PCDO name- Hara Bagh, Block-Sunder Nagar, District- Mandi	Irrigated by overflow of Bhakra Nangal Dam	Manual	>3.5 hact	Nil	6000-7000	6000-7000	6000-7000	Rs 0.95 lakh	Rs1.30 lakh	Rs1.30 lakh
6	PCDO name- Dhuala kaun,	Borewell	All	NA	NA	NA	NA	NA	NA	NA	NA

S. No.	Name of Nursery	Source of Irrigation (perennial/ ground water)	irrigation facility (Drip/Sprinkler/others)	Open area(in Sq.m)	Covered area (in Sq. m) Poly house/shade net house/others)	Total number of plants sale in last three years			Total sale value in last three year		
						2019	2020	2021	2019	2020	2021
	Block-Ponta Sahib, District-Sirmaur										
7	Karan fruit plants nursery	Natural Perennial Source	Manual	4.00	Nil	32000	35000	37000	Rs15.0 lakh	Rs15.0 lakhs	Rs20.0 Lakhs
8	Fruit nursery, Kandahaghat, Solan	Natural Perennial Source	Manual	0.75 acres	200.0 sq meter	1200	2500	>5000	Rs0.30 lakh	Rs0.45 lakh	Rs0.55 Lakh
9	Horticulture Research & Training Station and KVK UHF, Kandaghat Block of District Solan	Natural Perennial Source	All	Total area- 6.0 ha. Nursery-1.0 ha & Mother plant 1.0 hac	3000 sq meter	5865	35463	30800	Rs10.89 Lakh	Rs38.35 Lakh	Rs40.97 Lakh
10	PCDO Name - Arki, Block-Kunihar, District - Solan	Bore well	Manual & Drip	NA	NA	NA	NA	NA	NA	NA	NA
11	PCDO name-Dhang, Block-Dhrampur, District-Solan	Bore well	Manual & Drip	NA	NA	NA	NA	NA	NA	NA	NA
12	Jain Irrigation Systems Limited Jain	Bore well	All	900	150.0 acres	NA	NA	NA	NA	NA	NA

S. No.	Name of Nursery	Source of Irrigation (perennial/ ground water	irrigation facility (Drip/Sprinkler/others	Open area(in Sq.m)	Covered area (in Sq. m) Poly house/shade net house/others)	Total number of plants sale in last three years			Total sale value in last three year		
						2019	2020	2021	2019	2020	2021
	Plastic Park, PO Box No 72, NH No-6, Bambhori, Jalgaon-425001 Maharashtra, India**										
13	Central Institute of Subtropical Horticulture, Lucknow	Bore well	All	10.0acres	3.0 acres	NA	NA	NA	NA	NA	NA
14	Yadav Nursery, Front Maliha bad Petrol Pump, Maliha bad, Lucknow**	Borewell	Manual	1.5 acres	NA	0.55 lakh	0.60 lakh	1.05 Lakh	6.5 lakh	7.5 lakh	18.85 lakh
15	Kisan Nursery, Mahmood Nagar, Maliha bad Lucknow **	Bore well	Manual	2.5 acres	NA	1.5 lakh	1.5 Lakh	0.85 Lakh	18 -20 Lakh	20.0 - 25 Lakh	8.5 lakh

C. Source of funding

S.No.	Nursery name	Detail of source of funding in the development (Visited/Proposed)					Loan Taken (in Rs)			Bank Interest (in %)	
		Total Investment	GOI	State Govt	Individual /Private	Others if	Bank	Private	Other Institution	Bank Interest	others
1	Kamal Nursery	150 to 190 lacs	0	0	Individual /Private	0	0	0	0	0	0
2	PCDO Name - Bhumpal, Block - Nadaun, District- Hamirpur .		GOI	State Govt	Central & State Government	0	0	0	0	0	0
3	PCDO Name- Palampur, Block- Bhawarna District-Kangra,	Rs8.5 crore since 2017-22	World Bank	State Govt	Central & State Government	0	0	0	0	0	0
4	PCDO Name - Madhan, Block- Sunder Nagar District-Mandi	Rs2-3 Lakh /year	GOI	State Govt	Central & State Government	0	0	0	0	0	0
5	PCDO name- Hara Bagh, Block- Sunder Nagar, District- Mandi	Rs2-3 Lakh/ year	GOI	State Govt	Central & State Government	0	0	0	0	0	0
6	PCDO name- Dhuala kuan, Block- Ponta Sahib, District-Sirmaur	Rs2-3 Lakh/ year	GOI	State Govt	Central & State Government	0	0	0	0	0	0
7	Karan fruit plants nursery	Rs2-3 Lakh/ year	0	0	Individual /Private	0	0	0	0	0	0

S.No.	Nursery name	Detail of source of funding in the development (Visited/Proposed)					Loan Taken (in Rs)			Bank Interest (in %)	
		Total Investment	GOI	State Govt	Individual /Private	Others if	Bank	Private	Other Institution	Bank Interest	others
	Horticulture Research & Training Station and KVK UHF, Kandaghat Block of District Solan	NA	GOI	State Govt	Central & State Government	NA	NA	NA	NA	NA	NA
8	Fruit nursery, Kandaghat	Rs2.0 -3.0 lakh/year	0	0	Individual /Private	0	0	0	0	0	0
9	PCDO Name -Arki, Block-Kunihar, District -Solan	NA	GOI	State Govt	Central & State Government	0	0	0	0	0	0
10	PCDO name-Dhang, Block-Dhrampur, District-Solan	NA	GOI	State Govt	Central & State Government	0	0	0	0	0	0
11	Jain Irrigation Systems Limited Jain Plastic Park, PO Box No 72, NH No-6, Bambhori, Jalgaon-425001 Maharashtra, India**	NA	0	0	Individual /Private	NA	NA	NA	NA	NA	NA
12	Central Institute of Subtropical Horticulture, Lucknow	NA	GOI	State Govt	Central & State Government	NA	NA	NA	NA	NA	NA
13	Yadav Nursery, Front Malihabad Petrol Pump, Malihabad, Lucknow**	Rs12-15 lakh	0	0	Individual /Private	0	0	0	0	0	0
14	Kisan Nursery, Mahmood Nagar, Malihabad Lucknow **	Rs15-20 lakh	0	0	Individual /Private	0	0	0	0	0	0

d. Harvesting Season of fruit plants

S. No	Name of Plant (Crop)	Name of Variety	Harvesting periods of the Plantation					
			Normal Season (in the Months)	No. of Days	Peak Season (in the Months)	No. of Days	Lean Season (in the Months)	No. of Days
1	Sweet Orange	All varieties	November to January	90 days	Mid November to End of December	45 days	End of December to Jan	30 days
2	Guava	Lalit, Shweta, VNR Bihi	November to January	90 days	Mid Nov to Mid-December	30 days	Mid Dec- Mid Jan	30 days
3	Litchi	Dehradun, Calcattia	May -July	60 days	End of May to End June	45 days	First fortnight of July	15 days
4	Pomegranate	Bhagwa	September to November	90	Mid-September to Mid-October	30 days	Mid October to Mid-November	30 days
5	Persimmon	FYYU/ Jiro	September to November	60 days	End of September to mid-November	45 days	Mid November to mid-December	30 days
6	Plum	Santa Rosa	May-June	60 day	Mid May to Mid-June	30 days	II fortnight of June	15 days
		Red Beauty	May- June	60 days	End of May to Mid-June	30days	II fortnight of June	15 days
7	Pecan nut	Mahan	Mid-September to mid Nov	60 days	End of September to I week of November	45 days	Mid Nov to End November	15 days
		Nellis/ Berket	October to November	60 days	I week of October to Mid-November	45 days	Mid November to End November	15 days
8	Mango	Mallika (Late season Variety)	July - September	90 days	Mid July-Mid-August	30 days	Mid-August- I week of September	22 days
		Pusa Arunima	August-September	90 days	Mid August-Mid September	30 days	End Sep-End of October	30 days

e. Planting material requirement- Demand analysis

Year	Name of Plant	Variety	Feb-March Period (in Nos)	July- Aug Period (in Nos)
2023	Sweet Orange	Valencia	14582	34024
2023	Sweet Orange	Hamelin	14582	34024
2023	Sweet Orange	Natal	14582	34024
2023	Sweet Orange	Pera	14582	34024
2023	Sweet Orange	Westin	14582	34024
2023	Sweet Orange	Jaffa	14582	34024
2023	Sweet Orange	Blood Red	14582	34024
2023	Sweet Orange	Mosambi (Andhra)	14582	34024
2023	Guava	Lalit	33330	77770
2023	Guava	Shwetha	33330	77770
2023	Guava	VNR Bihi	33330	77770
2023	Pomegranate	Bhagwa	33330	77770
2023	Litchi	Dehradun	14063	32813
2023	Litchi	Calcuttia	14063	32813
2023	Persimmon	Fuyu	2344	5469
2023	Persimmon	Jiro	2344	5469
2023	Plum	Black Amber	2344	5469
2023	Plum	Santa Rosa	2344	5469
2023	Mango	Mallika	4166	9721
2023	Mango	Pusa Arunima	4166	9721
2023	Pecan Nut	Mahan	1043	2433
2023	Pecan Nut	Nellis	1043	2433
2024	Sweet Orange	Valencia	14582	34024
2024	Sweet Orange	Hamelin	14582	34024
2024	Sweet Orange	Natal	14582	34024
2024	Sweet Orange	Pera	14582	34024
2024	Sweet Orange	Westin	14582	34024
2024	Sweet Orange	Jaffa	14582	34024
2024	Sweet Orange	Blood Red	14582	34024
2024	Sweet Orange	Mosambi (Andhra)	14582	34024
2024	Guava	Lalit	33330	77770
2024	Guava	Shwetha	33330	77770
2024	Guava	VNR Bihi	33330	77770
2024	Pomegranate	Bhagwa	33330	77770
2024	Litchi	Dehradun	14063	32813
2024	Litchi	Calcuttia	14063	32813
2024	Persimmon	Fuyu	2344	5469
2024	Persimmon	Jiro	2344	5469
2024	Plum	Black Amber	2344	5469
2024	Plum	Santa Rosa	2344	5469
2024	Mango	Mallika	4166	9721
2024	Mango	Pusa Arunima	4166	9721
2024	Pecan Nut	Mahan	1043	2433
2024	Pecan Nut	Nellis	1043	2433
2025	Sweet Orange	Valencia	14582	34024
2025	Sweet Orange	Hamelin	14582	34024
2025	Sweet Orange	Natal	14582	34024
2025	Sweet Orange	Pera	14582	34024
2025	Sweet Orange	Westin	14582	34024
2025	Sweet Orange	Jaffa	14582	34024

Year	Name of Plant	Variety	Feb-March Period (in Nos)	July- Aug Period (in Nos)
2025	Sweet Orange	Blood Red	14582	34024
2025	Sweet Orange	Mosambi (Andhra)	14582	34024
2025	Guava	Lalit	33330	77770
2025	Guava	Shwetha	33330	77770
2025	Guava	VNR Bihi	33330	77770
2025	Pomegranate	Bhagwa	33330	77770
2025	Litchi	Dehradun	14063	32813
2025	Litchi	Calcuttia	14063	32813
2025	Persimmon	Fuyu	2344	5469
2025	Persimmon	Jiro	2344	5469
2025	Plum	Black Amber	2344	5469
2025	Plum	Santa Rosa	2344	5469
2025	Mango	Mallika	4166	9721
2025	Mango	Pusa Arunima	4166	9721
2025	Pecan Nut	Mahan	1043	2433
2025	Pecan Nut	Nellis	1043	2433
2026	Sweet Orange	Valencia	29164	68049
2026	Sweet Orange	Hamelin	29164	68049
2026	Sweet Orange	Natal	29164	68049
2026	Sweet Orange	Pera	29164	68049
2026	Sweet Orange	Westin	29164	68049
2026	Sweet Orange	Jaffa	29164	68049
2026	Sweet Orange	Blood Red	29164	68049
2026	Sweet Orange	Mosambi (Andhra)	29164	68049
2026	Guava	Lalit	66660	155540
2026	Guava	Shwetha	66660	155540
2026	Guava	VNR Bihi	66660	155540
2026	Pomegranate	Bhagwa	66660	155540
2026	Litchi	Dehradun	28125	65625
2026	Litchi	Calcuttia	28125	65625
2026	Persimmon	Fuyu	4688	10938
2026	Persimmon	Jiro	4688	10938
2026	Plum	Black Amber	4688	10938
2026	Plum	Santa Rosa	4688	10938
2026	Mango	Mallika	8333	19443
2026	Mango	Pusa Arunima	8333	19443
2026	Pecan Nut	Mahan	2085	4865
2026	Pecan Nut	Nellis	2085	4865
2027	Sweet Orange	Valencia	36455	85061
2027	Sweet Orange	Hamelin	36455	85061
2027	Sweet Orange	Natal	36455	85061
2027	Sweet Orange	Pera	36455	85061
2027	Sweet Orange	Westin	36455	85061
2027	Sweet Orange	Jaffa	36455	85061
2027	Sweet Orange	Blood Red	36455	85061
2027	Sweet Orange	Mosambi (Andhra)	36455	85061
2027	Guava	Lalit	83325	194425
2027	Guava	Shwetha	83325	194425
2027	Guava	VNR Bihi	83325	194425
2027	Pomegranate	Bhagwa	83325	194425
2027	Litchi	Dehradun	35156	82031
2027	Litchi	Calcuttia	35156	82031

Year	Name of Plant	Variety	Feb-March Period (in Nos)	July- Aug Period (in Nos)
2027	Persimmon	Fuyu	5859	13672
2027	Persimmon	Jiro	5859	13672
2027	Plum	Black Amber	5859	13672
2027	Plum	Santa Rosa	5859	13672
2027	Mango	Mallika	10416	24303
2027	Mango	Pusa Arunima	10416	24303
2027	Pecan Nut	Mahan	2606	6081
2027	Pecan Nut	Nellis	2606	6081
2028	Sweet Orange	Valencia	36455	85061
2028	Sweet Orange	Hamelin	36455	85061
2028	Sweet Orange	Natal	36455	85061
2028	Sweet Orange	Pera	36455	85061
2028	Sweet Orange	Westin	36455	85061
2028	Sweet Orange	Jaffa	36455	85061
2028	Sweet Orange	Blood Red	36455	85061
2028	Sweet Orange	Mosambi (Andhra)	36455	85061
2028	Guava	Lalit	83325	194425
2028	Guava	Shwetha	83325	194425
2028	Guava	VNR Bihi	83325	194425
2028	Pomegranate	Bhagwa	83325	194425
2028	Litchi	Dehradun	35156	82031
2028	Litchi	Calcuttia	35156	82031
2028	Persimmon	Fuyu	5859	13672
2028	Persimmon	Jiro	5859	13672
2028	Plum	Black Amber	5859	13672
2028	Plum	Santa Rosa	5859	13672
2028	Mango	Mallika	10416	24303
2028	Mango	Pusa Arunima	10416	24303
2028	Pecan Nut	Mahan	2606	6081
2028	Pecan Nut	Nellis	2606	6081

f. Total Availability Analysis of Plants with Proposed Nurseries

Year	Name of Nursery	Name of Plant	Variety	Total Availability with Nurseries (in Nos)		
				Feb-March Period	July-Period	Aug
2023	Sweet Orange	Sweet Orange	Valencia	0		0
2023	Sweet Orange	Sweet Orange	Hamelin	0		0
2023	Sweet Orange	Sweet Orange	Natal	0		0
2023	Sweet Orange	Sweet Orange	Pera	0		0
2023	Sweet Orange	Sweet Orange	Westin	0		0
2023	Sweet Orange	Sweet Orange	Jaffa	0		0
2023	Sweet Orange	Sweet Orange	Blood Red	0		0
2023	Sweet Orange	Sweet Orange	Mosambi (Andhra)	0		0
2023	Guava	Guava	Lalit	0		0
2023	Guava	Guava	Shwetha	0		0
2023	Guava	Guava	VNR Bihi	0		0
2023	Pomegranate	Pomegranate	Bhagwa	0		0
2023	Litchi	Litchi	Dehradun	0		0
2023	Litchi	Litchi	Calcuttia	0		0
2023	Persimmon	Persimmon	Fuyu	0		0
2023	Persimmon	Persimmon	Jiro	0		0
2023	Plum	Plum	Black Amber	0		0
2023	Plum	Plum	Santa Rosa	0		0
2023	Mango	Mango	Mallika	0		0
2023	Mango	Mango	Pusa Arunima	0		0
2023	Pecan Nut	Pecan Nut	Mahan	0		0
2023	Pecan Nut	Pecan Nut	Nellis	0		0
2024	Sweet Orange	Sweet Orange	Valencia	0		0
2024	Sweet Orange	Sweet Orange	Hamelin	0		0
2024	Sweet Orange	Sweet Orange	Natal	0		0
2024	Sweet Orange	Sweet Orange	Pera	0		0
2024	Sweet Orange	Sweet Orange	Westin	0		0
2024	Sweet Orange	Sweet Orange	Jaffa	0		0
2024	Sweet Orange	Sweet Orange	Blood Red	0		0
2024	Sweet Orange	Sweet Orange	Mosambi (Andhra)	0		0
2024	Guava	Guava	Lalit	0		0
2024	Guava	Guava	Shwetha	0		0
2024	Guava	Guava	VNR Bihi	0		0
2024	Pomegranate	Pomegranate	Bhagwa	0		0
2024	Litchi	Litchi	Dehradun	0		0
2024	Litchi	Litchi	Calcuttia	0		0
2024	Persimmon	Persimmon	Fuyu	0		0
2024	Persimmon	Persimmon	Jiro	0		0
2024	Plum	Plum	Black Amber	0		0
2024	Plum	Plum	Santa Rosa	0		0
2024	Mango	Mango	Mallika	0		0
2024	Mango	Mango	Pusa Arunima	0		0
2024	Pecan Nut	Pecan Nut	Mahan	0		0
2024	Pecan Nut	Pecan Nut	Nellis	0		0
2025	Sweet Orange	Sweet Orange	Valencia	0		0

Year	Name of Nursery	Name of Plant	Variety	Total Availability with Nurseries (in Nos)		
				Feb-March Period	July-Period	Aug
2025	Sweet Orange	Sweet Orange	Hamelin	0	0	
2025	Sweet Orange	Sweet Orange	Natal	0	0	
2025	Sweet Orange	Sweet Orange	Pera	0	0	
2025	Sweet Orange	Sweet Orange	Westin	0	0	
2025	Sweet Orange	Sweet Orange	Jaffa	0	0	
2025	Sweet Orange	Sweet Orange	Blood Red	0	0	
2025	Sweet Orange	Sweet Orange	Mosambi (Andhra)	0	0	
2025	Guava	Guava	Lalit	0	0	
2025	Guava	Guava	Shwetha	0	0	
2025	Guava	Guava	VNR Bihi	0	0	
2025	Pomegranate	Pomegranate	Bhagwa	0	0	
2025	Litchi	Litchi	Dehradun	0	0	
2025	Litchi	Litchi	Calcuttia	0	0	
2025	Persimmon	Persimmon	Fuyu	0	0	
2025	Persimmon	Persimmon	Jiro	0	0	
2025	Plum	Plum	Black Amber	0	0	
2025	Plum	Plum	Santa Rosa	0	0	
2025	Mango	Mango	Mallika	0	0	
2025	Mango	Mango	Pusa Arunima	0	0	
2025	Pecan Nut	Pecan Nut	Mahan	0	0	
2025	Pecan Nut	Pecan Nut	Nellis	0	0	
2026	Sweet Orange	Sweet Orange	Valencia	1980	4620	
2026	Sweet Orange	Sweet Orange	Hamelin	1980	4620	
2026	Sweet Orange	Sweet Orange	Natal	1980	4620	
2026	Sweet Orange	Sweet Orange	Pera	1980	4620	
2026	Sweet Orange	Sweet Orange	Westin	1980	4620	
2026	Sweet Orange	Sweet Orange	Jaffa	1980	4620	
2026	Sweet Orange	Sweet Orange	Blood Red	1980	4620	
2026	Sweet Orange	Sweet Orange	Mosambi (Andhra)	1980	4620	
2026	Guava	Guava	Lalit	5280	12320	
2026	Guava	Guava	Shwetha	5280	12320	
2026	Guava	Guava	VNR Bihi	5280	12320	
2026	Pomegranate	Pomegranate	Bhagwa	5130	11970	
2026	Litchi	Litchi	Dehradun	2667	6222	
2026	Litchi	Litchi	Calcuttia	2667	6222	
2026	Persimmon	Persimmon	Fuyu	1980	4620	
2026	Persimmon	Persimmon	Jiro	1980	4620	
2026	Plum	Plum	Black Amber	2664	6216	
2026	Plum	Plum	Santa Rosa	2664	6216	
2026	Mango	Mango	Mallika	533	1244	
2026	Mango	Mango	Pusa Arunima	533	1244	
2026	Pecan Nut	Pecan Nut	Mahan	800	1867	
2026	Pecan Nut	Pecan Nut	Nellis	800	1867	
2027	Sweet Orange	Sweet Orange	Valencia	3960	9240	
2027	Sweet Orange	Sweet Orange	Hamelin	3960	9240	
2027	Sweet Orange	Sweet Orange	Natal	3960	9240	
2027	Sweet Orange	Sweet Orange	Pera	3960	9240	
2027	Sweet Orange	Sweet Orange	Westin	3960	9240	
2027	Sweet Orange	Sweet Orange	Jaffa	3960	9240	

Year	Name of Nursery	Name of Plant	Variety	Total Availability with Nurseries (in Nos)		
				Feb-March Period	July-Period	Aug
2027	Sweet Orange	Sweet Orange	Blood Red	3960		9240
2027	Sweet Orange	Sweet Orange	Mosambi (Andhra)	3960		9240
2027	Guava	Guava	Lalit	10560		24640
2027	Guava	Guava	Shwetha	10560		24640
2027	Guava	Guava	VNR Bihi	10560		24640
2027	Pomegranate	Pomegranate	Bhagwa	11400		26600
2027	Litchi	Litchi	Dehradun	4267		9956
2027	Litchi	Litchi	Calcuttia	4267		9956
2027	Persimmon	Persimmon	Fuyu	3996		9324
2027	Persimmon	Persimmon	Jiro	3996		9324
2027	Plum	Plum	Black Amber	5328		12432
2027	Plum	Plum	Santa Rosa	5328		12432
2027	Mango	Mango	Mallika	2667		6222
2027	Mango	Mango	Pusa Arunima	2667		6222
2027	Pecan Nut	Pecan Nut	Mahan	1600		3733
2027	Pecan Nut	Pecan Nut	Nellis	1600		3733
2028	Sweet Orange	Sweet Orange	Valencia	5940		13860
2028	Sweet Orange	Sweet Orange	Hamelin	5940		13860
2028	Sweet Orange	Sweet Orange	Natal	5940		13860
2028	Sweet Orange	Sweet Orange	Pera	5940		13860
2028	Sweet Orange	Sweet Orange	Westin	5940		13860
2028	Sweet Orange	Sweet Orange	Jaffa	5940		13860
2028	Sweet Orange	Sweet Orange	Blood Red	5940		13860
2028	Sweet Orange	Sweet Orange	Mosambi (Andhra)	5940		13860
2028	Guava	Guava	Lalit	15840		36960
2028	Guava	Guava	Shwetha	15840		36960
2028	Guava	Guava	VNR Bihi	15840		36960
2028	Pomegranate	Pomegranate	Bhagwa	34200		79800
2028	Litchi	Litchi	Dehradun	8533		19911
2028	Litchi	Litchi	Calcuttia	8533		19911
2028	Persimmon	Persimmon	Fuyu	7992		18648
2028	Persimmon	Persimmon	Jiro	7992		18648
2028	Plum	Plum	Black Amber	7992		18648
2028	Plum	Plum	Santa Rosa	7992		18648
2028	Mango	Mango	Mallika	8000		18667
2028	Mango	Mango	Pusa Arunima	8000		18667
2028	Pecan Nut	Pecan Nut	Mahan	2400		5600
2028	Pecan Nut	Pecan Nut	Nellis	2400		5600

g. Gap analysis summary

Year	Name of Nursery	Name of Plant	Variety	Total Demand of Plants (in Nos)		Total Availability with Nurseries (Nos)		Gaps of Availability (in Nos)		Gaps in % age	
				Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug
2023	Sweet Orange	Sweet Orange	Valencia	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Hamelin	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Natal	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Pera	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Westin	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Jaffa	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Blood Red	14582	34024	0	0	14582	34024	100%	100%
2023	Sweet Orange	Sweet Orange	Mosambi (Andhra)	14582	34024	0	0	14582	34024	100%	100%
2023	Guava	Guava	Lalit	33330	77770	0	0	33330	77770	100%	100%
2023	Guava	Guava	Shwetha	33330	77770	0	0	33330	77770	100%	100%
2023	Guava	Guava	VNR Bihi	33330	77770	0	0	33330	77770	100%	100%
2023	Pomegranate	Pomegranate	Bhagwa	33330	77770	0	0	33330	77770	100%	100%
2023	Litchi	Litchi	Dehradun	14063	32813	0	0	14063	32813	100%	100%
2023	Litchi	Litchi	Calcuttia	14063	32813	0	0	14063	32813	100%	100%
2023	Persimmon	Persimmon	Fuyu	2344	5469	0	0	2344	5469	100%	100%
2023	Persimmon	Persimmon	Jiro	2344	5469	0	0	2344	5469	100%	100%
2023	Plum	Plum	Black Amber	2344	5469	0	0	2344	5469	100%	100%
2023	Plum	Plum	Santa Rosa	2344	5469	0	0	2344	5469	100%	100%
2023	Mango	Mango	Mallika	4166	9721	0	0	4166	9721	100%	100%
2023	Mango	Mango	Pusa Arunima	4166	9721	0	0	4166	9721	100%	100%
2023	Pecan Nut	Pecan Nut	Mahan	1043	2433	0	0	1043	2433	100%	100%
2023	Pecan Nut	Pecan Nut	Nellis	1043	2433	0	0	1043	2433	100%	100%

Year	Name of Nursery	Name of Plant	Variety	Total Demand of Plants (in Nos)		Total Availability with Nurseries (Nos)		Gaps of Availability (in Nos)		Gaps in % age	
				Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug
2024	Sweet Orange	Sweet Orange	Valencia	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Hamelin	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Natal	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Pera	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Westin	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Jaffa	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Blood Red	14582	34024	0	0	14582	34024	100%	100%
2024	Sweet Orange	Sweet Orange	Mosambi (Andhra)	14582	34024	0	0	14582	34024	100%	100%
2024	Guava	Guava	Lalit	33330	77770	0	0	33330	77770	100%	100%
2024	Guava	Guava	Shwetha	33330	77770	0	0	33330	77770	100%	100%
2024	Guava	Guava	VNR Bihi	33330	77770	0	0	33330	77770	100%	100%
2024	Pomegranate	Pomegranate	Bhagwa	33330	77770	0	0	33330	77770	100%	100%
2024	Litchi	Litchi	Dehradun	14063	32813	0	0	14063	32813	100%	100%
2024	Litchi	Litchi	Calcuttia	14063	32813	0	0	14063	32813	100%	100%
2024	Persimmon	Persimmon	Fuyu	2344	5469	0	0	2344	5469	100%	100%
2024	Persimmon	Persimmon	Jiro	2344	5469	0	0	2344	5469	100%	100%
2024	Plum	Plum	Black Amber	2344	5469	0	0	2344	5469	100%	100%
2024	Plum	Plum	Santa Rosa	2344	5469	0	0	2344	5469	100%	100%
2024	Mango	Mango	Mallika	4166	9721	0	0	4166	9721	100%	100%
2024	Mango	Mango	Pusa Arunima	4166	9721	0	0	4166	9721	100%	100%
2024	Pecan Nut	Pecan Nut	Mahan	1043	2433	0	0	1043	2433	100%	100%
2024	Pecan Nut	Pecan Nut	Nellis	1043	2433	0	0	1043	2433	100%	100%
2025	Sweet Orange	Sweet Orange	Valencia	14582	34024	0	0	14582	34024	100%	100%
2025	Sweet Orange	Sweet Orange	Hamelin	14582	34024	0	0	14582	34024	100%	100%
2025	Sweet Orange	Sweet Orange	Natal	14582	34024	0	0	14582	34024	100%	100%

Year	Name of Nursery	Name of Plant	Variety	Total Demand of Plants (in Nos)		Total Availability with Nurseries (Nos)		Gaps of Availability (in Nos)		Gaps in % age	
				Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug
2025	Sweet Orange	Sweet Orange	Pera	14582	34024	0	0	14582	34024	100%	100%
2025	Sweet Orange	Sweet Orange	Westin	14582	34024	0	0	14582	34024	100%	100%
2025	Sweet Orange	Sweet Orange	Jaffa	14582	34024	0	0	14582	34024	100%	100%
2025	Sweet Orange	Sweet Orange	Blood Red	14582	34024	0	0	14582	34024	100%	100%
2025	Sweet Orange	Sweet Orange	Mosambi (Andhra)	14582	34024	0	0	14582	34024	100%	100%
2025	Guava	Guava	Lalit	33330	77770	0	0	33330	77770	100%	100%
2025	Guava	Guava	Shwetha	33330	77770	0	0	33330	77770	100%	100%
2025	Guava	Guava	VNR Bihi	33330	77770	0	0	33330	77770	100%	100%
2025	Pomegranate	Pomegranate	Bhagwa	33330	77770	0	0	33330	77770	100%	100%
2025	Litchi	Litchi	Dehradun	14063	32813	0	0	14063	32813	100%	100%
2025	Litchi	Litchi	Calcuttia	14063	32813	0	0	14063	32813	100%	100%
2025	Persimmon	Persimmon	Fuyu	2344	5469	0	0	2344	5469	100%	100%
2025	Persimmon	Persimmon	Jiro	2344	5469	0	0	2344	5469	100%	100%
2025	Plum	Plum	Black Amber	2344	5469	0	0	2344	5469	100%	100%
2025	Plum	Plum	Santa Rosa	2344	5469	0	0	2344	5469	100%	100%
2025	Mango	Mango	Mallika	4166	9721	0	0	4166	9721	100%	100%
2025	Mango	Mango	Pusa Arunima	4166	9721	0	0	4166	9721	100%	100%
2025	Pecan Nut	Pecan Nut	Mahan	1043	2433	0	0	1043	2433	100%	100%
2025	Pecan Nut	Pecan Nut	Nellis	1043	2433	0	0	1043	2433	100%	100%
2026	Sweet Orange	Sweet Orange	Valencia	29164	68049	1980	4620	27184	63429	93%	93%
2026	Sweet Orange	Sweet Orange	Hamelin	29164	68049	1980	4620	27184	63429	93%	93%
2026	Sweet Orange	Sweet Orange	Natal	29164	68049	1980	4620	27184	63429	93%	93%
2026	Sweet Orange	Sweet Orange	Pera	29164	68049	1980	4620	27184	63429	93%	93%
2026	Sweet Orange	Sweet Orange	Westin	29164	68049	1980	4620	27184	63429	93%	93%
2026	Sweet Orange	Sweet Orange	Jaffa	29164	68049	1980	4620	27184	63429	93%	93%

Year	Name of Nursery	Name of Plant	Variety	Total Demand of Plants (in Nos)		Total Availability with Nurseries (Nos)		Gaps of Availability (in Nos)		Gaps in % age	
				Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug
2026	Sweet Orange	Sweet Orange	Blood Red	29164	68049	1980	4620	27184	63429	93%	93%
2026	Sweet Orange	Sweet Orange	Mosambi (Andhra)	29164	68049	1980	4620	27184	63429	93%	93%
2026	Guava	Guava	Lalit	66660	155540	5280	12320	61380	143220	92%	92%
2026	Guava	Guava	Shwetha	66660	155540	5280	12320	61380	143220	92%	92%
2026	Guava	Guava	VNR Bihi	66660	155540	5280	12320	61380	143220	92%	92%
2026	Pomegranate	Pomegranate	Bhagwa	66660	155540	5130	11970	61530	143570	92%	92%
2026	Litchi	Litchi	Dehradun	28125	65625	2667	6222	25458	59403	91%	91%
2026	Litchi	Litchi	Calcuttia	28125	65625	2667	6222	25458	59403	91%	91%
2026	Persimmon	Persimmon	Fuyu	4688	10938	1980	4620	2708	6318	58%	58%
2026	Persimmon	Persimmon	Jiro	4688	10938	1980	4620	2708	6318	58%	58%
2026	Plum	Plum	Black Amber	4688	10938	2664	6216	2024	4722	43%	43%
2026	Plum	Plum	Santa Rosa	4688	10938	2664	6216	2024	4722	43%	43%
2026	Mango	Mango	Mallika	8333	19443	533	1244	7800	18199	94%	94%
2026	Mango	Mango	Pusa Arunima	8333	19443	533	1244	7800	18199	94%	94%
2026	Pecan Nut	Pecan Nut	Mahan	2085	4865	800	1867	1285	2998	62%	62%
2026	Pecan Nut	Pecan Nut	Nellis	2085	4865	800	1867	1285	2998	62%	62%
2027	Sweet Orange	Sweet Orange	Valencia	36455	85061	3960	9240	32495	75821	89%	89%
2027	Sweet Orange	Sweet Orange	Hamelin	36455	85061	3960	9240	32495	75821	89%	89%
2027	Sweet Orange	Sweet Orange	Natal	36455	85061	3960	9240	32495	75821	89%	89%
2027	Sweet Orange	Sweet Orange	Pera	36455	85061	3960	9240	32495	75821	89%	89%
2027	Sweet Orange	Sweet Orange	Westin	36455	85061	3960	9240	32495	75821	89%	89%
2027	Sweet Orange	Sweet Orange	Jaffa	36455	85061	3960	9240	32495	75821	89%	89%
2027	Sweet Orange	Sweet Orange	Blood Red	36455	85061	3960	9240	32495	75821	89%	89%

Year	Name of Nursery	Name of Plant	Variety	Total Demand of Plants (in Nos)		Total Availability with Nurseries (Nos)		Gaps of Availability (in Nos)		Gaps in % age	
				Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug
2027	Sweet Orange	Sweet Orange	Mosambi (Andhra)	36455	85061	3960	9240	32495	75821	89%	89%
2027	Guava	Guava	Lalit	83325	194425	10560	24640	72765	169785	87%	87%
2027	Guava	Guava	Shwetha	83325	194425	10560	24640	72765	169785	87%	87%
2027	Guava	Guava	VNR Bihi	83325	194425	10560	24640	72765	169785	87%	87%
2027	Pomegranate	Pomegranate	Bhagwa	83325	194425	11400	26600	71925	167825	86%	86%
2027	Litchi	Litchi	Dehradun	35156	82031	4267	9956	30889	72075	88%	88%
2027	Litchi	Litchi	Calcuttia	35156	82031	4267	9956	30889	72075	88%	88%
2027	Persimmon	Persimmon	Fuyu	5859	13672	3996	9324	1863	4348	32%	32%
2027	Persimmon	Persimmon	Jiro	5859	13672	3996	9324	1863	4348	32%	32%
2027	Plum	Plum	Black Amber	5859	13672	5328	12432	531	1240	9%	9%
2027	Plum	Plum	Santa Rosa	5859	13672	5328	12432	531	1240	9%	9%
2027	Mango	Mango	Mallika	10416	24303	2667	6222	7749	18081	74%	74%
2027	Mango	Mango	Pusa Arunima	10416	24303	2667	6222	7749	18081	74%	74%
2027	Pecan Nut	Pecan Nut	Mahan	2606	6081	1600	3733	1006	2348	39%	39%
2027	Pecan Nut	Pecan Nut	Nellis	2606	6081	1600	3733	1006	2348	39%	39%
2028	Sweet Orange	Sweet Orange	Valencia	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Hamelin	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Natal	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Pera	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Westin	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Jaffa	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Blood Red	36455	85061	5940	13860	30515	71201	84%	84%
2028	Sweet Orange	Sweet Orange	Mosambi (Andhra)	36455	85061	5940	13860	30515	71201	84%	84%
2028	Guava	Guava	Lalit	83325	194425	15840	36960	67485	157465	81%	81%

Year	Name of Nursery	Name of Plant	Variety	Total Demand of Plants (in Nos)		Total Availability with Nurseries (Nos)		Gaps of Availability (in Nos)		Gaps in % age	
				Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug	Feb-March	July-Aug
2028	Guava	Guava	Shwetha	83325	194425	15840	36960	67485	157465	81%	81%
2028	Guava	Guava	VNR Bihi	83325	194425	15840	36960	67485	157465	81%	81%
2028	Pomegranate	Pomegranate	Bhagwa	83325	194425	34200	79800	49125	114625	59%	59%
2028	Litchi	Litchi	Dehradun	35156	82031	8533	19911	26623	62120	76%	76%
2028	Litchi	Litchi	Calcuttia	35156	82031	8533	19911	26623	62120	76%	76%
2028	Persimmon	Persimmon	Fuyu	5859	13672	7992	18648	-2133	-4976	-36%	-36%
2028	Persimmon	Persimmon	Jiro	5859	13672	7992	18648	-2133	-4976	-36%	-36%
2028	Plum	Plum	Black Amber	5859	13672	7992	18648	-2133	-4976	-36%	-36%
2028	Plum	Plum	Santa Rosa	5859	13672	7992	18648	-2133	-4976	-36%	-36%
2028	Mango	Mango	Mallika	10416	24303	8000	18667	2416	5636	23%	23%
2028	Mango	Mango	Pusa Arunima	10416	24303	8000	18667	2416	5636	23%	23%
2028	Pecan Nut	Pecan Nut	Mahan	2606	6081	2400	5600	206	481	8%	8%
2028	Pecan Nut	Pecan Nut	Nellis	2606	6081	2400	5600	206	481	8%	8%

Annexure VIII: Proforma for collecting data

a. Proforma for collecting metrological data

S.No.	Months	Temperature			Relative humidity			Wind speed	Sun Shine	Rainfall	No of rainy days	Evaporation
		*C			(%)							
		Max.	Mini	Mean	Morn.	Even.	Mean	Km/hr	(hrs)	(mm)	(no's)	(mm)
1	Jan											
2	Feb											
3	March											
4	April											
5	May											
6	June											
7	July											
8	August											
9	September											
10	October											
11	November											
12	December											

b. Proforma for soil analysis

Tests	Protocol	
MECHANICAL ANALYSIS		
Sand: Silt: Clay	International pipette method	
Gravel (%)	Manual sieving method	Sieving method
Physicochemical Analysis		
pH	IS 2720:PART 26:1987 (Reaff. 2002)	1:2. 5: soil : water Direct reading on “pH meter as per IS method
Electrical Conductivity (mmhos/cm)	APHA 21 st EDN:2005	Direct reading of soil water suspension by Conductivity meter
Total Soluble Salts	IS 2720:PART 21:1977 (Reaff. 2006)	10gram soil dissolved in 100ml water filtered and 50ml clear filtrate evaporated and soluble solids determined
Sodium Absorption Ratio (SAR)	Soil chemical analysis by Hesse	By calculation SAR =Na/ square root of (Ca+Mg)/2
Exchangeable Sodium (m.eq./100 gm of soil)	Soil chemical analysis by Hesse	1N NH4Ac extraction, analysis by ICP-OES
Exchangeable Potassium (ppm)	Soil chemical analysis by Hesse	1N NH4Ac extraction, analysis by ICP-OES
Exchangeable Magnesium(ppm)	Soil chemical analysis by Hesse	1N NH4Ac extraction, analysis by ICP-OES
Organic carbon (%)	IS 2720: PART 22:1972 (Reaff.2001)	Chromic-acid digestion, titration with Ferrous Sulfate
Total Nitrogen as N (kg/ha)	IS 6092: PART2SEC 5:2004/ISO 5315:1984	Sample digested with digestion mixture (CuSO ₄ , K ₂ SO ₄ & H ₂ SO ₄ . After reduction with Cr metal powder distilled & estimated.
Nitrate Nitrogen/Available nitrogen (ppm)	By Kjeldhal methods and IS 6092:PART2SEC 5:2004/ISO 5315:1984	Sample digested with digestion mixture (CuSO ₄ , K ₂ SO ₄ and H ₂ SO ₄), distilled and estimated. (Total Kjeldhal nitrogen as N “-“Kjeldhal nitrogen as N) reported as Nitrate Nitrogen
Available Phosphorous as P (ppm)	Soil chemical analysis by Hesse	Molybdate-blue colorimetric method Spectrophotometer
Available Potassium as K (ppm)	Soil chemical analysis by Hesse	Sample dissolved in 2M HCl and analysed by ICP-OES
Manganese as Mn (ppm)	EPA 3052	Acid digestion followed by AAS
Boron as B (mg/kg)	APHA 21 st EDN:2005	Sample dissolved in water & colorimetric estimation
Iron as Fe (%)	EPA 3052	Acid digestion followed by AAS
Copper as cu (ppm)	EPA 3052	Acid digestion followed by AAS
Zinc as Zn (ppm)	EPA 3052	Acid digestion followed by AAS
Arsenic as (mg/kg)	EPA 3052	Acid digestion followed by AAS
Cadmium as Cd (ppm)	EPA 3052	Acid digestion followed by AAS
Lead as Pb (ppm)	EPA 3052	Acid digestion followed by AAS

Tests	Protocol	
Mercury as Hg (ppm)	EPA 3052	Acid Digestion followed by AAS
CEC, meq/100g		Leaching with NH ₄ acetate solution, removal of the excess ammonium, and analysis of leachate by distillation & titration
The analytical procedures being used by lab must be in conformity with the official methods of AOAC (Association of Official Analytical Chemists, set up by United States Department of Agriculture, USA) and procedures prescribed by EPA (Environment Protection Agency, USA) and are followed worldwide.		

c. Proforma for water analysis

PROFORMA FOR WATER ANALYSIS WITH SITE											
S.No	Parameter	Site-1	Site -2	Site-3	Site-4	Site-5	Site-6	Site-7	Site-8	Site-9	Site-10
1	Location										
2	Name of the farmer										
3	Address										
4	Village										
5	District										
6	Contact Number										
7	Total area (in acres)										
8	Fruits										
9	Crops										
10	Cropping system (Monoculture)										
11	If multi- cropping than										
12	Name of the Crop										
S.No.	Tests										
1	Colour										
2	Odour										
3	Taste										
4	Turbidity (NTU)										
5	Electrical conductivity (mmhos/cm)										
6	pH										
7	Total Hardness (mg/l) As CaCO ₃										
8	Iron as Fe (mg/l)										
9	Chlorides (mg/l) as Cl										
10	Fluoride (mg/l)										
11	Total Dissolved Solids (mg/l)										
12	Sulphate as (SO ₄) (mg/l)										
13	Sodium as Na ⁺ (mg/l)										
14	Residual sodium carbonate (mg/l)										
15	Magnesium as Mg ²⁺ (mg/l)										
16	Potassium as K (mg/l)										
17	Phosphate as PO ₄ (mg/l)										

PROFORMA FOR WATER ANALYSIS WITH SITE											
18	Nitrate as NO ³⁻ (mg/l)										
19	Carbonate as CO ₃ (mg/l)										
20	Bicarbonates as HCO ₃ ⁻ (mg/l)										
	Microbial Parameters										
21	Coliform count (mpn/100ml)										
22	E.coli										
23	Salmonella spp.										

d. Nutrient deficiency symptoms

S. No.	Typical Deficiency	
	Nutrients	Deficiency Symptoms
1	Nitrogen(N)	Yellow or pale green colour of leaves. Drying of bottom leaves and short plant height.
2	Phosphorus (P)	Leaves developing red and purple colour. Slow growth and late maturity is observed. Lower leaves dry and develop purple colours between veins. Leaf petioles also develop purple colour.
3	Potassium(K)	Bottom leaves are scorched or burned on margins and tips. Leaves thicken and curl. Deficiency first develops in the wet portion of field.
4	Calcium (Ca)	Young leaves of the terminal buds develop wrinkled appearance and dieback at the tips and margins. Stalk finally dies at the terminal bud.
5	Magnesium (Mg)	There is general loss of green colour starting with the bottom leaves and moving upward. Veins of the leaves remain green.
6	Sulphur (S)	The veins and the tissue between them become light green in colour in young leaves. The growth of the plant is slow.
7	Iron (Fe)	Young leaves turn chlorotic. The main veins remain green. The stalk is short and slender. There is dieback of young growing tissues.
8	Manganese (Mn)	Spots of dead tissue scattered over young leaves. The smallest veins tend to remain green.
9	Zinc (Zn)	There is yellow stripping of the leaves between the veins. Older leaves die, and plant is severely dwarfed
10	Boron(B)	Young leaves of the terminal bud becoming light green at the base, with final breakdown. In later growth, leaves become twisted; stalk finally dies at terminal bud.
11	Copper (Cu)	Young leaves permanently wilted without spotting or marked chlorosis. Yellowing and chlorosis of normally green leaves.
12	Molybdenum (Mo)	Lower leaves of showing mottling, necrosis and curling of leaf edges.
13	Chlorine (Cl)	Leaves display the symptom of wilting of leaf blade tips. Chlorosis, bronzing, and necrosis are also observed in areas proximal to wilting.
14	Nickel (Ni)	Visual deficiency symptoms of nickel have not yet been found adequately. Its deficiency causes accumulation of nitrates and decrease in amino acid content (containing less than 0.1mg Ni/Kg).

Annexure IX: Major pest and diseases in nursery

a. Major diseases, Symptoms & Damage and Control measures

S.No.	Disease	Symptoms and Damage	Control Measures
1	Anthracnose	Regular to irregular spots on leaves with dark margins and greyish centre.	Spray Bitertanol/ Thiophanate methyl, Caixin, Kavach/ Rovral (2 g/l.) in humid weather
2	Bacterial canker	Cankorous spots on leaves	Apply Copper oxychloride during rainy season
3	Powdery mildew	White mealy growth on leaves	Wettable sulphur Carbendazim /Bitertanol / Thiophanate methyl, Caixin, Kavach/Rovral (2 g/l.) in September-March
4	Downy mildew	Pale-olive spots with milky white mycelium on the under surface of leaves	Apply Copper oxychloride, contact fungicide should be apply at 3-7 days interval and systemic fungicide at 10-15 days intervals.
5	Rust	Pale yellow pustules of uredospore are prominent on under surface showed necrotic pin head lesions.	Spraying Chlorothalonil (2 g/l) or Bitertanol (1 g/l) are recommended
6	Damping off	The infections take place at the base of the young stems or at the soil level. Tissue becomes water soaked and rapidly collapse thus topping the seedlings. These pathogens cause pre- and post-emergence damping off and wire stem of seedlings. It causes mortality of seedlings.	Treat seed/soil/media with Captaf/thiram/ Trichoderma etc.
7	Stem rot/ foot rot/ collar rot	Rooting of seedling stem near collar region	Spray Kavach/Rovral/Metalaxyl /M ancozeb/ Aliette (2 g/l)
8	Leaf spot	Dark brown to light brown, tiny pustules on leaf surface, the pustules soon enlarge and turn blakish in the centre	Spray Carbendazim / Bitertanol/ Thiophavate methyl, Calixin, Kavach/ Rovraal (2 g/l.) in rainy season/ November
9	Wilt	The foliar are yellowing and production of crookneck shoots. The leaves and shoots wither and become brownish. Stems when cut open show brown discoloration at the vascular region.	Soil fumigation and treating the nursery beds with benlate or with Thiophanate methyl and using <i>Tricoderma</i> etc.

b. Major Pest, Damage and their control measures

S.No.	Pest	Damage	Control Measures
1	Pseudo stem Borer	The grubs bore into the stem and feed within the stem.	Application of Malathion (0.1%) also controls the pest population.
2	Red Mite	They make holes in cotyledonary leaves of cucurbits. As a result, the seedlings die in the younger stage	Spraying Malathion (4 g/litre of water) or Metacid (1ml/litre of water)
3	Aphids	Aphids damage the plants by sucking the leaf sap in young stage, cotyledonary leaves crinkle and in severe cases the plants wither off.	Spraying Malathion (0.1 %) or Metasystox (0.1-0.2%)
4	Jassids	Both nymphs and adults suck the sap from the lower surface of the leaves. The infested leaf curl upward along the margins, which may turn yellowish and show, burnt up patches.	Spraying Malathion (0.1%) or Dichlorvos (0.05%)
5	Leaf Roller	Caterpillars roll leaves and feed on chlorophyll while remaining inside the folds. The folded leaves wither and dry up.	Spraying of Malathion (0.05%)
6	Red Spider mite	Different stages of mites are found in colonies covered by white-silky webs on lower surface of leaves. Nymphs and adults suck cell sap and white patches appear on leaves. Affected leaves become mottled, turn brown and fall.	Acaricides like Omite (0.05%) and Wettable Sulphur (0.3%) gives effective control of mites.
7	Mealy Bug	Nymphs and adults of mealy bugs suck sap from the leaves, tender shoots and the fruits. A heavy black sooty mould may develop on the honeydew like droplets secreted by mealy bugs.	Spraying of insecticides like Dichlorvos (0.02%) or Chlorpyrifos (0.05%) with fish oil rosin soap was found to control the insect population.
8	Root-Knot Nematodes	The affected plants show the development of galls on the roots. The plants become stunted, and the leaves show chlorotic symptoms.	Treating the nursery beds with Phorate@ 5 g a.i./m ² or Neem Cake 1 kg/m ² Select resistant varieties.
9	Thrips	Nymphs and black adults feed on tender leaves causing silverying, mottling and distortion of leaves.	Soil application of thimathion twice at 15 days interval at 5 gm/bed and take spray.
10	Leaf Folder	Larva fold leaves together and feed on chlorophyll. The affected leaves get skeletonized and dry.	Two or three sprays of Quinalphos @0.05%
11	Leaf Miner	Larvae attack tender leaves and feed in the epidermal layers of the leaf by making serpentine mines in which air gets trapped and gives them silvery appearance.	Spraying the plants with Quinalphos @0.05%
12	Leaf Eating Caterpillar	Larvae feed on lower surface of leaves by scraping while greenish-brown mature larvae feed voraciously during nights on these leaves.	Spraying of Quinalphos @0.05%
13	Cutworms	The tender plants are found damped at ground level during the night Young larvae feed gregariously on foliage but later segregate and enter soil.	Soil application of Phorate (1kg a.i./ha)

S.No.	Pest	Damage	Control Measures
14	Whitefly	The damage by whitefly also leads to yellowing of leaves and stunted growth, in severe cases leading to shedding of leaves	Spraying Triazophos 40 EC (1.5 ml/ L of water) + 1.0 ml of Dichlorvos 76 EC per litre of water.

Annexure X: Minutes of Meeting (04 January 2022)

Minutes of Meeting for Review of Nursery Development Plan Report (CS03)		
Date	04 January 2022	
Meeting Location	Department of Horticulture, Shimla	
Attendees of the meeting	Name	Designation
	HPSHIVA PMU	
	Devinder S Thakur	Project Director
	Deepak Gupta	Procurement Manager
	Manoj Sharma	Assistant Procurement Manager
	Rajeshwar Parmar	Nodal Officer
	Deb Majumdar	Procurement Management Specialist/Advisor HPSHIVA
	Satyaveer Singh	Monitoring & Evaluation Expert HPSHIVA
	Jamil Ahmad	GIS Specialist HPSHIVA
	Sushil Sharma	CAD Specialist HPSHIVA
	Ernst & Young LLP	
	Vaibhav Prakash	Engagement Manager/Director, Strategy and Transactions
	Arun Kumar Johri	International Horticulture Development Specialist (Team Leader)
	H P Singh	International Horticulture Specialist
	Neeru Dubey	National Horticulture Specialist/ Associate Vice President - EY
	Bhavitha Vigrahala	Support Team Member/ Associate - EY
Experts from CS 04 and CS 09 Package		
Discussion Topic	Draft Report for Nursery Development Action Plan, HDP and Intercropping	
Key discussion points	Devinder S Thakur, Project Director HPSHIVA welcomed the participants and started the discussion on Agenda Points. The important points agreed during the meeting are as follows: ▶ Nurseries to be incorporated under Himachal Pradesh State Nursery Act. Not necessarily NHB accreditation ▶ Incorporation of pre-testing certificate from nurseries in pre-qualification or tender criteria for bid ▶ Modification of financial criteria of bidding (for planting materials) from a fixed financial threshold amount to a multiple of estimated lot value/contract value – as per the ADB standard bidding guidelines ▶ Nursery development for Mango and Pecan Nut to be incorporated in the Nursery Development Plan report. ▶ Altitude wise location of nurseries to be suggested on a generic basis instead of naming specific districts because districts have locations with differing altitudes and simply naming a specific district does not present the full picture	

- ▶ Mortality rate in nurseries should be between 5-7% as against 20% proposed earlier
- ▶ Tissue culture unit for Pomegranate may be in Public Private mode not exclusively under government sector
- ▶ The finalized spacing as agreed for each crop (based on recommendations of YS Parmar University of Horticulture and Forestry/ CS04) are as below:

Crop/ Year	Spacing (m)
Citrus	3*3
Guava	3*3
Litchi	4*4
Pomegranate	3*3
Kiwi	4*3
Mango	3*3
Pecan nut	6*6
Persimmon	4*4
Plum	4*4

- ▶ Information regarding nurseries visited and surveyed to be indicated in the Nursery Development Report. These include the following:
 - 1.Details of source of funding of nurseries
 2. Details of infrastructure in the nurseries
 3. Harvesting seasons of fruit plants (normal, peak and lean seasons)
 4. Demand analysis of plant requirements from 2023 to 2030
 5. Total availability of plants with proposed nurseries
 6. Gap analysis of demand and supply of plants (variety wise and planting season wise)
 7. List of nurseries visited and surveyed for area, land cost, fencing, development cost, capacity of plants, mortality of plants, quality testing facilities
 8. Coordinates of the nurseries visited
- ▶ Revised draft of the Nursery Development Report incorporating the above issues will to be submitted by January 8, 2022
- ▶ Intercropping model will be shared by Dr. Somdev Sharma (of YS Parmar University of Horticulture and Forestry / Team Leader CS04)

The meeting ended with thanks to the chair.

Our offices

Ahmedabad

22nd Floor, B Wing, Privilon
Ambli BRT Road, Behind Iskcon Temple, Off
SG Highway
Ahmedabad - 380 059
Tel: + 91 79 6608 3800

Bengaluru

12th & 13th floor
"UB City", Canberra Block
No. 24, VittalMallya Road
Bengaluru - 560 001
Tel: + 91 80 6727 5000

Ground Floor, 'A' wing
Divyasree Chambers
11, O'Shaughnessy Road
Langford Gardens
Bengaluru - 560 025
Tel: + 91 80 6727 5000

Chandigarh

Elante offices, Unit No. B-613 & 614
6th Floor, Plot No- 178-178A
Industrial & Business Park, Phase-I
Chandigarh - 160 002
Tel: + 91 172 6717800

Chennai

Tidel Park, 6th & 7th Floor
A Block, No.4, Rajiv Gandhi Salai
Taramani, Chennai - 600 113
Tel: + 91 44 6654 8100

Delhi NCR

Golf View Corporate Tower B
Sector 42, Sector Road
Gurugram - 122 002
Tel: + 91 124 443 4000

3rd & 6th Floor, Worldmark-1
IGI Airport Hospitality District
Aerocity, New Delhi - 110 037
Tel: + 91 11 4731 8000

4th & 5th Floor, Plot No 2B
Tower 2, Sector 126
GautamBudh Nagar, U.P.
Noida - 201 304
Tel: + 91 120 671 7000

Hyderabad

THE SKYVIEW 10
18th Floor, "SOUTH LOBBY"
Survey No 83/1, Raidurgam
Hyderabad - 500 032
Tel: + 91 40 6736 2000

Jamshedpur

1st Floor, Shantiniketan
Building, Holding No. 1
SB Shop Area, Bistupur
Jamshedpur - 831 001
Tel: + 91 657 663 1000

Kochi

9th Floor, ABAD Nucleus
NH-49, Maradu PO
Kochi - 682 304
Tel: + 91 484 433 4000

Kolkata

22 Camac Street
3rd Floor, Block 'C'
Kolkata - 700 016
Tel: + 91 33 6615 3400

Mumbai

14th Floor, The Ruby
29 SenapatiBapatMarg
Dadar (W), Mumbai - 400 028
Tel: + 91 22 6192 0000

5th Floor, Block B-2
Nirlon Knowledge Park
Off. Western Express Highway
Goregaon (E)
Mumbai - 400 063
Tel: + 91 22 6192 0000

Pune

C-401, 4th floor
Panchshil Tech Park, Yerwada
(Near Don Bosco School)
Pune - 411 006
Tel: + 91 20 4912 6000

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