



NITI Aayog

ROADMAP FOR HORTICULTURE DEVELOPMENT

IN THE UT OF JAMMU AND KASHMIR

@ 2047



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Disclaimer

The analysis presented in this report draws on data and information obtained from government departments, official statistics, stakeholder consultations, field visits, and publicly available secondary sources. All efforts have been made to ensure accuracy of the information and analysis contained herein, however, neither the institution nor the authors shall be liable for any inadvertent errors or omissions.

ISBN: 978-81-991080-6-6



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Roadmap for Horticulture Development in the UT of Jammu and Kashmir

@ 2047

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MESSAGE

This report has been guided by a firm conviction that the horticulture sector in the Union Territory (UT) of Jammu and Kashmir possesses vast and largely untapped potential, not only as a driver of economic growth, but as a powerful instrument for enhancing livelihoods and improving the quality of life across the region. In view of the sector's pivotal role in stimulating growth, strengthening rural incomes, fostering community participation and building climate resilience, the preparation of a *Roadmap for Horticulture Development in the Union Territory of Jammu and Kashmir* was identified as a priority area for meaningful engagement by NITI Aayog. I am pleased to note that this important initiative has culminated in a comprehensive and forward-looking document.

This report builds upon the inherent strengths of the UT and sets out a clear, coherent and actionable roadmap for strengthening the entire horticulture value chain, from the provision of quality planting material and improvements in production and quality standards, to skills development, capacity building, value addition and enhanced market integration. It underscores the significant opportunity before Jammu and Kashmir to advance sustainable and inclusive growth through a dynamic, diversified and technology-enabled horticulture sector. Above all, it acknowledges the aspirations of the people of Jammu and Kashmir and the vital role that a vibrant horticulture ecosystem can play in fulfilling them.

It is my hope that this roadmap will serve as a practical and strategic guide for policymakers, institutions and stakeholders committed to the advancement of this critical sector. I am confident that the recommendations contained herein will help unlock new opportunities, strengthen support for farmers, and contribute meaningfully to a more prosperous, resilient and self-reliant future for Jammu and Kashmir.

I would also like to place on record my appreciation for the Agriculture Technology Vertical of NITI Aayog for its diligence and dedication in preparing this report.

(Suman Bery)

Place: New Delhi

Dated: 16.02.2026



प्रो. रमेश चन्द
सदस्य
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MEMBER



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Message

Growth in agriculture is considered crucial to achieve the vision of Viksit Bharata and to make India a \$30 Trillion economy by 2047. Within agriculture high value horticulture has emerged as a high growth segment driven by demand side factors and technological possibilities. Growing at nearly twice the rate of other crops, horticulture occupies just 6–7% of the cropped area in the country and yet contributes nearly 30% of total crop output in value terms. Production has surpassed foodgrains, reaching an estimated 367.72 million tonnes in 2024–25. Within our large country horticulture is ideally suited for growth of agriculture and overall economy in hill and mountainous regions.

In this national backdrop, the Union Territory of Jammu & Kashmir holds a uniquely strategic position. Endowed with diverse agro-climatic conditions, fertile soils, and rich biodiversity, the region specializes in high-value crops such as apples, walnuts, cherries, almonds, apricots, and saffron. Horticulture contributes 6–7% to J&K's GSDP and supports nearly 28% of its population, providing livelihoods to around 3.5 million people and sustaining 0.7 million families. Production has expanded from 10,000 tonnes in 1950–51 to 2.64 million tonnes in 2024–25, reflecting sustained growth and diversification. With focused interventions, ranging from technology adoption and climate-resilient practices to hi-tech nurseries, quality planting material, efficient irrigation, digital traceability, and modern post-harvest infrastructure, J&K can strengthen its leadership in high-value horticulture.

The "Roadmap for Horticulture Development in the UT of Jammu and Kashmir" outlines a forward-looking, actionable strategy aligned with national priorities, and grounded in the specific needs and strengths of the UT. It aims to diversify horticultural products across segments including dry fruits, fresh fruits, vegetables, floriculture, and minor crops; deepen value chains; and position the UT as a leader in horticulture-led development. I congratulate the team of the Agriculture Technology Division, NITI Aayog, for their efforts in preparing this important document and hope this will be very useful in taking horticulture to higher growth path in the coming decades.

[Ramesh Chand]

Place: New Delhi
Date : 12.02.2026



एक कदम स्वच्छता की ओर

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FOREWORD

India's agricultural sector is undergoing a structural transformation driven by a shift toward high-value horticulture. This transition represents not only a pathway to enhanced farm profitability but also a strategic national priority. Horticulture has emerged as a catalyst for value addition, agro-processing, and income generation. These trends align closely with the vision of *Atma Nirbhar Bharat*, positioning horticulture as a cornerstone of rural economic resilience.

The Union Territory of Jammu & Kashmir holds exceptional relevance in horticulture; the region contributes around 76% of India's apple production and accounts for nearly 96% of the country's walnut output. Additionally, it is the producer of GI-tagged Kashmiri saffron, underscoring its national significance. Blessed with unique agro-climatic advantages, rich biodiversity, and a long-standing tradition of fruit cultivation, the region is poised to leverage horticulture as a driver of inclusive growth, livelihood security, and export competitiveness. With apples, walnuts, saffron, vegetables, floriculture crops, and an emerging portfolio of niche products, J&K's horticulture sector has the potential to transform rural economies, diversify incomes, and place the region firmly on the global map of premium horticultural produce. However, realizing this requires a coordinated, future-oriented strategy that addresses systemic gaps, strengthens value chains, and harnesses new technologies for climate-resilient production.

The report, "Roadmap for Horticulture Development in the UT of Jammu and Kashmir," presents a comprehensive strategy for advancing the horticultural sector through a multifaceted and mission-driven approach. It proposes "Operation Golden Greens" as a flagship mission aimed at strengthening end-to-end value chains from germplasm to global markets across all major horticultural segments: (i) dry fruits, (ii) fresh fruits, (iii) vegetables, (iv) floriculture, and (v) minor crops. The mission is designed to be operationalized through crop-specific sub-missions, enabling focused strategies, targeted investments, and tailored interventions across each value chain.

I compliment to the team of the Agriculture Technology Division, NITI Aayog, for their dedicated efforts under the leadership of Dr. Neelam Patel in preparing this forward-looking document. Their work provides a clear roadmap for harnessing the full potential of horticulture as a driver of prosperity, sustainability, and self-reliance in Jammu & Kashmir.

Dated: 14th January, 2026


[B.V.R Subrahmanyam]





Acknowledgement

It gives me great satisfaction to present the report titled “Roadmap for Horticulture Development in the UT of Jammu and Kashmir”.

Within India’s Horticulture sector, Jammu and Kashmir (J&K) holds a uniquely distinguished position. The region is endowed with favourable geographic and climatic conditions that support the cultivation of a diverse range of horticultural products, including fruits, dry fruits, vegetables, spices, flowers, medicinal and aromatic plants, and honey. Horticulture, with fruits and dry fruits at its core, plays a pivotal role in the rural economy, sustaining the livelihoods of nearly 3.5 million people and contributing around 6-7% to the UT’s GDP. Over the decades, the sector has witnessed exceptional expansion, with production rising from 10,000 tonnes in 1950-51 to 2.64 million tonnes in 2024-25, generating an estimated annual turnover of nearly Rs. 10,000 crores. This progress has been propelled by scientific innovations, market-linked interventions and sustained government support. Recognised as an Export Zone for Apples and Walnuts, J&K is India’s leading producer of apples, cherries, walnuts, and almonds and is renowned for its saffron, honey, and kala zeera.

Despite these inherent advantages, the global presence of J&K’s horticultural products remains limited, due to multiple constraints across the value chain. These include senile orchards with limited crop varieties; inadequate access to quality planting material; significant post-harvest losses; limited adoption of modern technologies; insufficient marketing and export promotion activities, and fragmented institutional approach. Climate change and rapid technological advancements present both risks and opportunities, making it imperative for the sector to adapt and innovate.

To address these challenges and unlock the full potential of J&K’s horticulture sector, a phase-wise roadmap has been developed. The goal is to integrate marginal and small holders into the value chains, build a resilient, sustainable, competitive, and export-oriented horticulture ecosystem over time. The report proposes “Operation Golden Greens” as a flagship mission to strengthen end-to-end value chains from germplasm to market and is inclusive of all key horticultural segments, namely i) dry fruits, ii) fresh fruits, iii) vegetables, iv) floriculture and v) minor crops. It will be operationalised through crop-specific sub-missions and implemented through convergence of ongoing UT and Central schemes, ensuring coordinated resource mobilization and institutional alignment. The roadmap envisions bringing all horticulture-related activities under a unified institutional framework for the respective regions of Jammu and Kashmir, and leveraging public-private partnerships to drive investment and innovation.

Contd..2/-



The report was initiated in line with the guidance of the Hon'ble Vice Chairman, Shri Suman Bery, NITI Aayog, who had identified the preparation of a 'Roadmap for Horticulture Development in the UT of Jammu and Kashmir' as one of the key areas where NITI Aayog could extend meaningful support. This direction provided the foundation for initiating the present effort.

I take this opportunity to express my deepest gratitude to Hon'ble Vice Chairman, for his encouragement and support. I am equally grateful to Shri B.V.R. Subrahmanyam, CEO, NITI Aayog, for his constant support and guidance, which have greatly enriched this work. My sincere appreciation also goes to Prof. Ramesh Chand, Hon'ble Member, for his insightful suggestions and for chairing the Advisory Group, which significantly enhanced the quality of the report. I am grateful to all the Members of NITI Aayog for their continued support.

The report has benefited immensely from the expertise and constructive feedback of the distinguished members of the Advisory Group representing the Agriculture Production Department, Government of J&K; SKUAST-Kashmir; SKUAST-Jammu; ICAR; APEDA, Ministry of Commerce and Industries; Department of Agriculture and Farmers' Welfare; VKCNUTS Pvt. Ltd; and Fruit Master Agro Fresh Pvt. Ltd.

The valuable contributions of Shri Shailendra Kumar, Principal Secretary, Agriculture Production Department, Government of J&K, and his team; Prof. (Dr.) Nazir Ahmad Ganai, VC, SKUAST-K; Dr. B.N. Tripathi, VC, SKUAST-J; Dr. Mahendra Kumar Verma, Director, ICAR-Central Institute of Temperate Horticulture (CITH); and Dr. Prabhat Kumar, Horticulture Commissioner, Ministry of Agriculture and Farmers Welfare, are gratefully acknowledged.

I also gratefully acknowledge the contributions of all expert group members, whose domain knowledge and critical inputs significantly strengthened the analytical depth and policy relevance of the report.

I also would like to thank the concerned line ministries, particularly, the Ministry of Agriculture and Farmers' Welfare and the Ministry of Commerce and Industry for their valuable support.

My heartfelt appreciation goes to entire team of the Agriculture and Allied Sector Division for their collective effort and dedication in preparing this report.

Special thanks are due to Shri Yugal Joshi, Program Director, NITI Aayog and Ms. Keerti Tiwari, Director, Communication, NITI Aayog, for their thorough review and design of the report. Finally, I acknowledge the contributions of all other stakeholders who played a crucial role in shaping this report. I am confident that this report, with its strategic roadmap, will serve as a guiding document for accelerating horticultural development in J&K, fostering sustainable growth, strengthening rural livelihoods and enhancing ecological resilience.

Date:26.02.2026


(Dr. Neelam Patel)



Table of Contents



1. Introduction	1
1.1 Background	2
1.2 Geographical and Agro-Climatic Overview of J&K	4
1.2.1 Geography and Demography	4
1.2.2 Agroclimatic Diversity.....	5
1.2.3 Land-use Pattern	5
1.3 Significance and Scope of Horticulture in Jammu and Kashmir	7
1.4 Objectives	9
2. Horticulture Overview And Status	11
2.1 Area, Production and Productivity Trends of Fruits.....	13
2.1.1 Change in the area, production, and productivity of major fruits (2004-05 to 2022-23).....	14
2.1.2 Decadal Growth Trends in Area, Production and Productivity of Major.....	16
2.1.3 Identification of District-Wise Clusters of Major Fruits in J&K	21
2.1.4 Comparative Horticultural Performance of J&K vis-à-vis Major Producing States	25
2.1.5 Global Position of J&K's Key Horticulture Crops	28
2.1.6 Domestic Demand Trends of Fresh Fruits and Dry Fruits.....	30
2.2 Marketing Arrangements of Major Fruits	33
2.2.1 Marketing Channels of Major Fruits.....	33
2.2.2 Availability of Marketing Infrastructure in J&K	34
2.3 Export and import position of India for the Selected Commodities of Relevance to J&K.....	36
2.3.1 Apple Exports and Imports in India.....	36
2.3.2 Walnut Exports and Imports in India	37
2.3.3 Almond Exports and Imports in India.....	38
2.3.4 Saffron Exports and Imports in India.....	39
2.4 Registered and Unregistered Food Processing Units across the UT of J&K.....	41
2.4.1 Profiling of Existing Micro Enterprises Ecosystem	42
2.5 Existing Horticulture Infrastructure	45
2.6 Existing Schemes and their Performance for the Development of Horticulture in the UT	47
3. Challenges And Opportunities.....	49
3.1 Regional Constraints: Production To Post-Harvest Challenges.....	50
3.2 Post-harvest Losses of Major Horticulture Crops in J&K	51

3.3	Demand and Scope for Value Addition of Major Horticulture Crops in J&K	52
3.3.1	Major Gaps and Challenges in Promoting Processing.....	53
3.4	Potential of Horticultural Technologies and Adoption Challenges	56
3.4.1	Pre-Harvest.....	56
3.4.2	Post-Harvest	56
3.4.3	Constraints in the Adoption of Horticultural Technologies	60
3.5	Availability and Prospects of NABL Accredited Food Testing Laboratories in the UT of J&K	60
3.6	Vagaries of Weather and Climate Change	61
3.6.1	Impact of EWE and Importance of Early Warning System (EWS) in J&K	61
3.6.2	Limited Availability of Irrigation Facilities	62
3.7	SWOT Analysis for Horticulture in the UT of J&K.....	63
4.	Strategic Interventions for Horticulture Development in J&K.....	65
4.1	Strategy I: Productivity Enhancement through Varietal and Technological Shifts.....	66
4.1.1	Germplasm Management and Utilisation	66
4.1.2	Introduction of Best-Known Varieties and their Large-Scale Multiplication	66
4.1.3	Breeding for Introgression and Development of Desirable Traits in Commercial Varieties	71
4.1.4	Use of Proven Technologies and Germplasm Exchange	71
4.2	Strategy II: Establishment and upgradation of Hi-Tech Nurseries and Promoting Quality Seeds and Planting Materials.....	73
4.2.1	Setting Up Hi-Tech Nurseries and Modern Facilities.....	74
4.2.2	Ensuring Supply of Quality Planting Material.....	74
4.2.3	Strategic Approach to Promote Quality Planting Material Production Hubs	75
4.3	Strategy III: Crop Diversification for Sustainable Horticulture Growth	76
4.3.1	Promoting Region-specific Crop Diversification	76
4.4	Strategy-IV: Research and Innovation.....	80
4.4.1	Promoting Advanced Crop Management Practices	80
4.4.2	Encouraging R&D with National and International Collaboration	80
4.4.3	Integrating Innovative Technologies for Better Yield and Quality	81
4.4.4	Promoting Off-Season Cultivation.....	82
4.4.5	Developing Circular Economy Models for Zero Waste	84
4.4.6	Innovative Product Development from Horticulture, including Niche Crops	86
4.4.7	Quality Improvement Strategies	86
4.5	Strategy-V: Infrastructure Development	88
4.5.1	Improving Irrigation Facilities.....	88
4.5.2	Development of Processing Clusters	88
4.5.3	Creation of Farmer-Friendly on-Farm Storage Structures/Collection Centres.....	89
4.5.4	Establishment of Post-Harvest and Marketing Infrastructure for Fresh and Processed Products.....	90
4.5.5	Shift towards Innovative Packaging Strategies.....	91

4.6	Strategy-VI: Advancing Sustainable and Green Technology Interventions for Climate-Resilient Horticulture.....	92
4.6.1	Promoting Sustainable Horticulture Practices	92
4.6.2	Leveraging Green Technologies for Sustainable Horticulture.....	92
4.7	Strategy-VII: Capacity Building and Training for Improving Skill and Enhancing Output .	94
4.7.1	Farmer Training Programs on Modern Horticultural Practices	94
4.7.2	Strengthen Extension Services through Digital and Expert Advisory Services.....	94
4.7.3	Empowerment of Women and Youth in Horticulture	95
4.8	Strategy VIII: Market Linkages and Value Chain Development - Ensuring Higher Income and Access.....	95
4.8.1	Strengthening Market Connections	95
4.8.2	Carbon Financing for Tree Crops.....	96
4.8.3	Branding of the Products - Geographical Indication (GI) Tag.....	98
4.8.4	Promoting Horti-Tourism and developing Horti-Tourism Circuits	99
4.9	Strategy-IX: Strengthening of Export Potential	100
4.9.1	Unlocking Export Opportunities through Infrastructure and Quality Standards	100
4.9.2	Creation of Integrated Export Hubs	100
4.10	Strategy-X: Foster Public-Private Partnership (PPP) for horticulture development	100
4.10.1	Potential Areas for PPP Implementation in the Horticulture Value Chain.....	100
4.10.2	PPP Mechanisms for Horticulture Development	101
5.	Implementation Roadmap.....	103
5.1	Phase-wise action plan aligned with strategic interventions	105
5.1.1	Alignment of Phases with Intervention Horizons	105
5.1.2	Key Identified Components	106
5.1.3	Operation Golden Greens: A Mission Framework for Horticultural Transformation in J&K	108
5.1.4	Integrated Phase-wise Action Plan.....	111
5.1.5	Indicative Indicators of Progress for the Sub-missions	123
5.1.6	Institutional Mechanisms For Monitoring And Review	131
	Way Forward.....	133
	References	137
	Annexures	141

List of Tables

Table 1.1	Agroclimatic Zones of J&K	5
Table 1.2	Land Use Patterns in Jammu and Kashmir	7
Table 2.1	Physical Achievements in Horticulture Crops	12
Table 2.2	Trends in Area, Production and Productivity of Fruits in J&K (1980 to 2022)	14
Table 2.3	Change in the Area, Production and Productivity of Fruits Between 2004-05 and 2022-23	15
Table 2.4	Trends in the Area, Production and Productivity of Major Fruits in the UT of J&K (1980-2022)	17
Table 2.5	Trends in the Area, Production and Productivity of Major Dry Fruits in the UT of J&K (1980-2022)	19
Table 2.6	Trends in the Area, Production and Productivity of Saffron of UT of J&K	21
Table 2.7	District-wise Cluster Profiles of Horticulture Crops in J&K	24
Table 2.8	Comparative Horticultural Performance of J&K: Area, Production and Yield Profiles (2023-24)	27
Table 2.9	Trends in Per Capita Consumption (kg/year) of Apples and Dry Fruits (2011-12 to 2023-24)	31
Table 2.10	Marketing Infrastructure in J&K	34
Table 2.11	Trends in Exports and Imports of Apples in India	37
Table 2.12	Trends in Export and Import of Walnuts (in-shell and shelled) in India	38
Table 2.13	Trends in Export and Import of Almonds (in-shell and shelled) in India	39
Table 2.14	Trends in Export and Import of Saffron in India	41
Table 2.15	District-wise Distribution of Food Processing Formally Registered Functional Units in J&K	43
Table 2.16	Classification of Registered Food Processing Units of J&K Based on Their Line of Activity	44
Table 2.17	Details on Existing Horticulture Infrastructure	45
Table 2.18	Details on Existing Schemes for Horticulture Development	47
Table 3.1	Post-harvest Losses of Major Fruit Crops in J&K	51
Table 3.2	List of NABL Accredited Food Testing Laboratories in J&K	60
Table 4.1	Crop-wise V'arieties Recommended for Large-scale Multiplication in Jammu	67
Table 4.2	Crop-wise varieties Recommended for Large-scale Multiplication in Kashmir	70
Table 4.3	Traits Available and Recommended for Introgression in Commercial Varieties of Different Crops Through Various Strategies	71
Table 4.4	Status of Proven Technologies and Way Forward	72
Table 4.5	Proposed Crop Diversification Models in Jammu Region	78
Table 4.6	Proposed Crop Diversification Models in Kashmir Region	78
Table 4.7	Projected Cost Estimate of Innovative Products Developed	86
Table 4.8	Projected Cost Estimate of Compounds Extracted From by-Products of Niche Horticultural Crops of J&K	86
Table 4.9	Processing Clusters for Fruit Crops Proposed in Each District of J&K	89
Table 4.10	Cooling Technology Options for Small-Scale Farmers in Developing Regions	90
Table 5.1	Alignment of Phases with Intervention H orizons	106
Table 5.2	Sub-Missions under Operation Golden Greens	108
Table 5.3	Component-wise Allocation Matrix	110
Table 5.4	Convergence of Schemes Across Horticulture Sub-Missions (2026-47)	110
Table 5.5	Integrated Phase-wise Action Plan	111
Table 5.6	Indicators of Progress for the Sub-missions (indicative)	123

List of Figures

Fig. 1.1	Jammu and Kashmir (J&K) at a glance	4
Fig. 2.2	Global Almonds Production and Yield Comparison across Major Producing Regions (2023-24)	29
Fig. 2.3	Global Walnuts Production and Yield Comparison across Major Producing Regions (2023-24)	30
Fig. 2.4	Trends in the share of fresh fruits in household expenditure (1999-00 to 2023-24)	32
Fig. 2.5	Trends in the share of dry fruits in household expenditure (1999-00 to 2023-24)	33
Fig. 2.6	Existing marketing routes of major fruits	34
Fig. 2.7	Registered and Unregistered food processing units across the UT of J&K	42
Fig. 2.8	Distribution of total registered food processing units in J&K	43
Fig. 2.9	Share of horticulture-based food processing units across J&K	43
Fig. 3.1	Post-harvest losses at different stages of handling of Apples	52
Fig. 3.2	Share of horticulture-based food processing units across J&K	52
Fig. 3.3	Overview of CA stores of J&K	58
Fig. 3.4	Net irrigated area in the UT of J&K (2010-11 to 2023-24)	62
Fig. 4.1	Circular Economy Model	85
Fig. 4.2	Circular economy approach for the valorisation of Apple fruit	86
Fig. 4.3	Benefits for farmers through VCM	97
Fig. 5.1	Timeline of action for the development of Horticulture in J&K @2047	104

List of Map

Map 2.1	District-wise Horticulture Crop Clusters in J&K	22
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List of Abbreviations and Acronyms

AAS	Agro-Meteorological Advisory Services
AEZ	Agri Export Zone
AI	Artificial Intelligence
AIG	Academia-Industry-Government
AMFUs	Agromet Field Units
APEDA	Agricultural and Processed Food Products Export Development Authority
BMPs	Best Management Practices
CA	Controlled Atmosphere
CAGR	Compound Annual Growth Rate
CBOs	Community-Based Organisations
CEA	Controlled Environment Agriculture
CEH	Controlled Environment Horticulture
CFS	Climate Forecast System
CHCs	Custom Hiring Centres
CIF	Common Infrastructure Facility
CITH	Central Institute of Temperate Horticulture
CoE	Centre of Excellence
CPP	Clean Plant Programme
CSR	Corporate Social Responsibility
DAMUs	District Agro-Met Units
DIC	District Industries Centres
ECC	Evaporative Cool Chamber
EWEs	Extreme Weather Events
EWS	Early Warning System
FPO	Farmer Producer Organisation
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GFS	Global Forecast System
GI	Geographical Indication
GIS	Geographic Information Systems

GKMS	Gramin Krishi Mausam Seva
GM	Genetic Modification
GoI	Government of India
GPS	Global Positioning System
GSDP	Gross State Domestic Product
HADP	Holistic Agriculture Development Program
HBI	Horticulture Business Incubator
HDP	High Density Planting
HFIG	Horticulture Farmers Interest Groups
HID	High Intensity Discharge
ICAR	Indian Council of Agricultural Research
ICAR-CITH	Central Institute of Temperate Horticulture
ICT	Information and Communication Technology
IIT	Indian Institute of Technology
IoT	Internet of Things
IPM	Integrated Pest Management
J&K	Jammu and Kashmir
KKG	Kisan Khidmat Ghar
KPIs	Key Performance Indicators
KVKs	Krishi Vigyan Kendras
LMTs	Lakh Metric Tonnes
LPS	Low-Pressure Sodium
M&E	Monitoring and Evaluation
MAS	Marker-Assisted Selection
MIDH	Mission for Integrated Development of Horticulture
ML	Machine Learning
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MoES	Ministry of Earth Science
MoJS	Ministry of Jal Shakti
MoP	Ministry of Power
MoRD	Ministry of Rural Development
MV	Monetary Value

NABL	National Accreditation Board for Testing and Calibration Laboratories
NBPGR	National Bureau of Plant Genetic Resources
ND	Not Documented
NGOs	Non-Government Organisations
NHB	National Horticulture Board
NPOP	National Programme for Organic Production
PA	Precision Agriculture
PMFBY	Pradhan Mantri Fasal Bima Yojana
PMFME	PM Formalisation of Micro Food Processing Enterprises Scheme
PMKISAN	Pradhan Mantri Kisan Samman Nidhi
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
POPs	Packages of Practices
PPPs	Public-Private Partnerships
R&D	Research and Development
RBSHs	Rural Business and Service Hubs
RFID	Radio Frequency Identification
SAUs	State Agricultural Universities
SHGs	Self Help Groups
SKUAST-J	Sher-e-Kashmir University of Agricultural Sciences and Technology - Jammu
SKUAST-K	Sher-e-Kashmir University of Agricultural Sciences and Technology - Kashmir
SLUP	State Level Upgradation Plan
SMAEs	Smallholder Farmers and Small & Medium Agri-enterprises
SMAM	Sub-mission on Agriculture Mechanisation
SOPs	Standard Operating Procedures
ULO	Ultra-Low Oxygen
ULV	Ultra Low Volume
UT	Union Territory
VCM	Voluntary Carbon Markets
YSPUH&F	YS Parmar University of Horticulture and Forestry (YSPUH&F)
ZECC	Zero Energy Cool Chamber





Executive Summary

The Union Territory (UT) of Jammu and Kashmir (J&K), known as the “Land of Fruits” is endowed with favourable geographic and climatic conditions that support the cultivation of a wide variety of horticultural products, including fruits, dry fruits, vegetables, spices, flowers, medicinal and aromatic plants, and honey. Horticulture, primarily focused on fruits and dry fruits, is the cornerstone of the rural economy, providing livelihoods for approximately 3.5 million people and contributing 6-7% to the UT’s GDP. The sector has witnessed remarkable growth, with production increasing from 10,000 tonnes in 1950-51 to 2.64 million tonnes in 2024-25, generating an estimated annual turnover of ₹ 10,000 crore.¹ This expansion has been driven by scientific advancements and targeted government initiatives. J&K has been designated as an Export Zone for Apple and Walnut crops, and is the leading producer of apples, cherries, walnuts, and almonds in India. The region is also known for producing high-quality honey, kala zeera, and saffron.

Despite these strengths, J&K’s horticultural products have a limited presence in international markets, constrained by multiple challenges across the value chain. These include senile orchards with a limited crop varieties; inadequate production of quality planting material; reliance on imported varieties; insufficient cultivation area with no classification based on crop suitability; non-uniform produce (especially in crops like walnuts and almonds); significant post-harvest losses (up to 20-25% in apples); limited adoption of modern technologies; insufficient marketing strategies, a lack of coordinated sales and export promotion activities, and fragmented institutional approach. Furthermore, as the sector confronts growing threats from climate change and opportunities from emerging technologies, the horticulture sector in J&K must evolve and adapt proactively.

To address these challenges, leverage emerging opportunities and unlock the full potential of J&K’s horticulture sector, a phase-wise roadmap has been developed. This approach spans short, medium, and long term horizons, aligning interventions systematically across key identified components such as i) assessment and planning; ii) research and innovation; iii) skill development and capacity building, iv) quality planting material, nurseries and germplasm self-reliance, v) hi-tech horticulture production; vi) crop diversification and high-value crop promotion; vii) digital technology integration; viii) infrastructure development; ix) market access; x) value addition; xi) financial access and support; and xii) sustainability and environmental management. The goal is to integrate marginal and small holders into the value chains, build a resilient, sustainable, competitive, and export-oriented horticulture ecosystem over time. The roadmap envisions bringing all horticulture-related activities under a unified institutional framework and leveraging public-private partnerships to drive investment and innovation. A coordinated, inclusive, and sustainability-driven approach will be key to transforming J&K’s horticulture sector into a globally competitive and climate-resilient growth engine.

¹ Economic Survey 2024-25, J&K

The specific objectives of the report are as follows:

1. To analyse the current status of horticulture in the UT of J&K, including production, productivity of major crops, exports and imports, schemes, existing infrastructure, and challenges.
2. To identify opportunities for diversification, establishment of crop clusters and expansion of horticultural crops based on agro-climatic conditions and future demand.
3. To suggest strategies for infrastructure development, including irrigation facilities, cold storage, transportation, marketing infrastructure, availability of quality planting materials, certification and chemical-free production.
4. To identify opportunities for market linkages, value chain development and export to ensure better returns for horticulture produce.
5. To suggest innovations in horticulture, including the adoption of new technologies and best practices.
6. To propose strategies for promoting sustainable practices, addressing environmental concerns and mitigating the impact of climate change.
7. To develop skilled human resources to meet the requirements of horticulture and to enhance international competitiveness and farmers' incomes.
8. To explore opportunities for community engagement, stakeholder collaboration and promotion of horti-tourism to enhance rural development.
9. To suggest a regulatory framework for the smooth functioning of all components of the horticulture sector.

The key highlights of the report are:**1. Horticulture Overview and Status**

- (i) Over the past four decades, the area under fruit cultivation (fresh and dry) has expanded from 1.31 lakh ha in 1980 to 3.44 lakh ha in 2022, registering a CAGR of 2.33%. During this period, production of fruits has increased over fivefold, from 5.6 lakh tonnes in 1980 to 27.22 lakh tonnes in 2022, growing at a CAGR of 3.82%. However, the productivity has risen at a slower pace, from 4.3 t/ha in 1980 to 7.91 t/ha in 2022, with a CAGR of only 1.46%.

This implies that production growth has primarily been driven by an increase in cultivated area rather than productivity improvements. Given the limited scope for further area expansion, future development must rely on technology-driven improvements in yield.

- (ii) Among the top-performing fruits, Apple dominates, accounting for 50% of the total fruit area and over 77% of total fruit production in 2022-23. Apple yield (12.5 t/ha) is the highest among all the fruits. Among dry fruits, walnuts occupy a major proportion of the dry fruit area (93%) and overall fruit area (25%), and contribute about 12% to total fruit production.

Declining apple productivity (CAGR of -0.37% from 2020-22 to 2022-23) and area shrinkage in almond cultivation (CAGR of -2.59% from 1980-81 to 2022-23) raise concerns about future supply stability of these two crops.

- (iii) During 2000-01 to 2021-22, for saffron, the overall CAGR was 1.30% for area, 7.06% for production and 5.67% for productivity, indicating that productivity improvements have played a major role in sustaining saffron output despite fluctuations in cultivated area.
- (iv) A spatial classification of major horticulture crops in Jammu & Kashmir has been undertaken to identify district-wise production clusters in alignment with the revised National Horticulture Board (NHB) Cluster Development Programme (CDP) guidelines. The clustering approach is designed to enable economies of scale and facilitate region-specific, crop-focused policy interventions. Apples and walnuts emerge as the dominant crops with multiple, geographically dispersed clusters, while pear, cherry, and mango are characterised by more localised and specialised clusters. Saffron exhibits the highest spatial concentration, forming two distinct clusters centered in Pulwama and Kishtwar districts.
- (v) A comparative review of horticultural performance across major producing states indicates J&K's clear national leadership in apples, walnuts, and almonds, a strong but productivity-constrained presence in other temperate fruits, and a marginal role in tropical crops. J&K dominates India's apple, walnut, and almond sectors, accounting for the majority of national area and production and ranking first in yields, establishing these crops as its flagship strengths. In other temperate fruits such as pear, peach, and plum, the UT commands significant area and production but exhibits relatively lower yields compared to states like Punjab and Uttarakhand, indicating scope for productivity enhancement. In contrast, J&K's contribution to tropical fruits particularly citrus, mango, and ber is minimal, constrained by agro-climatic conditions and characterised by low yields.

The findings underscore the need for a horticulture strategy focused on improving productivity, quality, and value addition in apples, walnuts, almonds and other temperate fruits where J&K enjoys scale and market leadership, while treating tropical fruits as niche, localised diversification options rather than core growth drivers.

- (vi) A global comparison of Jammu & Kashmir's key horticultural crops—apples, almonds, and walnuts shows that while the UT holds national leadership in yields, it remains a relatively small player in global markets. In apples, J&K outperforms the national average but lags significantly behind global productivity leaders such as China, Chile, the USA, and Italy, underscoring substantial scope for yield enhancement and a strategic shift toward a quality and technology-driven apple economy rather than volume-based competition. In almonds, J&K accounts for a negligible share of global production but exhibits moderate yields higher than several traditional Mediterranean countries, suggesting a niche advantage rooted in agro-climatic suitability and quality potential; productivity gains through improved varieties and orchard management could strengthen competitiveness despite limited scale. In walnuts, J&K occupies a second-tier global position, with yields exceeding those of several major producers such as Türkiye, Mexico, Burkina Faso and comparable to China, but trailing

high-performing countries, indicating significant untapped potential. Overall, the analysis highlights productivity enhancement, quality upgrading, and improved planting material as key levers for improving J&K's global positioning in high-value temperate horticulture.

- (vii) Per capita consumption of both fresh fruits (notably apples) and dry fruits has risen sharply between 2011–12 and 2023–24, with particularly strong growth in rural areas. Apple consumption grew at a CAGR of over 10% in rural areas and 4% in urban areas indicating a broad-based expansion in domestic demand. While apple consumption has shown minor recent fluctuations suggesting sensitivity to prices and supply, dry fruits display more stable and sustained demand, with rural and urban consumption growing at 7.4% and 5.7% per annum, respectively, reflecting year-round availability and diversified use. At the same time, the share of household expenditure on fruits has increased steadily, with rural and urban spending on fresh fruits converging at around 2.5-2.6% of MPCE, and expenditure on dry fruits rising faster than fresh fruits across both segments. These trends point to growing health awareness and an expanding rural and semi-urban market base, creating opportunities to expand domestic markets beyond urban centres through strategies such as affordable pricing, smaller packaging formats, and value-added product innovations. For Jammu & Kashmir, this evolving demand profile underscores the urgency of strengthening supply-side responses, particularly, productivity enhancement in apples and expansion of area and processing capacity in dry fruits such as almonds, to fully capitalise on rising domestic demand through targeted production, marketing, and value-chain interventions.
- (viii) The marketing system for the sale of fruits in the state is still conventional, characterised by the dominance of contractors (pre- and post-harvest) and commission agents at the wholesale level. A major proportion of produce, varying from 67% to 82% depending on the fruit, is sold through contractors and relatively less through wholesalers (between 8% and 27%).

Despite PAN India initiatives like eNAM, farmers continue to rely on traditional marketing channels, compelled by a number of factors, including easy access to informal credit from Arthiyas or functionaries, small marketable surpluses, etc.

Strengthening the collectivisation of farming and marketing activities, coupled with institutional support for financing smallholders, could enable farmers to access more remunerative markets and improve their returns. In addition, the development of supporting infrastructure, including controlled atmosphere (CA) storage facilities and cold chain networks, etc., is critical for modernising and reforming the marketing arrangements for fruits. Equally important is the promotion of direct marketing channels such as FARMER-PRODUCER ORGANISATIONS (FPOs), cooperatives, farmer markets, e-commerce platforms, and tie-ups with organised retailers, which can reduce intermediaries, offer better price realisation, and enhance market access for growers.

- (ix) The marketing infrastructure for fruits and vegetables in J&K has expanded considerably, with 5 fully functional terminal mandis and 14 satellite mandis operational across various

districts. Additionally, 5 Apni Mandis are currently functional, providing local farmers with greater market access.

However, 6 satellite mandis and 7 Apni Mandis are still under development or in the process of operationalisation. Strengthening and fully operationalising these markets, alongside improving logistical facilities and market linkages, will be crucial for enhancing farmers' access to organised markets and ensuring better price realisation for their produce.

- (x) J&K's major horticultural products - Apple, Walnut, Almond and Saffron- possess significant global trade potential. However, India's presence in global markets for these commodities remains limited, with increasing import dependence and stagnant or declining exports.

- (a) While Apple exports from India have shown an increasing trend over the years, the growth has been much slower compared to imports. The quantity of apples exported increased from 17,170 tonnes in 2010 to 32,874 tonnes in 2024, registering a growth of 4.75%. However, the export value remained stagnant at around USD 13 million, with virtually no growth (-0.01%) suggesting declining unit values. In contrast, imports grew at a significantly higher CAGR of 10.85% in quantity and 9.23% in value, surpassing the growth rate of exports. Thus, India's apple trade balance has deteriorated over the years due to rising import dependency and a sluggish export growth rate. The trade deficit widened significantly, from USD -108.2 million in 2010 to USD -404.5 million in 2024. This growing deficit suggests that domestic production of apples is struggling to meet demand, leading to rising dependence on imports.

Addressing this issue requires a combination of import substitution strategies and export promotion efforts to strengthen the domestic apple industry. It highlights the need for (i) Enhancing domestic apple production through improved quality and productivity, with special emphasis on clonal rootstock multiplication, production of feathered plants and introduction of superior apple varieties; (ii) Reducing post-harvest losses by expanding storage and cold-chain infrastructure and establishing modern grading, packaging, processing and CA storage facilities; (iii) Promoting high-density apple plantations to improve yield and land productivity; (iv) Strengthening export competitiveness through better varieties, mechanisation of apple orchards, branding and improved market access.

- (b) India's walnut exports have weakened, with in-shell exports rising modestly (130 tonnes in 2010 to 333 tonnes in 2024; 6.9% CAGR), but shelled walnut exports decreased from 7,133 tonnes to 932 tonnes (-13.5% CAGR), reflecting loss of competitiveness. Export earnings followed a similar trend, with only marginal growth for in-shell (2.2%) and steep decline for shelled walnuts (-13.5%). At the same time, imports surged, driven by strong domestic demand. In-shell walnut imports jumped from 17 tonnes in 2010 to 55,448 tonnes in 2024 (78% CAGR), while shelled imports rose from 2 tonnes to 3,786 tonnes (73.1% CAGR). The higher volume of in-shell walnut imports compared to shelled walnut imports, indicate that domestic processors increasingly depend on imported raw walnuts for shelling and value addition. The trade balance has deteriorated sharply: in-shell walnuts moved from a small surplus

of USD 0.33 million in 2010 to a deficit of USD -84.9 million in 2024, while shelled walnuts shifted from a USD 39.1 million surplus to a USD -14.2 million deficit. This widening dependence on imports underscores the urgent need for policy support to boost competitiveness.

Emphasis should be placed on: i) Large-scale production of quality planting material of improved walnut varieties, particularly under protected structures to ensure high-quality yields; ii) Harvest management practices to optimise production and quality; iii) Grading, packaging, processing, and value addition to improve the overall marketability of domestic walnuts.

- (c) India has been a net importer of almonds (both in-shell and shelled), and this trend has increased over the period 2010 to 2024. India ranked 1st globally among in-shell almond importing countries and the import volume grew significantly by 11.06%. This surge reflects India's rising demand and presents potential opportunities for the domestic processing industry to expand value-addition. To boost domestic almond production and competitiveness, there is an urgent need for (i) Large-scale introduction of self-pollinating varieties such as Independence, Monterey, Carmel, Shasta, and Pyrenees, which can significantly improve yields; (ii) Strengthening nursery development and the availability of certified planting material; (iii) Promoting investment in post-harvest management, including processing and storage facilities, to add value and improve marketability.
- (d) India's saffron trade exhibits a distinct pattern where the export quantity was consistently higher than import quantity between 2010 and 2017, yet the value of imports far exceeded exports. After 2018, this trend reversed, with imports surpassing exports in both quantity and value, reflecting the dominance of premium imported saffron in the domestic market. The quantity of saffron exported rose from 0.43 tonnes in 2010 to 10.19 tonnes in 2024 registering a CAGR of 25.44%. However, export earnings increased only modestly, from USD 1.5 million to USD 3.61 million, at a CAGR of 6.49%, suggesting that Indian saffron is fetching lower unit value prices possibly due to weak branding and positioning. Imports surged from 3.06 tonnes (USD 4.8 million) in 2010 to 58 tonnes (USD 37.7 million) in 2024, leaving India a net importer with a widening deficit of USD -34 million in 2024.

Since Kashmir saffron has been granted Geographical Indication (GI) for its unique attributes, enhancing its visibility and competitiveness is crucial. Initiatives such as the Indian International Kashmir Saffron Park and dedicated branding campaigns can help secure premium positioning in global markets. Strengthening domestic production by increasing area in non-traditional areas with the support of irrigation systems and improved planting material, enhancing quality, and improving market linkages could help boost India's share in the global saffron trade.

- (e) Unregistered units represent a dominant share of the food processing sector in J&K, accounting for nearly 92.59 % of total food processing enterprises. Most of these units

fall under the category of micro units. Currently, there is no detailed data regarding the line of activity of these unregistered/unincorporated food processing enterprises. A comprehensive documentation indicating processing capacity, ownership structure, location, investment, employment strength, level of mechanisation and market outreach etc. should be created to map and understand these enterprises.

These units mostly operate with traditional knowledge and low mechanisation/automation, contributing to inefficiencies and bottlenecks. Addressing these challenges requires a focused approach: supporting unregistered units through capacity-building initiatives, facilitating access to credit and technology, and creating incentives for voluntary registration over time. In addition, the establishment of food processing industries under national schemes such as PMFME (Pradhan Mantri Formalisation of Micro Food Processing Enterprises) and PMKSY (Pradhan Mantri Kisan Sampada Yojana) can provide a strong institutional framework for modernising the sector.

The horticulture-based processing units- despite the region's strong production potential- represent only 39% (872 units) of the total registered units. Within the horticulture-based enterprises, edible oil processing accounts for the largest share of 35.43%, followed by spice processing (20.87 %) and processing of fruits and vegetables (20.29 %). There is a significant untapped potential for growth in the processing segments of horticulture products like walnut/nuts, spices, fruits and vegetables for primary processing and diversified product development. Post-harvest losses in J&K are substantial, with apples and vegetables losing 5,00,000 tonnes each (₹1500 crore and ₹1560 crore respectively), cherries suffering the highest percentage losses (40–49%), and saffron recording high value loss (₹4.8 crore) despite minimal quantity loss (0.48 tonnes). Thus, a strategic focus on expanding processing capabilities in the horticulture sector is imperative to prevent post-harvest losses, meet the evolving demands of the market and leverage horticulture strengths, thereby increasing the UT's economy.

2. Strategic Interventions and Implementation Roadmap

The roadmap includes the proposed mission framework “Operation Golden Greens” for horticultural transformation in J&K. It aims to implement the integrated phase-wise action plan through five sub-missions, dedicated to i) dry fruits, ii) fresh fruits, iii) vegetables, iv) floriculture and v) minor crops. The sub-missions are built on twelve identified common components but with differentiated priorities, allocations and activities aligned to its respective value chain and regional potential.

The implementation plan is organised into three phases - Phase 1 (2026-30), Phase 2 (2030-35) and Phase 3 (2035-47). These phases align with interventions grouped into three time horizons: short-term (2026-28) and medium-term (2028-30) actions fall within Phase 1, while long-term actions (2031 onwards) are implemented through Phases 2 and 3. This phased approach provides flexibility to adapt interventions based on emerging priorities, technological advancements and institutional readiness. Phase 1 focuses on building strong foundations and demonstrating early impact through short and medium-term interventions. Phase 2 targets scaling and consolidation of

infrastructure, institutional frameworks and innovation ecosystems. Phase 3 seeks to institutionalise a competitive, self-reliant and globally integrated horticulture economy. Further, implementation actions across the phases are organised under the following key identified components:

- (a) All key actions under the component '**Assessment and Planning**' are planned for the short term, indicating that Phase 1 is foundational and focuses on establishing a robust baseline, planning framework, and institutional alignment. These interventions are designed to lay the groundwork for medium- and long-term strategies in other components. Key actions to be taken are:
 - ▶▶ Conduct baseline surveys and mapping of horticulture potential in major districts.
 - ▶▶ Identify and categorise land suitable for horticulture expansion (district-wise zoning/ clusters).
 - ▶▶ Assess future requirements of seeds and planting material for all horticultural crops as per the State Horticulture Plan.
 - ▶▶ Formulate and notify updated horticulture policies and land use regulations.
 - ▶▶ Unify all horticulture activities under the respective Directorate of Horticulture for Jammu and Kashmir.
- (b) **The Research and Innovation** component is designed as a continuous process, starting in Phase 1 and scaling over time through Phases 2 and 3. The short-term actions focus on expanding foundational infrastructure like CoEs, SOPs, and training centers. Medium- and long-term interventions emphasise partnerships, scaling of innovations, AI-based tools, and climate-smart research. The approach combines institutional capacity-building, technology development, and farmer participation, aiming for widespread adoption and long-term resilience.
 - ▶▶ Strengthen, network and functionalise existing Centres of Excellence (COEs) as district-level innovation hubs.
 - ▶▶ Collaborate with national/international institutions for research-led CoEs through joint projects / MoUs (e.g. Indo-Israeli Agriculture Project (IIAP), Indo-Dutch projects etc.).
 - ▶▶ Define quality norms for CoEs and new technologies, setting standardised criteria for infrastructure, planting material, training and extension.
 - ▶▶ Expand specialised CoEs focused on climate-smart technologies and global R&D partnerships.
 - ▶▶ Establish at least 2 regional incubators along with incubation support mechanisms (through linkages with RKVY-RAFTAAR, NIF), to promote farmer-led innovations and integrate structured farmer feedback loops into the R&D system.

- ▶▶ Scale up region-specific technologies for production, post-harvest handling, and value addition with 50% adoption of selected technologies in the target districts.
- ▶▶ Develop and implement crop-specific Standard Operating Procedures (SOPs) and Package of Practices (POPs) covering cultivation, disease management and post-harvest care, tailored to agro-climatic zones following international standards.
- ▶▶ Support the development and field-testing of advanced precision tools and AI (e.g., pest detection for walnuts, harvesting tools for saffron, moisture sensors for apples) in collaboration with research institutes and start-ups.
- ▶▶ Develop and operationalise predictive crop models for at least 3 key crops, using integrated climate, pest and soil health data, to enable location-specific advisories for farmers.
- ▶▶ Set up permanent innovation platforms and rapid response systems for climate/pest shocks in the most vulnerable districts under the National Innovations on Climate Resilient Agriculture (NICRA) program.
- ▶▶ Establish at least one training centre and an agri-clinic centre in each district, with additional centres in 25 high-potential horticulture blocks. Integrate with existing KVKs and agri-extension networks to deliver hands-on training, advisory services, and digital agri-clinic support.

(c) **Skill Development and Capacity Building** component supports the strategic Phases 1, 2, and 3 by focusing on training, extension services, and empowerment of women and youth in the horticulture sector. The strategy aims to build a skilled and inclusive horticulture workforce. Short-term actions focus on launching training, startup incubation, and mobile extension services. Medium- and long-term actions deepen technical training, introduce cutting-edge agri-tech certifications, and strengthen institutional support (e.g., CRCs).

- ▶▶ Conduct at least 100 regular training programs annually on modern nursery management, GAP, IPM, and post-harvest management.
- ▶▶ Train at least 1000 agri-entrepreneurs across all districts and facilitate the incubation of 100 horticulture-based startups through state-run/ partnered incubation hubs.
- ▶▶ Upskill extension officers in AI, drones, pest management, and satellite monitoring; offer certification programs in partnership with tech institutions.
- ▶▶ Deploy over 50 mobile agri-advisory vans for on-site farmer support, demonstrations and best practice dissemination across all districts, with emphasis on remote and underserved areas.
- ▶▶ Establish at least one Community Resource Centre (CRC) per high-potential horticulture cluster equipped with training and IT facilities.

- ▶▶ Design targeted training programs to engage women and youth in agri-business, horticulture startups, and post-harvest management, ensuring at least 40% female/youth participation.
 - ▶▶ Provide financial and technical support for women and youth-led enterprises in horticulture, focusing on access to markets, technology, and credit, with over 100 enterprises supported annually.
 - ▶▶ Foster women and youth leadership roles in extension services, agri-entrepreneurship, and decision-making forums through targeted training and mentorship.
- (d) **Quality Planting Material, Nurseries, and Germplasm Self-reliance** component targets self-sufficiency in quality planting material, reducing reliance on imports and raising domestic standards. Phase 1 focuses on regulatory groundwork and foundational infrastructure: modern nurseries, tissue culture labs, and clean plant centres. Phase 2 and 3 emphasise scaling systems, regulatory enforcement, and developing export readiness. There's a strong push for technology adoption, public-private partnerships, and nursery accreditation to meet future demand with traceability and quality. Regulatory reforms like the Fruit Nurseries (Licensing) Act, 1987, are central to sustaining quality and managing imports.
- ▶▶ Amend and strengthen the existing Nursery Act to align with the Model Seed Act, through the State Legislature, to regulate seed quality, traceability, imports of planting material, and rootstock propagation.
 - ▶▶ Establish modern nurseries (40-50 ha) in each district with hydroponics, aquaponics, vertical farming, precision farming (automation, micro irrigation), tissue culture and renewable energy practices.
 - ▶▶ Establish at least one tissue culture lab in each agro-climatic zone.
 - ▶▶ Identify major crops and varieties dependent on imports; develop and scale germplasm through R&D institutions and certified nurseries.
 - ▶▶ Operationalise clean plant centres for priority crops, ensure supply of pathogen-free, certified planting material to nurseries and farmers.
 - ▶▶ Scale up proven propagation technologies (e.g. rootstock multiplication, feathered apple plants, walnut/olive propagation) via model nurseries and demonstrations, with an adoption by at least 50% of the nurseries.
 - ▶▶ Upgrade nurseries to meet certification standards for high-density planting systems and climate-resilient crops.
 - ▶▶ Develop around 3 cluster-based model nurseries and 7 seed villages in PPP mode involving KVKs, private nurseries and FPOs, to meet region-specific planting material demands.

- ▶▶ Set up third-party inspection and nursery rating systems to ensure compliance and traceability.
 - ▶▶ Develop and implement export protocols, phytosanitary certification and targeted market outreach programs for planting material exports in collaboration with DoH, export promotion councils and certification agencies.
- (e) **Hi-Tech Horticulture Production** focuses on modernising horticulture practices through technology integration, resource-efficient systems, and automation. The short and medium term is geared toward piloting and demonstrating technologies like automated nurseries, greenhouses, micro-irrigation, and orchard rejuvenation. The long-term focus is on scaling successful models, increasing adoption, and mechanising key operations to reduce drudgery and enhance productivity. There is also a strong emphasis on demonstration-based learning, institutional support through custom hiring centres, and collaboration with private sector innovators.
- ▶▶ Pilot automated nursery units in 2 districts and scale to 10 districts in the medium term and expand to all districts in the long term.
 - ▶▶ Deploy greenhouse, hydroponics, vertical farming models and precision horticulture practices on at least 100 demonstration plots statewide.
 - ▶▶ Implement orchard rejuvenation programs for old and senile orchards through farmer training programs, expert consultation services and community-based approaches.
 - ▶▶ Expand micro-irrigation systems across horticulture areas to cover 50% of the total horticulture area by medium term and 75% by long term.
 - ▶▶ Strengthen and expand the Custom Hiring Centre (CHC) network by
 - Establishing 100 additional horticulture-focused centres in under-served clusters, and
 - Upgrading 387 existing CHCs with orchard-specific machinery, and promoting digital access, skilling, and targeted subsidies under the Sub-Mission on Agricultural Mechanisation (SMAM).
- (f) **Crop Diversification and High-value Crop Promotion** aim at broadening the horticulture base to reduce dependence on a few crops and tap into high-value, niche, and off-season markets through strategic promotion of traditional, emerging, and sub-tropical crops. The short term emphasises reviving traditional crops, saffron and olive promotion, and laying the groundwork for vegetable and flower value chains. Medium- and long-term target emerging crops like nuts, berries, and temperate fruits, along with tomato, onion and potato (TOP) crops positioning and processing infrastructure. A key feature is linking production to value chains through packhouses, branding, and export readiness, with a strong role for FPOs/SHGs.

- ▶▶ Initiate a focused revival program for traditional and lost crops (e.g., kala zeera, singhara (water chestnut), lotus stem, asafoetida, mushroom) through germplasm conservation, targeted cultivation in North Kashmir, research trials in partnership with SKUAST, market promotion campaigns and community-based approaches.
- ▶▶ Enhance saffron productivity to around 7.8 kg/ha by:
 - Installing improved sprinkler/drip irrigation systems across 2,000 hectares;
 - Distributing better planting materials (high-yielding corms) to at least 10,000 farmers; and
 - Piloting saffron cultivation in non-traditional areas such as Poonch, Kishtwar, Bandipora, with phased expansion over the next 5 years.
- ▶▶ Develop a complete olive value chain - covering plantation, processing and marketing- by establishing oil extraction infrastructure and support systems to revive and expand olive cultivation in potential clusters such as Udampur, Reasi, Rajouri, Ramban, Doda, Kishtwar, Baramulla (Uri).
- ▶▶ Introduce and scale up cultivation of high-value nuts and berry crops (such as hazelnut, chestnut, pecan nut, pistachio, blueberry, raspberry) through active involvement of SHGs/FPOs.
- ▶▶ Establish grapes and kiwi production clusters in suitable agro-zones (e.g., Ganderbal, Baramulla, Ramban, Udampur, Kathua) supported by packhouses and cold storage.
- ▶▶ Develop and implement a marketing strategy to position J&K as a key supplier of summer TOP crops to northern markets under Operation Greens.
- ▶▶ Establish 3-5 vegetable seed production hubs, develop high-value vegetable production clusters, and set up minimal processing units in key agro-climatic zones.
- ▶▶ Promote commercial-scale kharif onion and garlic cultivation in identified suitable zones by establishing post-harvest storage units and securing market tie-ups for off-season supply.
- ▶▶ Facilitate development of value addition and processing infrastructure for local fruits (e.g., mango, pomegranate, guava) with branding and shelf-life extension technologies in key production clusters.
- ▶▶ Standardise bulb production technology for high-value flowers like tulip, gladiolus, iris, and saffron through collaboration with SKUAST and extension to nurseries and farmers.
- ▶▶ Promote commercial cultivation of high-value medicinal and aromatic crops for traditional and alternative medicine markets across key agroclimatic zones under J&K Aroma Arogya Gram (JAAG) project.

- (g) **Digital Technology Integration** focuses on mainstreaming digital tools and platforms across the horticulture value chain in J&K. This component aims to digitally empower farmers, enable real-time decision-making, and enhance transparency and traceability in the horticulture supply chain. The short-term focus is on laying the foundation: introducing traceability tools in select crops and digitising Kisan Khidmat Ghars (KKGs). The medium and long-term goals include operationalising early warning systems, launching e-market platforms, and ensuring product compliance with domestic and international quality norms via testing labs. This digital integration supports other roadmap components like hi-tech production, exports, extension, and value chain traceability.
- ▶▶ Establish real-time early warning systems for pest, disease and weather threats in all districts using remote sensing, AI & IoT tools.
 - ▶▶ Deploy precision farming technologies and traceability systems (blockchain, QR codes) in at least three major horticulture value chains (apple, walnut, saffron).
 - ▶▶ Set up regional quality control units and testing labs (chemical residue, MRLs, phytosanitary norms) in key horticulture clusters.
 - ▶▶ Develop and operationalise digital platforms to support e-marketing of fresh and processed produce, tailored to the needs of farmers, FPOs and local agribusinesses.
 - ▶▶ Strengthen KKGs at the panchayat level as digital information hubs and integrate them with farmer-centric mobile apps to deliver real-time updates on prices, weather, pest alerts and best practices.
- (h) **Infrastructure Development** aims to upgrade post-harvest, logistics, renewable energy, and R&D ecosystems across the UT. This component aims to close key infrastructural gaps from production to export. Phase 1 focuses on foundational infrastructure (cold storages, warehouses, processing units, solar integration, mechanisation). Phases 2 and 3 introduce advanced facilities like CA/ULO storage, testing labs, export logistics, and decentralised renewable grids. The inclusion of renewables, ICT, and quality assurance systems aligns with the circular economy and export-readiness goals. R&D infrastructure (labs, advisory systems, packaging institute) reflects a forward-looking approach to product quality and market competitiveness.
- ▶▶ Develop basic cold storage (0-5°C) and packhouse infrastructure strategically located in key production areas at the block and district levels.
 - ▶▶ Establish at least 5 integrated cold chain hubs in high-value horticulture clusters, each with linkages to processing units and export terminals.
 - ▶▶ Develop modern warehousing facilities with grading and sorting facilities across major horticulture clusters.

- ▶▶ Set up advanced CA and ULO storage facilities in at least 3 key production clusters under Agriculture Infrastructure Fund in North and Central Kashmir, ensuring regional balance and equitable access.
 - ▶▶ Promote crop-specific mechanisation across the value chain - including pre-harvest, harvest, post-harvest handling, processing, and preservation in the targeted horticulture clusters through FPOs.
 - ▶▶ Establish processing clusters for fruit crops proposed in each district.
 - ▶▶ Strengthen first- and last-mile road and rail connectivity to major horticulture clusters by prioritising them under PM Gati Shakti and state-level infrastructure planning.
 - ▶▶ Promote air/ railways freight support and cargo handling for perishables (through incentives and infrastructure at airports).
 - ▶▶ Install solar-powered cold storage, irrigation pumps and packhouses across the districts, prioritising high-production clusters and leveraging schemes like PM-KUSUM and Agri-Infra Fund.
 - ▶▶ Promote decentralised renewable energy grids in production clusters and nurseries.
 - ▶▶ Develop ICT-enabled knowledge dissemination systems (advisory platforms, mobile-based systems).
 - ▶▶ Establish 5-6 regional lab testing and diagnostic centres in key horticulture clusters and 2-3 agro-processing R&D units linked to SKUASTs to support quality assurance, pathogen detection, and value-added product development.
 - ▶▶ Establish NABL-accredited Food Testing Labs in each Food Park and upgrade existing labs to meet FSSAI 2006 standards; align with national testing institutions for quality assurance and consumer safety.
 - ▶▶ Establish an Indian Institute of Packaging Centre to design commodity-specific packaging materials for niche crops and facilitate research, training, and industry collaboration.
- (i) **Market Access** component aims at improving both domestic and international market integration for farmers and FPOs in Jammu & Kashmir through infrastructure, capacity building and certification systems. Short-term interventions include foundational work: establishing direct markets, enabling e-commerce, initiating branding and certification, and basic export facilitation. Medium and long-term phases focus on scaling up through EPZs, export hubs, intelligence systems, and deeper global integration. Integration with digital platforms (eNAM, e-commerce), branding, and logistics modernisation is central to linking producers to value chains. Export competitiveness is aimed to be enhanced through certification systems, testing labs, and training programs, aligned with international standards.

- ▶▶ Establish direct marketing channels by promoting farmer markets (at least 2 in each district), FPO/cooperatives-led markets in key urban and rural/peri-urban areas.
 - ▶▶ Facilitate the onboarding of farmers/FPOs onto e-commerce platforms such as Open Network for Digital Commerce (ONDC) for direct sales.
 - ▶▶ Upgrade existing price discovery mechanisms by expanding real-time digital platforms such as e-NAM, integrating them across mandis (remaining 7), FPOs (around 318), and e-commerce channels.
 - ▶▶ Develop regional branding initiatives and certification schemes such as GI and organic labels, with the involvement of local communities, FPOs.
 - ▶▶ Establish export facilitation centres, one each in Jammu and Kashmir region, with customs clearance, documentation, financial assistance and real-time market intelligence; streamline logistics for export promotion.
 - ▶▶ Set up export certification centres (for MRL testing, GAP certification, etc) and compliance systems in both Jammu and Kashmir regions.
 - ▶▶ Facilitate product certification (through NPOP, organic, and international food safety standards).
 - ▶▶ Conduct regular capacity building for farmers/exporters (at least 1000 annually) on global standards and export procedures, tailoring modules by crops and regions.
 - ▶▶ Establish intelligence hubs for global demand forecasting, price trends and quality standard requirements.
 - ▶▶ Develop integrated export hubs at the district level (warehousing, aggregation, processing of high-value crops).
 - ▶▶ Set up integrated Export-oriented Processing Zones (EPZs) with processing, cold storage, packaging, quality labs and customs clearance support.
- (j) Value addition component focuses on enhancing value addition through the establishment of small-scale processing units, industry-scale processing facilities, and branding initiatives for key products. Short-term and medium-term goals involve setting up small processing units, developing branding for key horticultural products (e.g., apple, saffron, walnut), and initiating geographical indication (GI) registration. Long-term phases focus on scaling up processing capacity through PPPs, continuing brand development, and further promotion of products both nationally and internationally. A significant emphasis is placed on horticulture, integrating tourism circuits with horticultural production, creating new revenue streams for farmers while promoting regional products. The goal is to promote branding, certification, and market linkages that enhance the competitive edge of local horticultural products in both domestic and international markets.

- ▶▶ Establish over 100 small-scale minimal processing units (e.g grading, dehydration, pulp extraction) across key clusters.
- ▶▶ Set up industry-scale processing units in high-potential districts (such as Anantnag, Baramulla, Pulwama, Jammu, Kathua) through PPPs and Agri Infra Fund.
- ▶▶ Continue development of brand (e.g. for apple, saffron, walnut, cherry) and quality certification programs.
- ▶▶ Facilitate GI registration for key products and promote them nationally and internationally.
- ▶▶ Develop horti-tourism circuits in key production districts by partnering with local communities/cooperatives and the tourism department, and promote regional products.

(k) **Financial Access and Support** focuses on improving financial access for horticultural stakeholders, with a focus on smallholders, FPOs, and agripreneurs. Short-term and medium-term emphasises facilitating easy access to credit, including concessional loans, collateral-free loans via NABARD's Credit Guarantee Fund, and subsidised interest schemes for horticulture loans. Additionally, the creation of a dedicated financing window through cooperative banks, SHGs, and MFIs is crucial for smallholder support. Long-term actions focus on further investment promotion, such as establishing a Horticulture Development Fund to support high-density planting, post-harvest units, and Public-Private Partnerships (PPPs) for infrastructure and R&D.

- ▶▶ Facilitate easy access to loans at concessional rates, especially for smallholders and FPOs by expanding KCC coverage and strengthening partnership with banks and NBFCs.
- ▶▶ Leverage NABARD's Credit Guarantee Fund (₹1,000 crore) to facilitate collateral-free loans for SHGs, FPOs, and individual farmers.
- ▶▶ Provide subsidised interest schemes for horticulture loans.
- ▶▶ Create a dedicated smallholder financing window through cooperative banks, SHGs and MFIs.
- ▶▶ Design and implement crop-specific insurance schemes for major horticulture crops across the districts.
 - Target 60% farmer enrolment, with special outreach and premium support for marginal and small farmers.
- ▶▶ Create and operationalise a dedicated Horticulture Development Fund, including support for high-density planting, post-harvest and processing units.
- ▶▶ Promote Public-Private Partnerships models for infrastructure, R&D and processing investments.

- ▶▶ Encourage private investment through targeted mechanisms and incentives (e.g., viability gap funding).
- ▶▶ Attract Foreign Direct Investment for high-tech horticulture and export-oriented units by organising investment summits, offering policy incentives and improving ease of doing business.

(l) **Sustainability and Environmental Management** component aim to integrate sustainability at all levels, focusing on regulatory compliance, sustainable farming practices, climate resilience, and a circular economy approach. It aims for transitioning to organic, climate-smart, and waste-reducing practices, with a focus on long-term sustainability, climate adaptation, and environmental stewardship.

- ▶▶ Draft amendments to the State Forest Act to permit the removal of old/unproductive trees for orchard rejuvenation.
- ▶▶ Conduct quarterly awareness programs for farmers and forest officials on revised regulations, best practices for orchard rejuvenation, and compliance requirements, led by horticulture and forest departments.
- ▶▶ Establish a regulatory mechanism to oversee the implementation of amendments, ensuring adherence to environmental guidelines and sustainable land use practices.
- ▶▶ Promote organic farming/natural farming models and certification schemes.
 - Achieve a 50% reduction in pesticide usage across target areas; bring 40-50% of agricultural land under organic farming in the long term.
- ▶▶ Implement micro-irrigation, water harvesting and efficient irrigation systems.
 - Increase the area under micro-irrigation to at least 2% of total horticulture area, focusing on high-density plantation areas (around 10,000 ha).
- ▶▶ Incentivise sustainable practices (carbon farming and eco-labelling) and integrate into FPOs through capacity building and certification assistance.
- ▶▶ Develop and promote climate-resilient varieties suited for local agro-climatic zones.
- ▶▶ Mainstream integrated pest management, nutrient management and conservation farming.
- ▶▶ Develop district-level disaster management plans.
- ▶▶ Establish early warning systems for extreme weather and pest outbreaks in horticulture clusters.
- ▶▶ Create climate-resilient farming zones through agro-climatic mapping and targeted crop planning.
- ▶▶ Scale up agroforestry and mixed farming models combining fruit trees with under-utilised crops.

- Develop carbon sequestration programs as part of a broader climate-smart transition.
- Promote composting and vermicomposting units using horticultural and organic waste in key horticultural clusters by providing technical training and market linkages for compost products through FPOs, SHGs and rural entrepreneurs.
- Facilitate R&D and pilot projects through FPOs/cooperatives/SHGs on converting pruning waste and biomass into biochar or biogas.
- Promote cooperative-led value chains for waste-to-wealth enterprises (e.g., fruit pulp waste to pectin or animal feed) through capacity building and financial support in key horticulture clusters.
- Develop policy incentives for circular practices in horticulture (reuse, recovery, recycling).

3. Way Forward

Major recommendations, structured thematically with embedded geographic and agro-climatic differentiation, follow below:

S.No.	Theme	Action	Geographic and Agro-Climatic Application
1.	Institutional and Policy Reforms (<i>Statewide framework Zone-sensitive implementation</i>)	• Unify all horticulture-related activities (fruits, vegetables, floriculture, spices, plantation crops, apiculture, saffron, protected cultivation, nurseries, and seeds) under respective Directorate of Horticulture for Jammu and Kashmir to address institutional fragmentation. • Amend the Fruit Nurseries (Licensing) Act, 1987 to strengthen regulation of planting material production, certification, traceability, and imports • Amend the State Forest Act to enable orchard rejuvenation while ensuring ecological safeguards.	• Kashmir Valley: Facilitate removal and replacement of senile apple and walnut orchards for high-density rejuvenation using climate-resilient cultivars. • Jammu Plains: Strengthen nursery regulation and quality control for subtropical vegetables, TOP crops, and imported planting material.

S.No.	Theme	Action	Geographic and Agro-Climatic Application
2.	Nursery and Planting Material Systems (Zone-specific specialisation within a unified certification framework)	- Establish PPP-based model nurseries, seed villages, and high-tech nurseries; introduce standardised certification systems and capacity-building for modern nursery management. - Establish modern nurseries (40-50 ha) in each district with hydroponics, aquaponics, vertical farming, precision farming (automation, micro irrigation), tissue culture and renewable energy practices. - Establish at least one tissue culture lab in each agro-climatic zone	Jammu (Subtropical): Nurseries for TOP crops, garlic, grapes, and off-season vegetables, with a focus on heat- and humidity-tolerant varieties. Kashmir Valley (Temperate): High-tech nurseries for apples, walnuts, kiwi, saffron, and floriculture, including clonal rootstocks. Cold and High-Altitude Areas (>2500 m): Pilot nurseries for niche crops such as medicinal herbs, seed potatoes, and berries.
3.	Productivity Enhancement and Crop Diversification (Cluster-based, agro-ecologically aligned)	Promote high-density plantations, crop-specific SOPs/POPs, and horticultural clusters to enhance productivity and profitability.	Jammu Plains:– Subtropical clusters for grapes, garlic, onion, tomato, and off-season vegetables – Revival of water chestnut and lotus stem in wetland belts Kashmir Valley:– Temperate fruit clusters (apple, kiwi, walnut), saffron belts, and floriculture zones – Orchard rejuvenation using disease-resistant, high-yielding cultivars
4.	Research, Innovation and Infrastructure (Centres of Excellence in key districts)	Strengthen, functionalise and network existing Centres of Excellence (COEs) and integrate advanced pre- and post-harvest technologies across value chains.	Temperate districts: COEs for apple, walnut, and saffron; expansion of CA/ULO storage facilities. Subtropical districts: Vegetables-focussed COEs; packhouses and grading facilities near transport corridors. Across zones: Modernisation of irrigation systems, on-farm storage, aggregation, and collection centres.

S.No.	Theme	Action	Geographic and Agro-Climatic Application
5.	Sustainability and Climate-Resilient Practices (Statewide adoption with zone-specific adaptation)	Promote organic and natural farming, climate-resilient varieties, and circular economy models aligned with national sustainability goals.	Jammu (Subtropical): Natural farming practices combined with crop residue recycling and water-efficient irrigation systems. Kashmir (Temperate): Organic certification for apples and saffron; adoption of climate-resilient temperate cultivars.
6.	Human Capital Development and FPO Strengthening (Division-wise targeting)	Strengthen farmer training, women and youth entrepreneurship, and FPO/SHG capacities across horticulture value chains.	Jammu Division: Skills development in vegetable aggregation, grading, and primary processing. Kashmir Valley: Training in orchard management, post-harvest handling, quality standards, and export compliance. Across J&K: Digital extension services, mobile-based advisories, and improved access to credit and insurance.
7.	Markets, Value Addition and Exports (cluster-based export infrastructure development)	Strengthen cold chains, packaging systems, digital market integration, and export-oriented infrastructure to minimise 25-35% post-harvest losses and boost off-season supply to northern markets.	All zones: District-level integrated export hubs with quality certification, e-commerce, and retail integration. Jammu Division: Prioritise vegetable export hubs with minimal processing and moisture-resistant, low-cost packaging for vegetables. Kashmir Valley: Expansion of CA storage, minimal processing facilities for apples and kiwi; GI branding and linkage with horti-tourism.
8.	Community Engagement, PPPs and Horti-Tourism (Location-specific development)	Promote community participation, PPP models, and horticulture-linked tourism to enhance rural livelihoods.	Kashmir Valley: Apple, saffron, and floriculture-based tourism circuits integrated with GI branding. Jammu Foothills: Vegetable clusters linked with agro- and rural tourism pilot initiatives.

Through a phased, inclusive, and innovation-driven approach, the roadmap envisions transforming J&K into a national and global leader in high-value horticulture by 2047, contributing to India's vision of a Viksit Bharat.

1

INTRODUCTION



1.1 Background

Indian horticulture is a dynamic and vital segment of the agricultural landscape, driving economic growth and ensuring nutritional security. It plays a pivotal role in the country's agriculture sector, contributing significantly to its economy² and food security. Encompassing a diverse range of fruits, vegetables, flowers, spices, medicinal and aromatic plants, plantation crops and honey, the horticulture sector is characterised by its high growth rate³ and substantial export potential⁴.

India is the second-largest producer of fruits and vegetables globally, with an estimated production of 367.72 million tonnes in 2024-25 (2nd Advance estimate). Horticultural crops cover 29.27 million hectares (2024-25, 2nd Advance estimate). The sector provides livelihood to millions of farmers and supports numerous industries, including food processing, pharmaceuticals, and cosmetics. Horticultural exports have also shown a consistent upward trend. The Government of India has launched several initiatives to promote horticulture, such as the Mission for Integrated Development of Horticulture (MIDH), which aims to enhance productivity, production, improve quality, and ensure better market access for horticultural produce.

Despite its achievements, the horticulture sector faces challenges such as inadequate infrastructure, post-harvest losses, and climate change impacts. However, with advancements in technology, improved management practices, and increased focus on organic farming and sustainability, the future prospects are promising. With continued support and innovation, the sector is poised for significant growth in the coming years.

Horticulture is a cornerstone of Jammu and Kashmir's (J&K) economy, contributing significantly to the region's economy and providing livelihood to a substantial portion of its population.⁵ The unique climatic conditions and fertile soils of J&K create an ideal environment for the cultivation of a wide range of high-quality horticultural crops, including fruits, vegetables, spices, medicinal and aromatic plants and flowers. In J&K, horticulture (fruits and dry fruits) covers over 3.45 lakh hectares, with the production of 2.6 million tonnes in 2023-24, making it a crucial player in India's horticulture sector. Apples are the most significant fruit crop, with J&K being the largest apple-producing region in India, contributing over 70% of the country's apple production. Other important fruits include pears, cherries, apricots, strawberries, almonds, and walnuts. The region is also renowned for saffron, with the Pampore area being a significant hub for this valuable spice, with its high quality and distinct flavour. The region's horticultural diversity also includes vegetables such as potatoes, tomatoes, radish, carrots and green vegetables, along with spices like chillies, garlic and turmeric, kala zeera cultivated using both traditional and modern farming techniques. Floriculture is also gaining momentum, with an increasing focus on cultivating tulips, marigolds, and roses. A wide variety of medicinal and aromatic plants are also produced in both regions.

² The horticulture sector accounts for 37.6% of the value of output in agriculture (Horticultural Statistics at a glance, 2021)

³ The annual growth rate (2020-21 over 2019-20) of area under horticulture crops and production was 3.75% and 4.41% respectively (Horticultural Statistics at a glance, 2021)

⁴ In 2023-24, India's exports of fresh fruits and vegetables amounted to USD 1,814.58 million, covering both categories—fresh fruits and fresh vegetables. <https://apeda.gov.in/FreshFruitsAndVegetables>

⁵ The contribution of horticulture to GSDP of J&K is about 6-7% and is a source of livelihood for 28% of the total population, providing direct and indirect employment to around 3.5 million people and supporting nearly 0.7 million families across the UT (Economic Survey, Jammu and Kashmir, 2024-25).

The region's horticultural products, particularly apples and walnuts, have a significant export market. In 2023-24, fruits worth over ₹ 2806.22 crore were exported, amounting to a total quantity of 508.29 thousand tonnes. The government of J&K, with central government support, has implemented various schemes to promote horticulture. These include the High-Density Plantation Scheme, which aims to increase productivity and improve quality. Other initiatives focus on providing subsidies for cold storage facilities, promoting organic farming, and enhancing market linkages.

Despite its potential, the horticulture sector in J&K faces challenges such as inadequate infrastructure, transportation issues, and susceptibility to weather-related disruptions. The future of horticulture in the region looks promising, with ongoing efforts to introduce advanced farming techniques, expand high-density plantations, and improve cold chain infrastructure to reduce post-harvest losses. With its diverse agro-climatic conditions suitable for a diverse group of horticulture crops and significant economic contribution, the sector holds immense potential for growth and development, driving socio-economic progress in the region.

To harness the immense potential of this sector in J&K, it is essential to develop a comprehensive road map focused on intensive, technology-driven growth, enhanced quality standards and efficient post-harvest management. Improving the availability of quality planting materials will be crucial for ensuring long-term growth and sustainability. Developing clusters for efficient transport, marketing, and processing of speciality fruits will further maximise profits for growers. The road map sets clear horticultural goals and outlines strategies focused on leveraging technologies, strengthening market linkages and promoting value-added products. This roadmap will guide policymakers, scientists, growers, industrialists, and other stakeholders in optimising the horticultural potential of J&K. The aim is to achieve higher production, improved productivity and better quality with greater value realisation year after year, reaching its peak by 2047 in alignment with the vision of Viksit Bharat.



Figure 1. 1: Jammu and Kashmir (J&K) at a glance

1.2 Geographical and Agro-Climatic Overview Of J&K

1.2.1 Geography and Demography

The UT of J&K is geographically divided into three zones – the mountainous and semi-mountainous plain known as the Kandi belt, the hills including the Siwalik ranges, and the mountains of the Kashmir valley and the Pir Panjal range. Major rivers flowing through J&K include the Chenab, Jhelum and Tawi. Due to its varied topography and location, the UT experiences extreme climatic variations. The UT comprises two main divisions, namely, the Jammu division and the Kashmir division. Each region has its own culture, languages and beliefs.

Located between 32.17” and 36.58” North latitude and 73.26” and 80.30” East longitude, J&K is a strategically important territory, sharing long borders with Pakistan and China and characterised primarily by hilly terrain. The UT consists of twenty (20) districts (10 in Jammu and 10 in Kashmir division, 207 Tehsils, 285 Blocks and 4291 Panchayats. There are as many as 6832 villages and 118 urban areas.

The population of J&K as per Census 2011 was 1.23 crore with a population density of 290 persons per sq. km. The projected population for 2021-22 is estimated at 1.35 crore (J&K Statistics, 2021). The average land holdings size is 0.59 ha (as per Agriculture Census, 2015-16) and the net irrigated area is 310.59 thousand ha (2023-24), accounting for 42% of the net sown area. This indicates that farming in J&K is characterised by small, fragmented landholdings, and a significant portion of agriculture still relies on

rainfall, highlighting the need for improved irrigation infrastructure to ensure sustainable agricultural growth.

1.2.2 Agroclimatic Diversity

J&K exhibits wide climatic variation, ranging from 45 °C in the plains of Jammu division to as low as -15 °C in the snow-capped mountains of Kashmir. Based on physiographic characteristics, the UT is broadly divided into two main regions

- ▶ the outer Himalayas comprising the Jammu province, and
- ▶ the lesser Himalayas comprising the Kashmir Valley.

The UT has four major agro-climatic zones - three in the Jammu region and one in the Kashmir region, which support a diverse range of fruit crops. In several districts, overlapping agro-climatic zones allow the coexistence of both subtropical and temperate fruit crops within the same region. These zones and their corresponding suitable fruit crops are detailed below (Table 1.1).

Table 1.1: Agroclimatic Zones of J&K

Region	Agro-Climatic Zone	Altitude Range (m)	Climatic Characteristics	Coverage Area	Suitable Fruit Crops ⁶
Jammu	Low Altitude Subtropical Zone	< 300-1000	Hot summers, good monsoons, dry winters; primarily alluvial soils; max. rainfall July-Sept	Jammu, Samba, the lower parts of Kathua and Udhampur	Mango, Litchi, Citrus, Guava, Ber, Loquat, Grapes, Strawberry, Aonla
	Mid-Hill / Intermediate Zone	1000-1500	Good monsoon rains, wet and cold winters	Mid-altitude areas of the Pir Panjal range: Doda, Poonch, Rajouri, Udhampur, Kathua, Ramban	Peach, Plum, Apricot, Pear, Pecan nut, Olive, Kiwi
	High Hills	1500-4000	Severe winters, heavy monsoon rainfall, major drainage base: River Chenab and its tributaries and River Ravi	Upper parts of Kathua and the higher reaches in the Jammu region	Apple, Pear, Peach, Plum, Apricot, Walnut, Pecan nut, Almond
Kashmir	Mid to High Altitude Temperate Zone	-	Dry, warm summers; wet, severe winters with snowfall at higher altitudes; alluvial soils	Entire Kashmir Valley (such as Anantnag, Pulwama, Srinagar, Budgam, Baramulla, Kupwara)	Apple, Cherry, Almond, Saffron, Walnut, Pear, Apricot, Peach, Plum

1.2.3 Land-use Pattern

The UT of J&K is basically an agrarian area, and agriculture occupies an important place in the economy. Agriculture in UT is generally rain-fed, with about 40% irrigated area in the Jammu division and 60% irrigated area in the Kashmir division. Table 1.1 shows

⁶ <https://hortijmu.jk.gov.in/agroclimate.html> (accessed on March 25th, 2025)

that forest area, the largest category of land use, remained relatively stable at around 27% of the reporting area, with a marginal decrease from 27.39% in 2020-21 to 27.09% in 2022-23. The total area not available for cultivation also fluctuated slightly, accounting for around 22% of the total reporting area across the years. The area under social forestry remained stable at 8 thousand ha (0.34%) in 2020-21 and 2021-22 but increased to 14 thousand ha (0.59%) in 2022-23. With the increase in social forestry and a stable forest area, there is an opportunity to integrate agroforestry systems, where horticultural crops can grow alongside trees, offering ecological and economic benefits.

The area under uncultivable land excluding fallows (including permanent pastures, grazing land and waste land) increased from 326 thousand ha (13.86%) in 2020-21 to 347 thousand ha (14.55%) in 2022-23. Fallow land other than current fallows have remained relatively stable with a slight decrease from 38 thousand ha (1.62%) in 2020-21 to 37 thousand ha (1.55%) in 2022-23. The area under current fallows increased over the three years from 82 thousand ha (3.49%) in 2020-21 to 98 thousand ha (4.11%) in 2022-23. There could be potential for reclaiming fallow and uncultivable land for horticulture, especially if water management practices are improved or if the land is suitable for a fruit orchard or medicinal plants.

The net sown area (NSA) remained relatively stable, with a slight decrease from 736 thousand ha (31.30%) in 2020-21 to 733 thousand ha (30.74%) in 2022-23, suggesting that while the area under cultivation is not shrinking drastically, there is no significant expansion either. This could reflect saturation in the available land for conventional agriculture and the need to shift towards intensive agricultural practices, such as better use of available land, improved crop rotation, and the adoption of high-yielding and climate-resilient horticultural practices. It also suggests that for the growth in horticulture, the focus should be on improving productivity.

Thus, the land use trends in J&K suggest a relatively stable base for horticulture, but growth will depend on better land management, technological advancements and policies that encourage sustainable agricultural practices.

Table 1.2: Land Use Patterns in Jammu and Kashmir

S. No.	Use	2020-21		2021-22		2022-23	
		Area (000 ha)	% of reporting area	Area	% of reporting area	Area (000 ha)	% of reporting area
1.	Area under Forest	644	27.39	646	27.48▲	646	27.09▼
2.	Area not available for cultivation						
	(a) Area put on non-agricultural uses	214	9.10	213	9.06	214	8.97
	(b) Barren and Uncultivable land	295	12.54	295	12.55▲	302	12.66▲
	(c) Marshy & Waterlogged land	0.56	0.02	0.41	0.02	0.42	0.02
	(d) Land under Still Water	8	0.34	7	0.30▼	7	0.29▼
	Total (2)	517.56	22.01	515.41	21.93	523	21.94

S. No.	Use	2020-21		2021-22		2022-23	
		Area (000 ha)	% of reporting area	Area	% of reporting area	Area (000 ha)	% of reporting area
3.	Social forestry	8	0.34	8	0.34	14	0.59▲
4.	Other uncultivable land, excluding fallows						
	(a) Permanent pastures and other grazing land	107	4.55	106	4.51▼	108	4.53▲
	(b) Land under miscellaneous tree crops not included in the area sown	64	2.72	63	2.68▼	66	2.77▲
	(c) Culturable waste land	155	6.59	154	6.55▼	159	6.67▲
	Total (4)	326	13.86	323	13.74▼	347	14.55▲
5.	Fallow lands						
	(a) Fallow lands other than the current fallows	38	1.62	37	1.57▼	37	1.55▼
	(b) Current fallows	82	3.49	88	3.74▲	98	4.11▲
	Total (5)	120	5.10	125	5.32▲	135	5.68▲
6.	Net Area Sown	736	31.30	733	31.19▼	733	30.74▼
7.	Reporting Area	2351.56	100.00	2350.41	100.00	2358.50	100.00

Source: Jammu and Kashmir Economic Survey 2024-25

1.3 Significance and Scope of Horticulture in Jammu And Kashmir

Building on the unique agro-climatic advantages and established horticulture base, Jammu and Kashmir has the potential to emerge as a model horticulture economy. With over eight lakh farm families engaged in the sector, particularly in the Kashmir division, which contributes over 90% of the fruit production, the sector serves as a vital pillar of rural livelihoods. However, there is significant untapped potential for the cultivation of subtropical fruits as well as low chilling cultivars of temperate fruits in mid to high hills of the Jammu division. A strategic focus on region-specific crop diversification, high-value horticulture, and sustainable intensification can unlock new avenues for income generation, export growth, and employment creation. Such diversification can help farmers mitigate risks associated with market fluctuations, climate variability, and emerging pest and disease pressures.

Quality seeds and planting materials are the backbone of a sound horticulture industry. The number of hi-tech fruit nurseries has doubled in both J&K regions from 9 and 161 in 2017-18 to 19 and 383, respectively, in 2021-22.⁷ However, there remains significant scope for developing the Jammu region as a hub for nursery production, which is currently at a nascent stage. Given the perishable nature of horticulture produce, the importance of post-harvest management can hardly be overemphasised, especially with respect to reducing post-harvest losses and enhancing

⁷ Economic Survey, Jammu and Kashmir, 2022-23

value addition. For example, apples, the dominant crop, suffer post-harvest losses ranging from 20-25%. Strengthening the cold chain and value addition infrastructure is therefore essential.

As the sector faces evolving challenges from climate change and increasing opportunities from emerging technologies, the horticulture sector in J&K must evolve and adapt proactively. Despite horticulture's importance, there is currently no well-defined horticulture policy in place. The policy should propose to introduce desirable fruit cultivars, promote the use of quality seeds and planting material, encourage high-density plantations and farm mechanisation, support diversification into high-value crops, and strengthen market linkages. It must also emphasise soil health management, ecosystem preservation, artificial intelligence applications, enhanced processing and storage capacity, traceability, value addition, and branding.

Equally important is the integration of sustainable agricultural practices, such as organic and natural farming, efficient water use through micro-irrigation and integrated pest and nutrient management, to ensure long-term ecological balance and climate resilience. Promoting agroforestry and biodiversity-friendly practices can further strengthen sustainability goals.

Participation of marginal and smallholders, who constitute the majority of horticulture producers in J&K, is essential.⁸ Access to extension services, affordable credit, quality inputs, and aggregation platforms such as Farmer Producer Organisations (FPOs) will be essential to integrate smallholders into value chains and ensure economies of scale.

In addition, the future of horticulture in the region must be rooted in community engagement and inclusive development. Rural employment generation, improved living standards, and the active involvement of rural youth and women through skill development initiatives and producer organisations should be prioritised. Empowering communities to take ownership of horticulture value chains will be crucial for achieving scalability, equity, and long-term impact.

Thus, a coordinated, inclusive, and sustainability-driven approach will be key to transforming J&K's horticulture sector into a globally competitive and climate-resilient growth engine.

1.4 Objectives

The primary objective of the study is to formulate a roadmap outlining strategies and actionable recommendations for enhancing horticultural development in the UT of Jammu and Kashmir. The roadmap will seek to address existing challenges, leverage emerging opportunities and promote sustainable growth in the sector. The specific objectives are as follows:

- 1.4.1 To analyse the current status of horticulture in the UT of Jammu and Kashmir, including production, productivity of major crops, exports and imports, schemes, existing infrastructure, and challenges.
- 1.4.2 To identify opportunities for diversification, establishment of crop clusters and expansion of horticultural crops based on agro-climatic conditions and future demand.
- 1.4.3 To suggest strategies for infrastructure development, including irrigation facilities, cold storage, transportation, marketing, availability of quality planting materials, certification and chemical-free production.

⁸ In 2015-16, marginal and small holders constituted 95% of the landholdings in J&K (Digest of Statistics, 2023-24).

- 1.4.4 To identify opportunities for market linkages, value chain development and export to ensure better returns for horticulture produce.
- 1.4.5 To suggest innovations in horticulture, including the adoption of new technologies and best practices.
- 1.4.6 To propose strategies for promoting sustainable practices, addressing environmental concerns and mitigating the impact of climate change.
- 1.4.7 To develop skilled human resources to meet the requirements of horticulture and to enhance international competitiveness and farmers' incomes.
- 1.4.8 To explore opportunities for community engagement, stakeholder collaboration and promotion of horti-tourism to enhance rural development.
- 1.4.9 To suggest a regulatory framework for the smooth functioning of all components of the horticulture sector.



2

HORTICULTURE OVERVIEW AND STATUS



The horticulture sector in the Union Territory (UT) of Jammu and Kashmir (J&K) is a vital contributor to the region's economy, generating ₹10,000 crore annually and supporting around 35 lakh people. With its favourable climate, J&K is renowned as the "Land of Fruits," producing a diverse range of crops. The sector has witnessed significant transformation, focusing on productivity, quality enhancement, and year-round availability through technological advancements/ interventions and modern farming practices. Key achievements across the area, production, market connectivity, exports and storage infrastructure are summarised below in Table 2.1.

In recent years, significant initiatives have focused on adopting High-Density Plantation (HDP) techniques, rejuvenating old orchards, and promoting local production of quality planting material. HDP adoption has surged, with 32.49 lakh HDP plants distributed in 2023-24, compared to 6.41 lakh in 2021-22. This expansion is complemented by efforts to rejuvenate old orchards and promote the local production of high-quality planting material. Area under horticulture increased modestly from 3.35 lakh ha (2020-21) to 3.45 lakh ha (2023-24), indicating steady expansion. Production rose from 22.30 lakh tonnes to a peak of 27.22 lakh tonnes in 2022-23, before slightly declining to 26.43 lakh tonnes in 2023-24, suggesting improved productivity with minor fluctuations. High/medium-density plantations saw a notable increase, with 4776 ha added in 2021-22 and 4023 ha in 2023-24, reflecting modernisation in planting methods.

Infrastructure development, particularly in cold storage, has also been a priority. In 2023-24, twelve Controlled Atmosphere (CA) storage units with a 60,000 metric ton capacity were installed, raising the total to 2.70 lakh metric tons. Expansion plans under the Holistic Agriculture Development Program (HADP) aim to add 55,000 metric tons over the next five years. The HADP has allocated ₹1,028.21 crore for horticulture projects, targeting productivity increase and market integration. Digital platforms like the National Agriculture Market (e-NAM) have enhanced trade efficiency, linking 17 of 24 functional mandis and facilitating transactions worth ₹416 crore. Food processing units surged from 8 in 2020-21 to 197 in 2023-24, reflecting a strong push for value addition and rural enterprise development. Fruit exports peaked at 19.05 lakh tonnes in 2022-23, before dropping to 13.67 lakh tonnes in 2023-24, with total export revenue dropping from ₹8646 crore to ₹5756 crore.

With a focus on modernisation, infrastructure, and market connectivity, J&K's horticulture sector is set for sustained growth, positioning the region as a leading hub for high-quality fruit production in domestic and global markets. However, some volatility in production and exports suggests the need for greater resilience through climate adaptation and market diversification.

Table 2.1: Physical Achievements in Horticulture Crops

S.No.	Particulars	Unit	Years			
			2020-21	2021-22	2022-23	2023-24
1.	Area under major horticulture crops	Lakh ha	3.35	3.42 ▲	3.44 ▲	3.45 ▲
2.	Production of major horticulture crops	Lakh tonnes	22.30	24.31 ▲	27.22 ▲	26.43 ▼
3.	Area brought under high/medium density	ha	880.89	4776.88 ▲	2540.04 ▼	4023.00 ▲

S.No.	Particulars	Unit	Years			
			2020-21	2021-22	2022-23	2023-24
4.	Mandis are connected with e-NAM	Number	4	6 ▲	11 ▲	17 ▲
5.	Value of trade through e-Mandis	₹ in crore	0.14	0.75 ▲	32.72 ▲	416.39 ▲
6.	Quantity of Fruit Exported					
	Fresh fruit	Lakh tonnes	11.86	17.13 ▲	18.31 ▲	13.59 ▼
	Dry fruit	Lakh tonnes	0.014	0.012 ▼	0.74 ▲	0.08 ▼
	Total		11.87	17.14 ▲	19.05 ▲	13.67 ▼
7.	Revenue Earned					
	Fresh fruit	₹ in crore	4449	5890 ▲	6900 ▲	5100 ▼
	Dry fruit	₹ in crore	561	479 ▼	1746 ▲	656 ▼
	Total	₹ in crore	5010	6369 ▲	8646 ▲	5756 ▼
8.	CA storage capacity	tonnes	151286	193374 ▲	210374 ▲	270374 ▲
9.	Food processing units established / upgraded	Number	8	63 ▲	124 ▲	197 ▲

Source: Economic Survey, 2024, Government of J&K

The sector is gradually commercialising, creating new jobs and business opportunities for the local population in hi-tech and high-density farming, pest and disease management, and production of clonal rootstocks. Developmental initiatives are also geared towards educating farmers on modern practices, modernising irrigation systems, and diversifying crops with new fruit crops like nectarine and kiwi and expanding processing infrastructure. However, despite significant gains, challenges such as market volatility, climate vulnerability, pest outbreaks, and gaps in value addition and branding persist. Addressing these through targeted policy measures and institutional support will be essential to secure the sector's long-term sustainability and competitiveness.

In this context, this chapter offers a comprehensive overview of the horticulture sector in J&K, focusing on critical aspects of the value chain including area, production, productivity, domestic demand, marketing arrangements, exports, imports, processing, supporting infrastructure and government schemes.

2.1 Area, Production, and Productivity Trends of Fruits

Over the past four decades, the area under fruit cultivation (fresh and dry) has expanded from 1.31 lakh ha in 1980 to 3.44 lakh ha in 2022, registering a CAGR of 2.33% (Table 2.2). This reflects a total expansion of 2.13 lakh ha since 1980. During this period, production of the fruits has increased over fivefold, from 5.63 lakh tonnes in 1980 to 27.22 lakh tonnes in 2022, growing at a CAGR of 3.82%. However, the productivity has risen at a slower pace, from 4.3 t/ha in 1980 to 7.91 t/ha in 2022, with a CAGR of only 1.46%.

This implies that production growth has primarily been driven by an increase in cultivated area rather than productivity improvements. Given the limited scope for further area expansion, future growth must rely on technology-driven improvements in yield.

Table 2.2: Trends in Area, Production and Productivity of Fruits in J&K (1980 to 2022)

Year	Area (lakh ha)	Production (Lakh tonnes)	Productivity (t/ha)
1980	1.31	5.63	4.30
1985	1.48	7.92	5.35
1990	1.76	7.70	4.37
1995	1.98	8.61	4.34
2000	2.19	9.32	4.25
2005	2.67	14.04	5.25
2010	3.25	22.22	6.84
2015	3.36	24.87	7.39
2020	3.35	22.30	6.66
2022	3.44	27.22	7.91
CAGR (1980 to 2022) (%)	2.33	3.82	1.46

Source: Digest of Statistics (various issues), DE&S, GoJK

2.1.1 Change in the Area, Production, and Productivity of Major Fruits (2004-05 to 2022-23)

The diversification process of the fruit sector in J&K has spurred since 2002-05 with the introduction of fruits such as peach, plum, citrus, mango, etc. In 2022-23, fruits (both fresh and dry) occupied as high as 344 thousand ha of area with a production of 2722 thousand tonnes at the yield level of 7.9 t/ha (Table 2.3). Out of J&K's total horticultural area of 344 thousand ha, 73.2% is dedicated to fresh fruit and 26.8% to dry fruit cultivation. With a few exceptions, most fruits have seen an increase in area and production by 2022-23.

Among the top-performing fruits, Apple dominates, accounting for 50% of the total fruit area and over 78% of total fruit production in 2022-23. Apple yield (12.5 t/ha) is the highest among all the fruits. Among dry fruits, Walnut occupies a major proportion of the dry fruit area (93%) and overall fruit area (25%) and contributes only about 12% to total fruit production. During 2004-05 to 2022-23, Cherry has shown a significant increase in production, especially on account of productivity gains. All the minor fruits have gained importance due to an increase in productivity levels.

Some fruits, however, have experienced a decline in cultivation. For instance, the decline of area under Ber (3.1 thousand ha) and Apricot (0.9 thousand ha) was relatively less whereas the area under Almond has declined sharply by 10 thousand hectares. Notably, while

almond area has contracted, production has fallen only marginally due to more than two-fold increase in productivity suggesting a shift toward fewer but more efficient orchards.⁹

Table 2.3: Change in the Area, Production and Productivity of Fruits Between 2004-05 and 2022-23

Year	2004-05			2022-23			Absolute Change since 2004-05		
	Area (000 ha)	Production (000 tonnes)	Productivity (t/ha)	Area (000 ha)	Production (000 tonnes)	Productivity (t/ha)	Area (000 ha)	Production (000 tonnes)	Productivity (t/ha)
Apple	108	1093	10.13	172	2146	12.5	63.7	1053	2.38
Pear	10.54	40.25	3.82	14.32	90.5	6.3	3.8	50.2	2.50
Apricot	4.93	11.98	2.43	4.02	12.0	3.0	-0.9	0.0	0.56
Peach	1.94	2.13	1.10	2.59	8.0	3.1	0.7	5.9	1.99
Plum	3.39	3.71	1.09	4.64	17.7	3.8	1.3	14.0	2.72
Cherry	2.55	7.37	2.89	2.99	22.9	7.7	0.4	15.5	4.76
Citrus Fruits	10.4	15.16	1.46	16.03	32.7	2.0	5.6	17.6	0.58
Mango	7.98	13.29	1.67	14.36	31.4	2.2	6.4	18.1	0.52
Ber	7.97	12.8	1.61	4.88	10.2	2.1	-3.1	-2.6	0.48
Other Fresh Fruits	9.94	17.65	1.78	15.87	34.6	2.2	5.9	17.0	0.41
Total Fresh Fruits	168	1218	7.27	251.31	2406	9.6	83.7	1189	2.31
Walnut	74.89	100.6	1.34	86.38	303.8	3.5	11.5	203	2.17
Almond	15.43	13.47	0.87	5.43	11.3	2.1	-10.0	-2.2	1.21
Other Dry Fruits	0.42	0.19	0.45	0.63	0.2	0.3	0.2	0.0	-0.20
Total Dry Fruits	91	114	1.26	92	315	3.4	1.7	201	2.15
All Fruits	258	1332	5.16	344	2722	7.9	85.4	1390	2.76

Source: Digest of Statistics (various issues), DE&S, GoJK

⁹ Besides other fruits including almonds, J&K has launched Modified High Density Plantation Scheme in 2022 to bring 5500 ha of land under this scheme and it is aimed to enhance production, productivity and raise farmers' income. https://hortijmu.jk.gov.in/pdf/REVISED%20MODIFIED%20HIGH%20DENSITY%20PLANTATION%20SCHEME%20FOR%20APPLE,%20WALNUT,%20ALMOND,%20CHERRY,%20MANGO,%20LITCHI,%20OLIVE%20ETC._compressed.pdf

2.1.2 Decadal Growth Trends in Area, Production, and Productivity of Major Fresh and Dry Fruits

Compound annual growth rates (CAGR) have been estimated to examine the decadal growth trends in area, production and productivity of major fruits. For this analysis, major fresh fruits including apple, pear and cherry and major dry fruits including walnut and almond have been considered. For clarity and comparison, the period from 1980-81 to 2022-23 has been divided into four decadal phases: phase I (1980-81 to 1989-90), phase II (1990-91 to 1999-00), phase III (2000-01 to 2009-10) and phase IV (2010-11 to 2022-23) (Table 2.4 and 2.5).

(i) Fresh Fruits

(a) Apple

The area under apple cultivation increased at a rising pace in the first three phases. However, the area saw a slower expansion rate of 1.61% in phase IV (Table 2.4). Apple production has exhibited a similar trend, though wide inter-year fluctuation could be observed, especially in phase II (3.9%) & III (6.88%). Since 1980-81, the production of apples has grown by 3.36%, exceeding the growth in area (2.52%). The productivity levels of apples (0.81%) have been increasing at a relatively lower rate compared to area and production, indicating that the production growth was primarily driven by expansion in cultivated area rather than productivity. It even declined in phase IV (-0.37%), suggesting possible challenges in yield improvement.

(b) Pear

The area and production of pears have increased in all the phases in absolute terms. During 1980-81 to 2022-23, the productivity of pears grew at 5.84%, driving strong production growth (8.28%) even though area expansion was moderate (2.31%). In Phase I, a significant productivity surge (18.52%) led to a remarkable production increase (23.53%) despite a modest area expansion (4.23%). Except for phase III, strong productivity-led growth was witnessed in phases II and IV.

(c) Cherry

Among the three fresh fruits, cherry recorded the highest productivity growth (6.71%) and strong growth in production (9.38%), despite only 2.51% growth in area expansion during 1980-81 to 2022-23. However, phase IV saw a decline in area (-1.21%) while productivity rebounded sharply (7.23%), suggesting a shift towards more efficient, intensive cultivation practices.

Table 2.4: Trends in the Area, Production and Productivity of Major Fruits in the UT of J&K (1980-2022)

Phase	Year	Area (ha)	Production (tonnes)	Productivity (t/ha)
(a) Apple				
Phase I	1980-81	60286	536300	8.91
	1989-90	68201	644814	9.45
	CAGR	1.38	2.07	0.66
Phase II	1990-91	68723	658165	9.58
	1999-00	86651	929022	10.72
	CAGR	2.61 ▲	3.90 ▲	1.26 ▲
Phase III	2000-01	88149	751310	8.53
	2009-10	139041	1367805	9.84
	CAGR	5.19 ▲	6.88 ▲	1.60 ▲
Phase IV	2010-11	141717	1852413	13.07
	2022-23	171610	2146350	12.51
	CAGR	1.61 ▼	1.23 ▼	-0.37 ▼
Overall CAGR		2.52	3.36	0.81
(b) Pear				
Phase I	1980-81	5491	3200	0.58
	1989-90	7969	21429	2.69
	CAGR	4.23	23.53	18.52
Phase II	1990-91	8085	16665	2.06
	1999-00	9110	29241	3.21
	CAGR	1.34 ▼	6.45 ▼	5.04 ▼
Phase III	2000-01	9169	31324	3.42
	2009-10	12400	45820	3.70
	CAGR	3.41 ▲	4.32 ▼	0.88 ▼
Phase IV	2010-11	12540	52500	4.19
	2022-23	14320	90490	6.32
	CAGR	1.11 ▼	4.64 ▲	3.49 ▲
Overall CAGR		2.31	8.28	5.84

Phase	Year	Area (ha)	Production (tonnes)	Productivity (t/ha)
(c) Cherry				
Phase I	1980-81	1054	530	0.5
	1989-90	1387	3538	2.55
	CAGR	3.10	23.48	19.84
Phase II	1990-91	1438	4168	2.9
	1999-00	2293	5316	2.32
	CAGR	5.32 ▲	2.74 ▼	-2.45 ▼
Phase III	2000-01	2368	5293	2.24
	2009-10	3400	10900	3.21
	CAGR	4.10 ▼	8.36 ▲	4.08 ▲
Phase IV	2010-11	3460	11450	3.31
	2022-23	2990	22880	7.65
	CAGR	-1.21 ▼	5.94 ▼	7.23 ▲
Overall CAGR		2.51	9.38	6.71

Source: Digest of Statistics, (Various issues), DE&S, GoJK

(ii) Dry fruits

(a) Walnut

Walnut area expanded steadily across the first three phases (growth of 4.23% to 4.49%) but declined in phase IV (-0.32%), possibly due to land constraints or competition from other crops. Production growth, however, remained positive across the phases. With phase IV witnessing a notable shift, productivity growth (5.64%) surpassed area expansion, indicating a successful move toward high-yielding varieties and improved orchard management.

(b) Almond

The area under almond cultivation has consistently declined after phase I, with a sharp fall of -9.33% in phase IV. Though productivity gains (9.37% in phase IV) partially offset the area loss, overall production declined by -0.84% during this phase. The strong early gains (phase I and II) were driven by productivity improvements, but the recent trend suggests urgent attention is needed to arrest area decline through policy interventions and promotion of modern almond orchards.

Table 2.5: Trends in the Area, Production and Productivity of Major Dry Fruits in the UT of J&K (1980-2022)

Phase	Year	Area (ha)	Production (tonnes)	Productivity (t/ha)
(a) Walnut				
Phase I	1980-81	26737	15000	0.56
	1989-90	39715	43125	1.08
	CAGR	4.49	12.45	7.57
Phase II	1990-91	40917	38583	1.01
	1999-00	59428	74906	1.26
	CAGR	4.23 ▼	7.65 ▼	2.49 ▼
Phase III	2000-01	59900	83399	1.39
	2009-10	88593	154276	1.74
	CAGR	4.44 ▲	7.07 ▼	2.53 ▲
Phase IV	2010-11	89789	163744	1.82
	2022-23	86380	303810	3.52
	CAGR	-0.32 ▼	5.29 ▼	5.64 ▲
Overall CAGR		2.83	7.43	4.47
(b) Almond				
Phase I	1980-81	16328	1860	0.11
	1989-90	19118	3374	0.18
	CAGR	1.77	6.84	5.62
Phase II	1990-91	19197	2208	0.12
	1999-00	18817	9672	0.51
	CAGR	-0.22 ▼	17.84 ▲	17.44 ▲
Phase III	2000-01	18059	10901	0.61
	2009-10	17581	12515	0.71
	CAGR	-0.30 ▼	1.55 ▼	1.70 ▼

Phase	Year	Area (ha)	Production (tonnes)	Productivity (t/ha)
Phase IV	2010-11	17587	12511	0.71
	2022-23	5430	11310	2.08
	CAGR	-9.33 ▼	-0.84 ▼	9.37 ▲
Overall CAGR		-2.59	4.39	7.25

Source: Digest of Statistics, (Various issues), DE&S, GoJK

Thus, the overall growth in fruit (fresh and dry) production in J&K has been mainly area-driven in the earlier phases, with encouraging shifts towards productivity-led growth recently (especially in pear, cherry, walnut and almond). However, declining productivity in apple and area shrinkage in almond cultivation raise concerns for sustainability of future supply. This is especially critical given that J&K accounts for nearly 79% of India's total apple production and about 91% of national almond production (2023-24 final estimates)¹⁰, making the region's performance central to the country's horticultural output and market stability.

(iii) Saffron

Saffron is an important spice crop grown exclusively in Pulwama, Budgam, Srinagar and Kishtwar districts of J&K¹¹, which ranks second in global saffron production, contributing 7% to the world's total saffron production.¹² In 2021-22, J&K produced approximately 15.04 tonnes from 3715 ha with a yield of 4.05 kg/ha (Table 2.6). Pampore in Pulwama, known as the "Saffron town of Kashmir," is a notable cultivation area. The area under saffron showed an increasing trend during phase I¹³ (2000-01 to 2009-10) growing at a rate of 0.65% annually. However, this trend reversed in phase II (2010-11 to 2021-22), with a decline of -0.17% (Table 2.6). This discouraging trend in the saffron area, despite the inception of the National Saffron Mission in 2010, needs to be reversed to sustain the economic viability of this high-value crop. Efforts may be focused on expanding cultivation to non-traditional areas through improved irrigation systems and quality planting materials.

Despite the decline in cultivated area, both production and productivity of saffron have shown an increasing trend, though at a slower pace during phase II (2010-22 to 2021-22). During this period, production grew at 4.21%, mainly driven by an increase in productivity (4.48%). However, this growth was slower than in Phase I (8.85% production growth and 7.82% productivity growth). Over the entire period (2000-01 to 2021-22), the overall CAGR was 1.30% for area, 7.06 % for production, and

¹⁰ Calculated from data provided in <https://agriwelfare.gov.in/en/StatHortEst>

¹¹ In 2023-24, Pulwama and Kishtwar accounted for 67% and 33% of total saffron production in J&K (Digest of Statistics, 2023-24).

¹² <https://iiim.res.in/saffron-production/>

¹³ Based on data availability, the time period of analysis could be considered from 2000-01 to 2021-22, which was divided into two phases: phase I (2000-01 to 2009-10) and phase II (2010-11 to 2021-22).

5.67% for productivity was observed, indicating that productivity improvements have played a major role in sustaining saffron output despite fluctuations in cultivated area.

Kashmiri saffron, unique for its altitude of 1,600-1,800 m above mean sea level, received a GI tag in 2020, making it the only saffron with this designation. This recognition enhances its export market prominence and ensures better prices for farmers. Kashmiri saffron is distinguished by its longer, thicker stigmas, deep-red colour, high aroma, bitter flavour and chemical-free processing. To further leverage the GI tag, efforts must be made to promote Kashmiri saffron as a premium global brand. Given its unique quality, J&K has the potential to be an Agri-export zone for saffron.

Table 2.6: Trends in the Area, Production and Productivity of Saffron of UT of J&K

Phase	Year	Area (000 ha)	Production (tonnes)	Productivity (kg/ha)
Phase I	2000-01	2831	3.59	1.27
	2009-10	3000	7.7	2.50
CAGR (%)		0.65	8.85	7.82
Phase II	2010-11	3785	9.55	2.50
	2021-22	3715	15.04	4.05
CAGR (%)		-0.17 ▼	4.21 ▼	4.48 ▼
Overall CAGR (%)		1.30	7.06	5.67

Source: Department of Agriculture, Kashmir; <https://www.data.gov.in/resource/year-wise-details-production-and-productivity-saffron-jammu-and-kashmir-2019-20-2021-22>

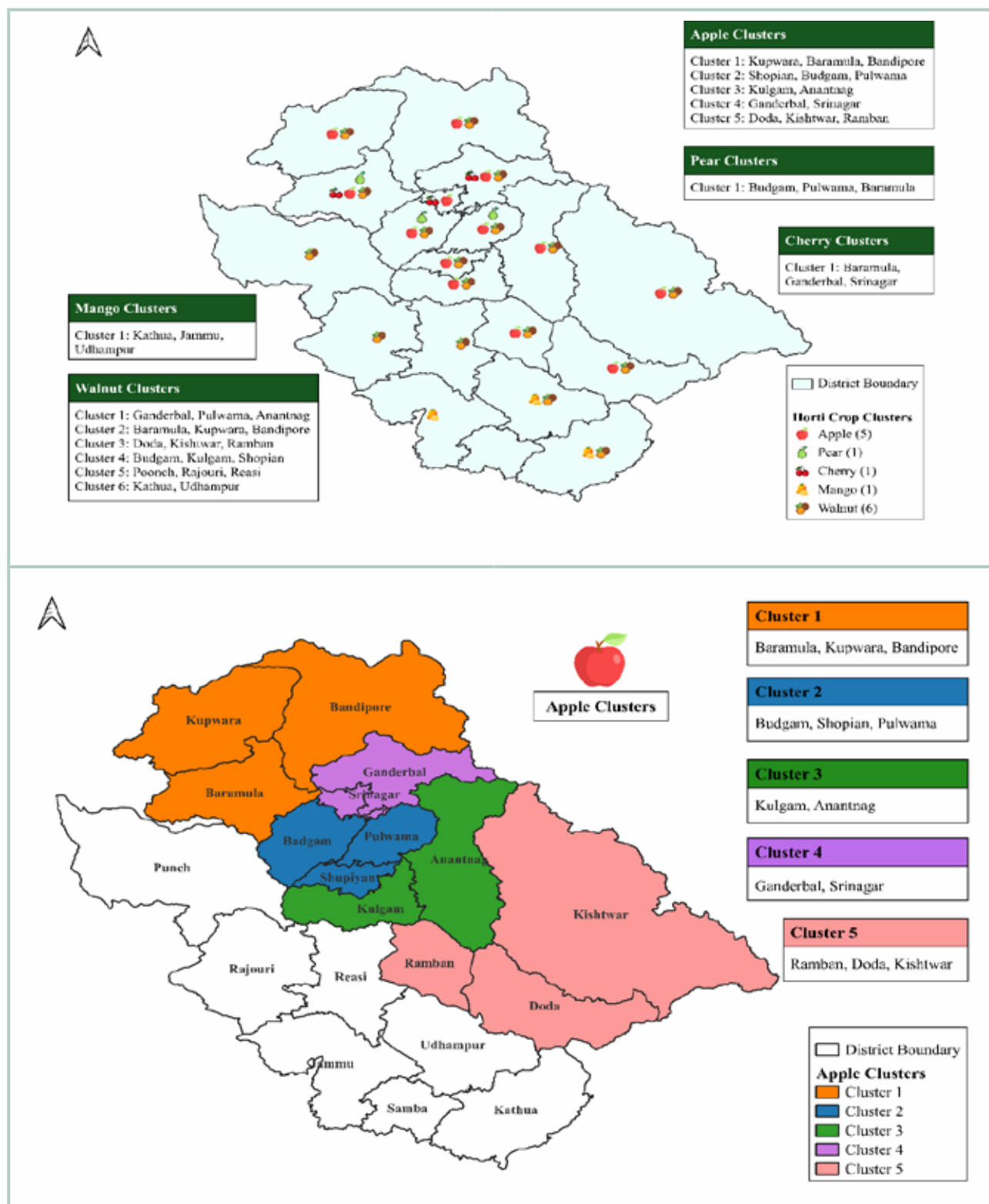
2.1.3 Identification of District-wise Clusters of Major Fruits in J&K

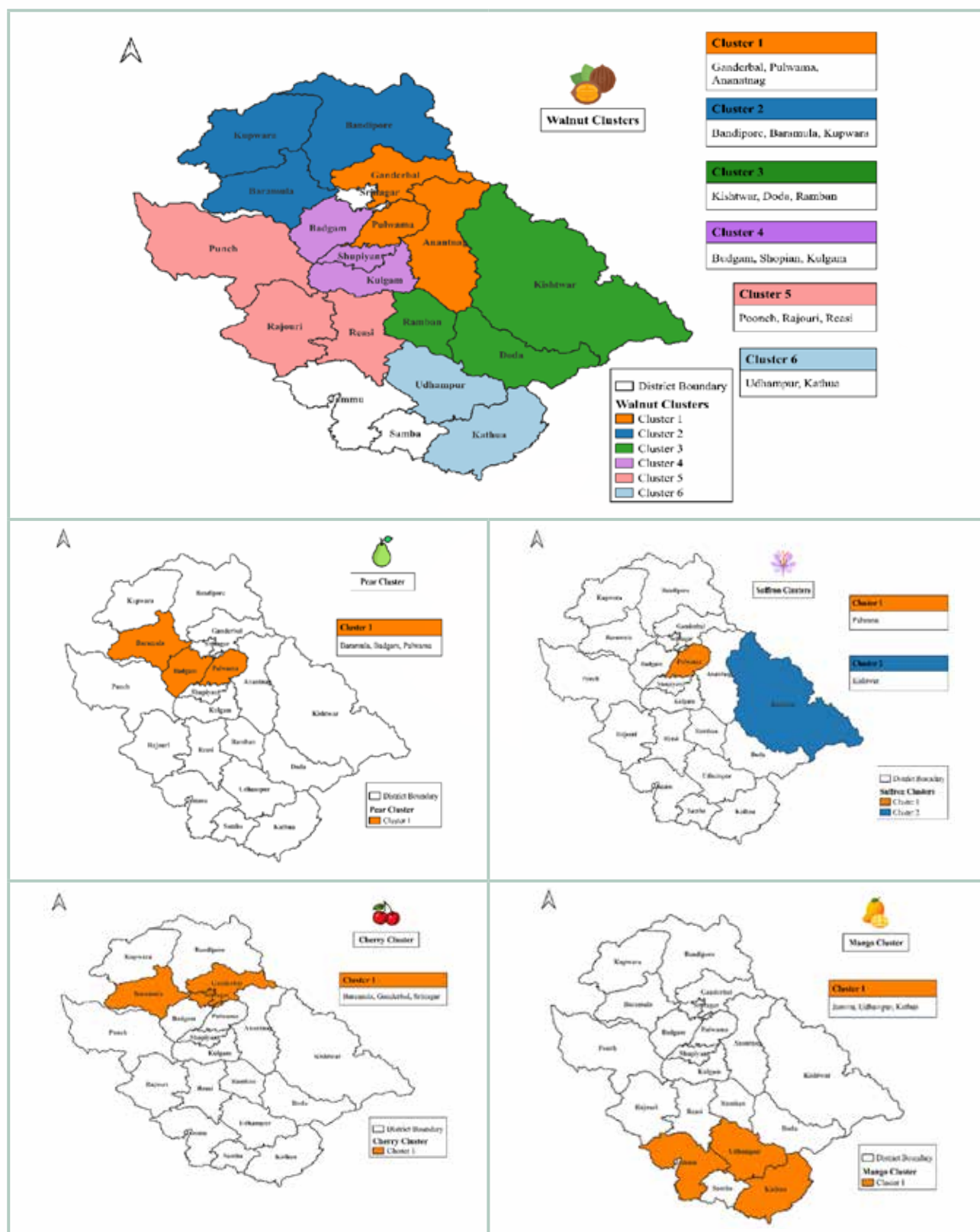
Map 2.1 presents a spatial classification covering major horticulture crops in J&K identified based on district-level data availability and aligned with the revised National Horticulture Board (NHB) guidelines under the Cluster Development Programme (CDP)¹⁴. The clustering is based on agro-climatic suitability, production concentration, and contiguity of districts, enabling economies of scale and region-specific policy interventions. Apples and walnuts emerge as predominant crops with multiple, geographically dispersed clusters, while pear, cherry and mango form more localised and specialised clusters. Saffron forms two distinct and highly concentrated cluster, centered in Pulwama and Kishtwar districts.

Table 2.7 summarises district-wise cluster distribution, agro-climatic zones and the crop-wise area share, production share and productivity levels.

¹⁴ https://nhb.gov.in/pdf/CDP_NRGuidelines.pdf

Map 2.1: District-wise Horticulture Crop Clusters in J&K





Source: Authors' computation

Please note that although almonds are an important horticultural crop in Jammu & Kashmir, a separate almond cluster could not be identified in this analysis as the farm gate value is less than ₹ 100 crore. Similarly, district wise area and production data on specific vegetables was not available.

Table 2.7: District-wise Cluster Profiles of Horticulture Crops in J&K

S. No.	Crop	No. of Clusters	No. of Districts	District name	Agro-climatic zone	Area share (%)	Production Share (%)	Average Productivity (t/ha)
1.	Apple	Cluster 1	3	Baramulla, Kupwara, Bandipora	Temperate	29.6	38.4	15.6
		Cluster 2	3	Budgam, Shopian, Pulwama	Temperate	30.7	31.8	12.4
		Cluster 3	2	Kulgam, Anantnag	Temperate	21.6	23.0	12.7
		Cluster 4	2	Ganderbal, Srinagar	Temperate	5.6	5.2	11.1
		Cluster 5	3	Ramban, Doda, Kishtwar	Sub-tropical; temperate; intermediate	7.4	1.1	1.8
		District Total				100	100	12.0
2.	Pear	Cluster 1	3	Baramulla, Budgam, Pulwama	Temperate	26.7	44.0	10.4
		District Total				100	100	6.3
3.	Cherry	Cluster 1	3	Baramulla, Ganderbal, Srinagar	Temperate	59.7	68.5	8.4
		District Total				100	100	7.4
4.	Mango	Cluster 1	3	Jammu, Udhampur, Kathua	Sub-tropical; temperate; intermediate	76.4	75.7	2.1
		District Total				100	100	2.2

S. No.	Crop	No. of Clusters	No. of Districts	District name	Agro-climatic zone	Area share (%)	Production Share (%)	Average Productivity (t/ha)
5.	Walnut	Cluster 1	3	Ganderbal, Pulwama, Anantnag	Temperate	26.5	38.2	5.1
		Cluster 2	3	Bandipore, Baramulla, Kupwara	Temperate	14.6	16.2	3.9
		Cluster 3	3	Kishtwar, Doda, Ramban	Sub-tropical; temperate; intermediate	19.6	15.3	2.8
		Cluster 4	3	Budgam, Shopian, Kulgam	Temperate	12.2	15.3	4.5
		Cluster 5	3	Poonch, Rajouri, Reasi	Sub-tropical; temperate; intermediate	16.6	9.4	2.0
		Cluster 6	2	Udhampur, Kathua	Sub-tropical; temperate; intermediate	10.3	5.3	1.8
		District Total				100	100	3.6
6.	Saffron	Cluster 1	1	Pulwama	Temperate	88.067	66.667	0.0007
		Cluster 2	1	Kishtwar	Temperate, intermediate	6.014	33.333	0.0052
		District Total				100	100	0.0009

Source: Authors' computation based on Digest of Statistics, 2023-24

2.1.4 Comparative Horticultural Performance of J&K vis-à-vis Major Producing States

This section compares Jammu and Kashmir's horticultural performance with major producing states, highlighting its top-ranking leadership in apples, walnuts, and almonds, moderate performance in other temperate fruits, and marginal role in tropical crops (Table 2.8).

Apple, Walnut, and Almond: Flagship Strengths

- J&K has by far the largest apple area (172.14 thousand ha) and production (2.06 million tonnes), giving it more than half of total apple area and over threequarters of national production among major states, and ranks 1st in yield.

- (ii) In walnuts, J&K completely dominates with 86.44 thousand ha (nearly 89% of total area) and 307.11 thousand tonnes (about 97% of total production), giving it a 1st rank in yield.
- (iii) In almonds, too J&K leads contributing to 55.86% of total area and 90.8% of total production and ranks 1st in yield.

Other Temperate Fruits: Significant Presence But Sub-Optimal Yield

- (i) For pear, J&K has the largest area (14.35 thousand ha) and production (90.02 thousand tonnes), contributing the highest share of total area but with lower yield (6.28 t/ha) and 3rd rank in yield compared to Punjab and Uttarakhand.
- (ii) In peach, J&K has moderate area and production compared to Punjab and Uttarakhand. Its yield (3.07 t/ha) is the lowest among the listed states, placing it 3rd in yield ranking despite 7.45% share in total production.
- (iii) In plum, with an area of 4.66 thousand ha, J&K had the highest production (27.51% in total production) but lower yield (4.01 t/ha) than states such as Punjab (17.64 t/ha with merely an area of 0.61 thousand ha) and Uttarakhand (4.76 t/ha with an area of 2.63 thousand ha). This indicates that production was mainly driven by area rather than productivity in case of J&K.

Tropical Fruits: Marginal Role

- (i) For citrus, J&K's area (16.31 thousand ha) and production (33.7 thousand tonnes) are very small compared with states like Andhra Pradesh, Madhya Pradesh, Maharashtra and Punjab, with the lowest yield and last rank in yield, confirming that citrus is not a strategic crop for the UT.
- (ii) J&K's mango and ber area and production are tiny relative to Uttar Pradesh, Andhra Pradesh or Madhya Pradesh, and its yields are the lowest, reinforcing that tropical fruit expansion is constrained by agroclimatic limits.

Implications for J&K Horticulture Strategy

- (i) The analysis suggests that J&K's horticulture strategy should continue to focus on productivity enhancement and quality improvement in apples, walnuts, almonds, pears and other temperate fruits where it enjoys scale and market power but lags in yield relative to hill states such as Uttarakhand (particularly for pear, peach and plum).
- (ii) At the same time, J&K can treat citrus, mango and ber as niche or localised diversification options rather than major growth drivers, aligning investments in R&D, infrastructure and value chains primarily with highaltitude temperate horticulture where J&K is already nationally prominent.

Table 2.8: Comparative Horticultural Performance of J&K: Area, Production and Yield Profiles (2023-24)

	Major Producing States	Area (000 ha)	Production (000 tonnes)	Yield (t/ha)	Share in Total Area (%)	Share in Total Production (%)	Ranking in terms of yield
Apple	Jammu & Kashmir	172.14	2064.3	11.9	56.6	78.61	1
	Himachal Pradesh	116.24	506.69	4.36	38.22	19.3	2
	Uttarakhand	11.33	42.97	3.79	3.73	1.64	3
Pear	Punjab	5.19	122.09	23.52	14.81	44.51	1
	Jammu & Kashmir	14.35	90.02	6.27	40.96	32.82	3
	Uttarakhand	3.75	25.4	6.77	10.69	7.49	2
Peach	Punjab	2.94	52.72	17.93	17.62	48.49	1
	Uttarakhand	5.52	36.3	6.58	33.08	33.39	2
	Jammu & Kashmir	2.64	8.1	3.07	15.79	7.45	3
	Himachal Pradesh	4.77	4.48	0.94	28.56	4.12	4
Plum	Jammu & Kashmir	4.66	18.69	4.01	25.82	27.51	3
	Himachal Pradesh	9.01	13.89	1.54	49.92	20.45	4
	Uttarakhand	2.63	12.51	4.76	14.55	18.41	2
	Punjab	0.61	10.76	17.64	3.36	15.84	1
Citrus Fruits	Andhra Pradesh	158.71	3174.16	20.0	14.1	21.81	2
	Madhya Pradesh	169.62	2774.62	16.4	15.07	19.07	3
	Maharashtra	261.54	2722.84	10.4	23.23	18.71	4
	Punjab	56.49	1380.87	24.4	5.02	9.49	1
	Jammu & Kashmir	16.31	33.7	2.1	1.45	0.23	
Mango	Uttar Pradesh	323.29	5990.53	18.53	13.49	26.75	1
	Andhra Pradesh	398.822	4985.276	12.5	16.64	22.26	2
	Bihar	164.63	1580.43	9.60	6.87	7.06	4
	Karnataka	137.5	1457.03	10.60	5.74	6.51	3
	Gujarat	177.5	1115.14	6.28	7.41	4.98	5
	Jammu & Kashmir	14.24	30.81	2.16	0.59	0.14	
Ber	Madhya Pradesh	12.94	145.03	11.21	24.96	27.55	2
	Gujarat	10.71	105.06	9.81	20.65	19.96	3
	Chattisgarh	4.33	69.43	16.03	8.35	13.19	1
	Odisha	6.31	39.23	6.22	12.17	7.45	4
	Jammu & Kashmir	4.88	10.43	2.14	9.42	1.98	5
Walnut	Jammu & Kashmir	86.44	307.11	3.55	88.85	96.64	1
	Uttarakhand	5.68	8.37	1.47	4.29	0.56	2
	Himachal Pradesh	4.18	1.77	0.42	5.84	2.63	3
Almond	Jammu & Kashmir	5.41	11.21	2.07	55.86	90.8	1
	Himachal Pradesh	4.26	1.13	0.27	44.03	9.15	2

Source: Computed from <https://agriwelfare.gov.in/en/StatHortEst>

Note:

- (1) The ranking for fruits such as citrus, mango is not provided for J&K as it is relatively not a major producer of these fruits.
- (2) Saffron has not been considered as J&K is the major and the only producer of saffron in India as per the 2023-24 final estimates

2.1.5 Global Position of J&K's Key Horticulture Crops

This section examines how Jammu & Kashmir's key horticultural crops¹⁵ particularly apples, almonds and walnuts, in which J&K ranks first in yield nationally (as was evident in section 2.1.4), compare with major global producers in terms of production and productivity.

(i) Apples

J&K despite being India's leading apple-producing region, appears as a small player in global terms (Fig 2.1). China leads in total production of apples in the world with a yield of about 24.85 t/ha. Chile (50.9 t/ha), USA (42.9 t/ha), and Italy (41.9 t/ha) lead in terms of yield but not volume suggesting smaller cultivated areas despite higher productivity. Iran (20.47 t/ha) achieves a moderate yield, performing significantly better than India and J&K. However, J&K (12 t/ha) performs better than the national average (9.46 t/ha) and Russia (10.34 t/ha), but large yield gaps remain when compared to global benchmarks indicating major opportunity for growth. Thus J&K remains a modest global player in apples highlighting the need for closing the productivity gap and shift toward a quality and technology-driven apple economy, rather than competing on global volume.

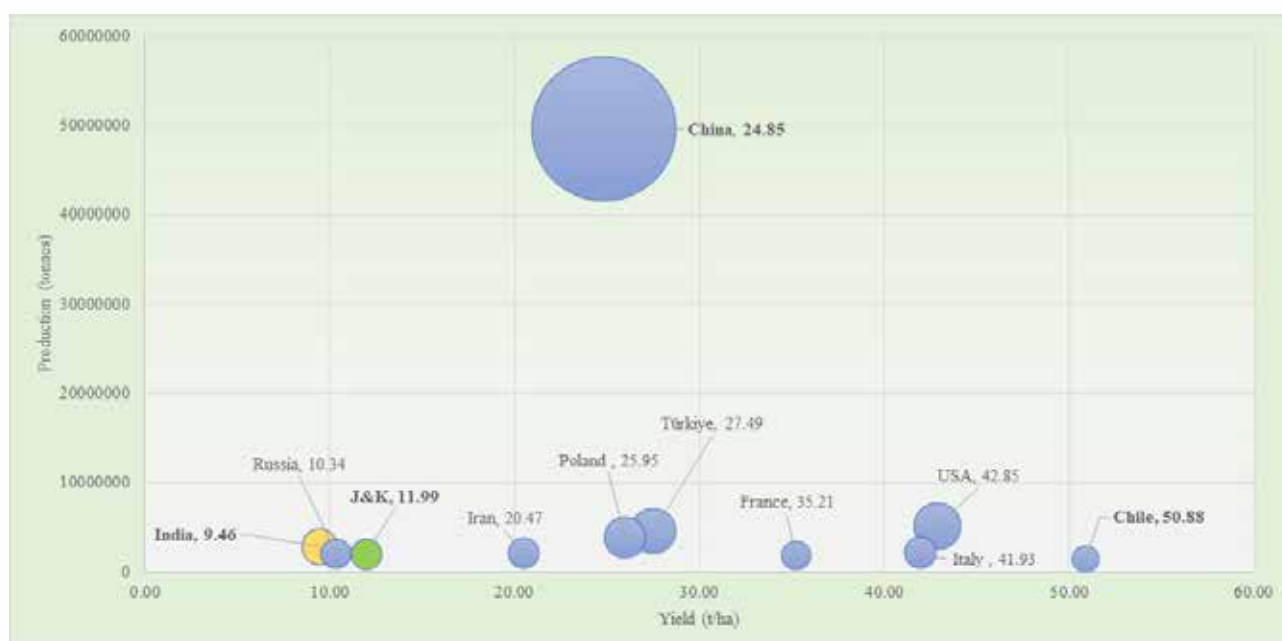


Fig 2.1: Global Apple Production and Yield Comparison across Major Producing Regions (2023-24)

Source: FAOSTAT; Digest of Statistics, J&K (2023-24)

Note: The size of the bubble indicates share in world production. Yellow colour indicates India while green indicates J&K

(ii) Almonds

J&K is a very small but relatively efficient almond producer in the global context. It has a meagre share of 0.63% in world production but has a moderate yield level of around 2.07 t/ha, higher than several traditional Mediterranean countries. J&K's comparative

¹⁵ Saffron could not be considered for the analysis due to unavailability of recent global data on production and yield.

advantage in almonds stems not from scale but a combination of reasonably good yields and agro-climatic conditions that can support quality production. Closing the yield gap with global leaders like the USA (3.21 t/ha) and Australia (6.36 t/ha) through improved varieties, highdensity planting and better orchard management could significantly upgrade J&K's competitiveness, even if its overall share in world production remains modest.

Thus, while J&K currently remains a minor global player in almonds, it has a strong foundation for yield enhancement, which is essential for strengthening its position in the global almond market.

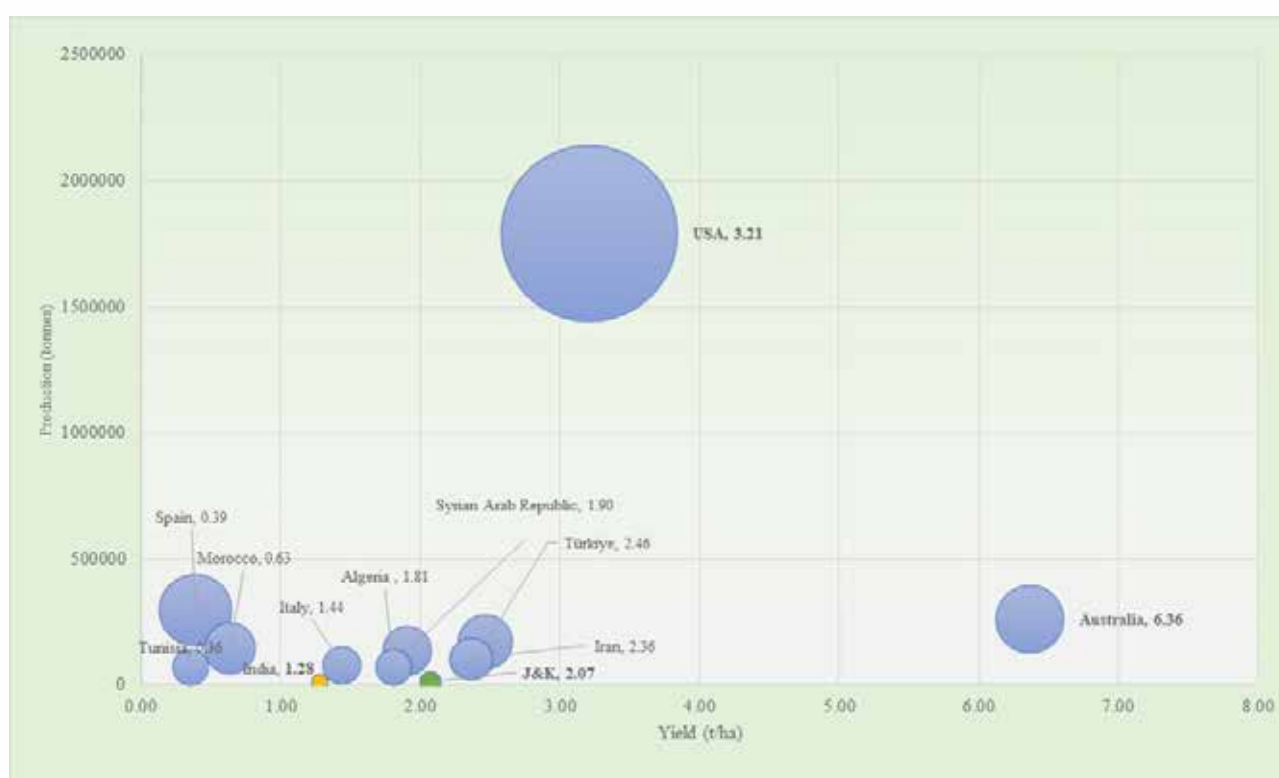


Fig 2.2: Global Almonds Production and Yield Comparison across Major Producing Regions (2023-24)

Source: FAOSTAT; Digest of Statistics, J&K (2023-24)

Note: The size of the bubble indicates share in world production. Yellow colour indicates India while green indicates J&K

(iii) Walnuts

China (35.1%) and the USA (18.74%) dominate world walnut output, with high production levels, while J&K has a modest share¹⁶ (7.70%). J&K's production is comparable to or higher than countries such as Chile, Mexico, Burkina Faso and possibly close to Türkiye, placing it in a "second tier" group of producers rather than a marginal player.

J&K also stands out as a moderately high-yield producer with a yield of around 3.55 t/ha, which places it above several major producers such as Türkiye (2.07 t/ha), Mexico (1.39 t/ha), Burkina Faso (1.48 t/ha), and even national average (3.27 t/ha). Large-scale

¹⁶ Please note that overall, India accounted for 7.97% of global walnut production in 2023-24, making it the fifth largest walnut producer world-wide.

leaders such as China (3.93 t/ha) and the USA (4.80 t/ha) combine decent yields with vast orchard areas, which explain their dominance in world production. Emerging high-yield countries such as Iran (6.21 t/ha), Chile (4.30 t/ha), Ukraine (7.86 t/ha), Uzbekistan (9.45 t/ha) and Romania (16.18 t/ha) outperform J&K in productivity, indicating significant scope for improvement in orchard management and planting material quality. Thus, J&K occupies a second-tier position globally in walnuts, with competitive yields but considerable untapped potential that could be realised through improved practices.

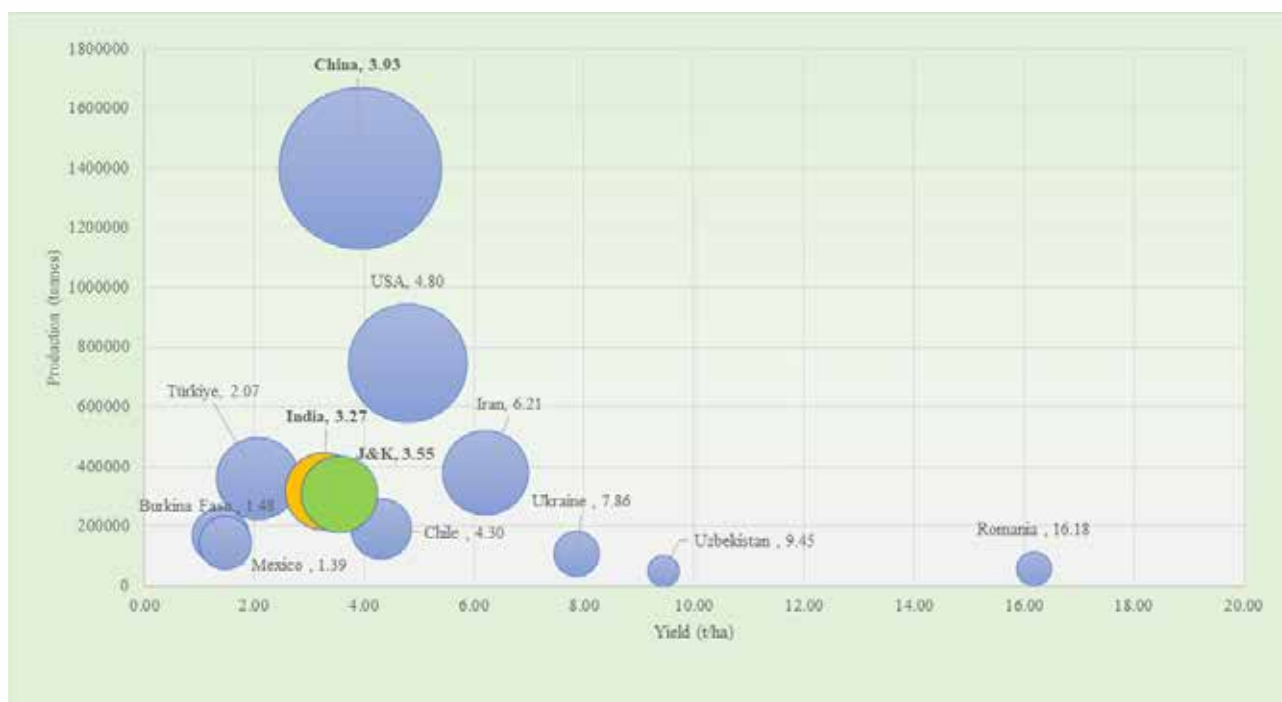


Fig 2.3: Global Walnuts Production and Yield Comparison across Major Producing Regions (2023-24)

Source: FAOSTAT; Digest of Statistics, J&K (2023-24)

Note: The size of the bubble indicates share in world production. Yellow colour indicates India while green indicates J&K

Overall, the analysis highlights productivity enhancement, quality upgrading, and improved planting material as key levers for improving J&K's global positioning in high-value temperate horticulture.

2.1.6 Domestic Demand Trends of Fresh Fruits and Dry Fruits

Understanding domestic demand for fresh and dry fruits is critical for framing sustainable horticulture strategies in Jammu & Kashmir. The per capita consumption of fruits could be expected to show an upward trend, driven by rising incomes, urbanisation, and greater health consciousness. Analysing these patterns helps to identify opportunities for expanding production, improving supply chains, and investing in value-added products.

(i) Analysis of per capita consumption trends for fresh and dry fruits

An analysis of per capita consumption (kg/year) for major horticulture crops, namely apples and dry fruits (Table 2.9), reveals important demand-side dynamics that are critical for aligning production strategies in Jammu & Kashmir.

Between 2011-12 and 2023-24, per capita consumption of apples increased significantly in rural (CAGR of 10.59%) and urban areas (CAGR of 4.37%):

- In rural areas, it increased from 0.70 kg/year to a peak of 3.26 kg/year in 2022-23, before slightly declining to 2.33 kg/year in 2023-24
- In urban areas, it increased from 2.29 kg/year to a peak of 4.97 kg/year in 2022-23, before slightly declining to 3.83 kg/year in 2023-24.

Similarly, dry fruit consumption grew substantially between 2011-12 to 2023-24:

- Rural consumption rose from 1.12 kg/year to 2.63 kg/year (CAGR of 7.40%).
- Urban consumption increased from 1.87 kg/year to 3.65 kg/year (CAGR of 5.72%).

The slight dips observed in 2023-24 for apple consumption is possibly indicative of potential sensitivity to factors such as price volatility, supply disruptions, or consumer preference shifts. In contrast, dry fruits continue to exhibit higher per capita consumption, partly because they are non-perishable, have year-round availability and are consumed in multiple forms making their demand more stable and less affected by seasonal fluctuations. Importantly, while urban consumers still consume more than rural consumers, the gap is narrowing, suggesting a strong emerging demand in rural markets. This trend offers an opportunity for diversified marketing strategies, improved cold-chain logistics, and promotion of premium quality, value-added products to cater to expanding rural and semi-urban demand bases.

The rising domestic demand, especially in the rural segment, underlines the importance of aligning horticultural production and processing efforts with evolving consumption patterns.

Table 2.9: Trends in Per Capita Consumption (kg/year) of apples and dry fruits (2011-12 to 2023-24)

	Year	per capita consumption (kg/year)	
		Rural	Urban
Apples	2011-12	0.7	2.29
	2022-23	3.26	4.97
	2023-24	2.33	3.83
	CAGR (2011 to 2023) (%)	10.59	4.37
Dry Fruits	2011-12	1.12	1.87
	2022-23	2.51	3.67
	2023-24	2.63	3.65
	CAGR (2011 to 2023) (%)	7.4	5.72

Source: Computed from various rounds of Household Consumption Expenditure Survey, NSSO

(ii) Share of fresh fruits and dry fruits in household expenditure

The growth in fresh fruits and dry fruits is not just in volume but also in budget allocation, showing households' stronger willingness to spend on nutritious foods. Fig 2.1 and Fig 2.2 show the share of fresh fruits and dry fruits in average Monthly Per Capita Expenditure

(MPCE) across the rural and urban households from 1999-00 to 2023-24. In rural areas, the share of spending on fresh fruits steadily increased from 1.42% in 1990-00 to 2.66% in 2023-24. This suggests the growing importance of fresh fruits in rural diets.

In urban areas, the share of fresh fruits initially declined slightly and then stabilised. It fell from 1.95% in 1999-00 to 1.68% in 2004-05 but recovered to 2.61% by 2023-24. There has also been a convergence of rural and urban shares. By 2022-23 and 2023-24, the share of fresh fruits in rural (2.54%-2.66%) and urban (2.5%-2.61%) MPCE became almost equal. It shows a promising trend for expanding domestic markets beyond urban centres and adopting strategies that leverage rural demand, such as affordable pricing, small packaging units and value-added product innovations.

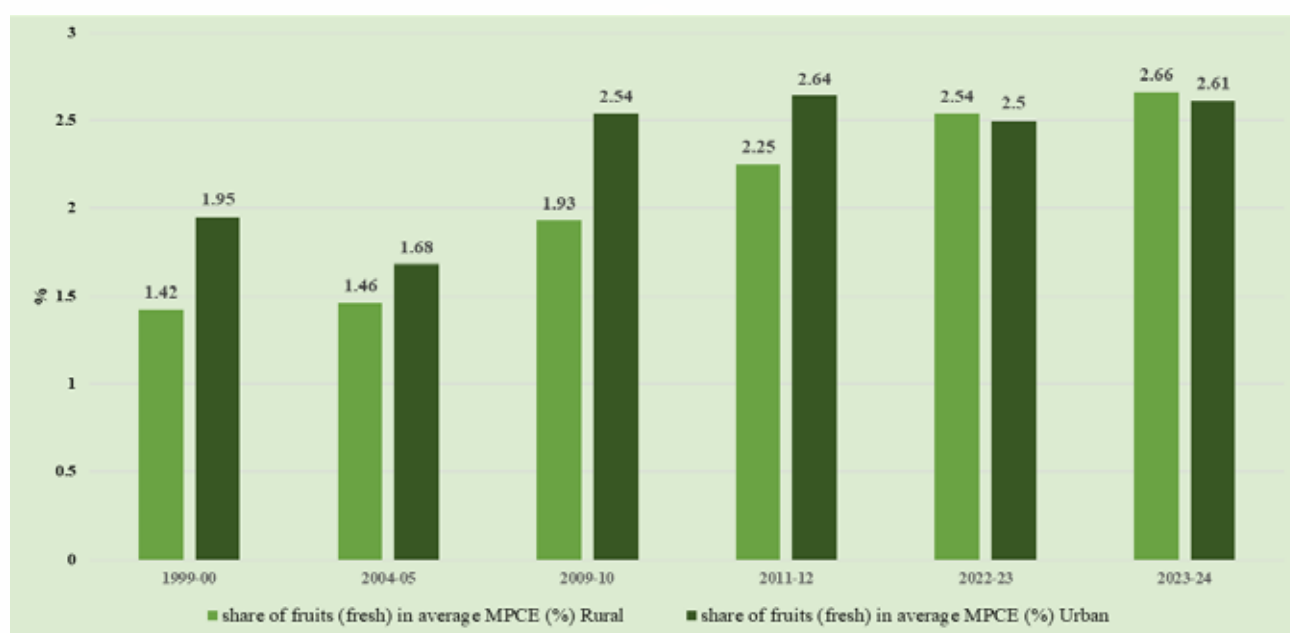


Fig. 2.4: Trends in the share of fresh fruits in household expenditure (1999-00 to 2023-24)

Source: Compiled from various rounds of Household Consumption Expenditure Survey, NSSO

Concerning the share of dry fruits in MPCE from 1999-00 to 2023-24, there has been a remarkable rise- almost quadrupling in rural areas (from 0.30% to 1.19%) and more than doubling in urban areas (from 0.47% to 1.26%) (Fig. 2.2). This rate of increase is higher than that observed for fresh fruits which was less than twice for both rural and urban areas. This points towards rising health consciousness, greater year-round availability, steady prices and higher perceived value of dry fruits in daily diets.¹⁷ Further, although, urban households are still spending a slightly higher share of MPCE on dry fruits, the gap between rural and urban narrowed significantly.

¹⁷ <https://economictimes.indiatimes.com/industry/cons-products/food/more-indians-going-nuts-over-dry-fruits/articleshow/106391857.cms?from=mdr> (accessed on December 19, 2025)

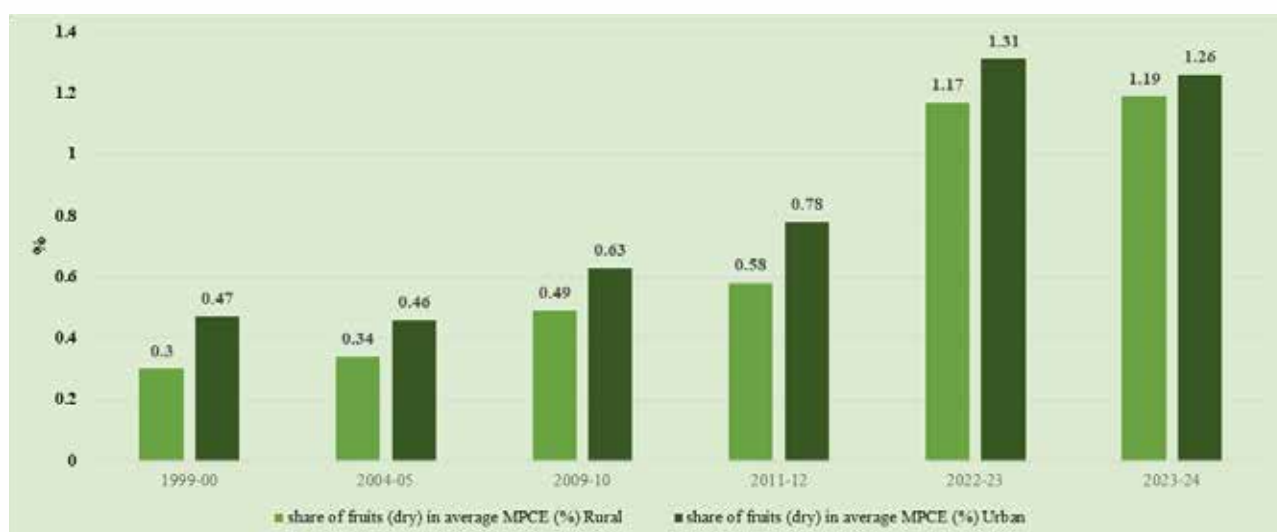


Fig. 2.5: Trends in the share of dry fruits in household expenditure (1999-00 to 2023-24)

Source: Compiled from various rounds of Household Consumption Expenditure Survey, NSSO

The rapid growth in per capita consumption and share in household expenditure, especially among rural consumers, indicates a significant expansion in domestic demand for both fresh and dry fruits. Notably, the share of dry fruits in household expenditure has risen at a faster pace than that of fresh fruits across both rural and urban households. For J&K, these demand-side developments emphasise the need for stronger supply-side responses. While production has generally increased, the pace of supply-side improvements (for instance, among others, the productivity of apples and area under almonds) will be critical to fully capitalise on this demand growth through targeted interventions.

2.2 Marketing Arrangements of Major Fruits

2.2.1 Marketing Channels of Major Fruits

The marketing system for the sale of fruits in J&K is still conventional, characterised by the dominance of contractors (pre- & post-harvest) and commission agents at the wholesale level. The fruits grown commercially in J&K are being disposed of through marketing functionaries. As indicated in Fig. 2.3, a major proportion of produce, ranging from 67% to 82% depending on the fruit, is sold through contractors and relatively less through wholesalers (between 8% and 27%). Despite pan-India initiatives like eNAM, farmers continue to rely on traditional marketing channels, compelled by a number of factors, including easy access to informal credit from Arthiyas or functionaries, small marketable surpluses, etc.

Strengthening the collectivisation of farming through farmer-producer organisations (FPOs)/self-help group (SHG) / Primary agricultural credit society (PACS) and marketing activities, coupled with institutional support for financing smallholders, could enable farmers to access more remunerative markets and improve their returns. In addition, the development of supporting infrastructure, including Controlled Atmosphere (CA)

storage facilities and cold chain networks, etc. is critical for modernising and reforming the marketing arrangements for fruits in the territory. Equally important is the promotion of direct marketing channels such as FPOs, cooperatives, farmer markets, e-commerce platforms, and tie-ups with organised retailers, which can reduce intermediaries, offer better price realisation, and enhance market access for growers.

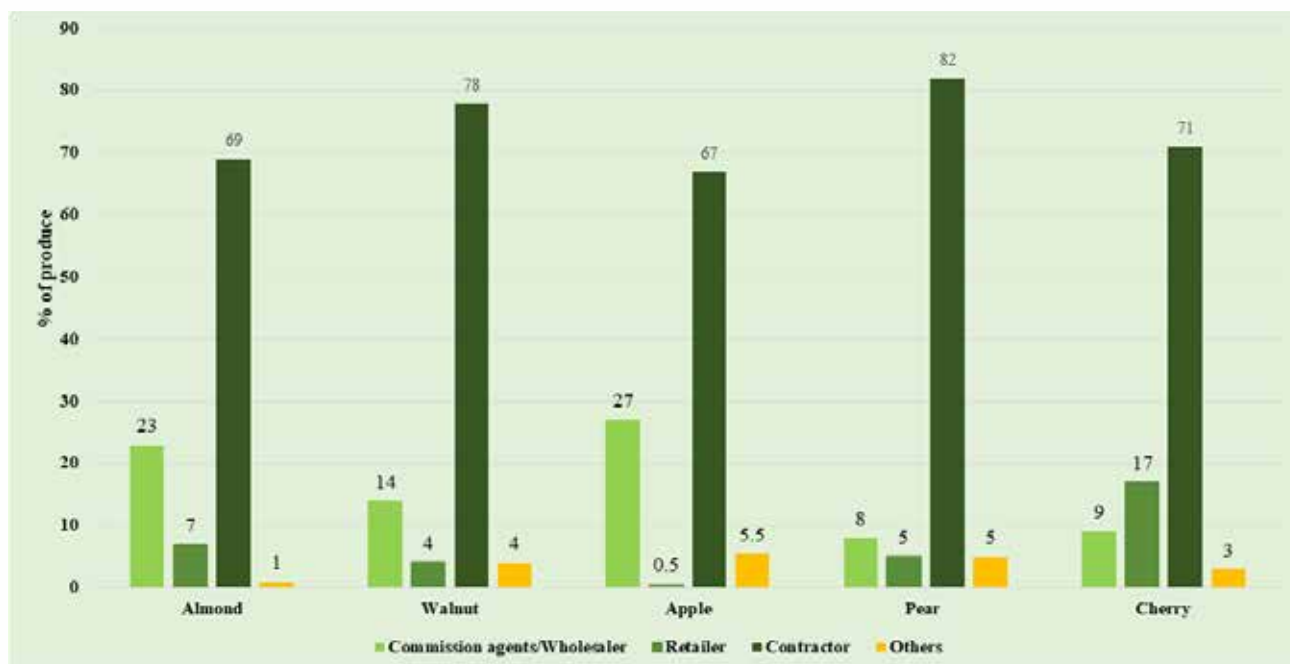


Fig 2.6: Existing marketing routes of major fruits

Source: SKUAST-K

2.2.2 Availability of Marketing Infrastructure in J&K

The marketing infrastructure for fruits and vegetables in J&K has expanded considerably, with five fully functional terminal mandis and fourteen satellite mandis operational across various districts (Table 2.10). Additionally, five Apni Mandis are currently functional, providing local farmers with greater market access. However, six satellite mandis and seven Apni Mandis are still under development or in the process of operationalisation. Strengthening and fully operationalising these markets, alongside improving logistical facilities and market linkages, will be crucial for enhancing farmers' access to organised markets and ensuring better price realisation for their produce.

Table 2.10: Marketing Infrastructure in J&K

S. No.	Category of Markets	Functional	Non-Functional /under- development / under- operationalisation
1.	Terminal Markets	1. Narwal 2. Parimpora 3. Aglar Shopian 4. Sopore 5. Jablipora	-

S. No.	Category of Markets	Functional	Non-Functional /under- development / under- operationalisation
2.	Satellite Markets	1. Pulwama (Pachhar) 2. Kulgam 3. Charar-i-Shaoref 4. Handwara 5. Batingoo 6. Kupwara 7. Zazna (Ganderbal) 8. Baramulla (Kanispora) 9. Bishnah 10. Prichoo (Pulwama) 11. Udampur 12. Batote 13. Kathua 14. Rajouri	1. Arhama 2. Paryote (Doda) 3. Kremshor 4. Poonch 5. Akhnoor 6. Potushay
3.	Apni Mandi	1. Mandi (Poonch) 2. Tapyal (Samba) 3. Mari (Reasi) 4. Kanderi (Doda) 5. Garian (Udhampur)	1. Dayalachak (Chadwal) 2. Pouni (Reasi) 3. Ari (Mendhar) 4. Khanshabib (Budgam) 5. Bani (Kathua) 6. Nunmai (Kulgam) 7. Naidkhai

Source: Agriculture Production Department, GoJK

2.3 Export and Import Position of India for the Selected Commodities of Relevance to J&K¹⁸

J&K's major horticultural products, such as Apple, Walnut, Almond and Saffron, possess significant global trade potential. However, India's presence in global markets for these commodities remains limited, with increasing import dependence and stagnant or declining exports.

2.3.1 Apple Exports and Imports in India

Indian apples are exported to countries such as Bangladesh, Nepal, Bhutan, United Arab Emirates, Saudi Arabia Bahrain, Qatar, Maldives, Kuwait and United Kingdom.¹⁹ Though Apple exports have shown an increasing trend over the years, the growth has been much slower compared to imports. Table 2.11 presents the export and import trends of apples in India from 2010 to 2024, highlighting the growing trade deficit over time. The quantity of apples exported increased from 17,170 tonnes in 2010 to 32,874 tonnes in 2024, registering a growth of 4.75%. However, the export value remained stagnant at around USD 13 million, with virtually no growth (-0.01%) suggesting declining unit

¹⁸ Please note as detailed export statistics of fruits from J&K is limited, the analysis is based on India's overall export and import trends for fruits that are predominantly grown in J&K. This approach provides useful insights but it might not fully capture J&K's specific contribution to national exports. This also underscores the need for targeted efforts to enhance and streamline horticultural exports from the region. The period considered for analysis is based on data availability.

¹⁹ As per the World Integrated Trade Solution data base, in 2024, Bangladesh and Nepal accounted for 88.4% share of the total traded value of apples and 97.37% share of the total traded quantity of apples.

values. (Table 2.9). In contrast, imports grew at a significantly higher CAGR of 10.85% in quantity and 9.23% in value, surpassing the growth rate of exports.

India's apple imports have surged over the years from 1,22,878 tonnes in the year 2010 to 5,19,652 tonnes in 2024. The import value increased from USD 121.3 million in 2010 to USD 417.6 million in 2024. This indicates a growing reliance on imported apples to meet domestic demand. Globally, India ranks 3rd among the world's top apple-importing countries and meets around 53 % of its apple demand from Iran and Turkey and the rest from countries such as Afghanistan, United States, South Africa, New Zealand, Poland, Chile and Italy.²⁰

Thus, India's apple trade balance has deteriorated over the past 15 years due to rising import dependency and a sluggish export growth rate. The trade deficit (export value minus import value) widened significantly, from USD -108.2 million in 2010 to USD -404.5 million in 2024. This growing deficit suggests that domestic production is struggling to meet demand, leading to rising dependence on imports. Addressing this issue requires a combination of import substitution strategies and export promotion efforts to strengthen the domestic apple industry.

Table 2.11: Trends in Exports and Imports of Apples in India

Year	Export quantity (tonnes)	Export value (USD million)	Import quantity (tonnes)	Import value (USD million)	Trade balance (USD million)
2010	17170	13.1	122878	121.3	-108.2
2011	25749	14.8	179015	185.6	-170.8
2012	19477	10.4	186368	196.1	-185.7
2013	37165	13.6	194335	211.5	-197.9
2014	15797	5.7	204570	234.4	-228.7
2015	18321	6.8	193692	209.9	-203.2
2016	12660	5.4	246808	237.8	-232.4
2017	7278	3.7	330605	307.7	-304.0
2018	12894	5.9	280094	298.3	-292.4
2019	19431	9.8	242713	244.0	-234.1
2020	30346	14.1	215538	201.3	-187.2
2021	29050	14.3	436194	377.4	-363.1
2022	52892	21.3	392483	314.3	-293.0
2023	22338	9.5	469550	363.1	-353.6
2024	32874	13.0	519652	417.6	-404.5
CAGR (%) (2010-24)	4.75	-0.01	10.85	9.23	

Source: UNCOMTRADE

2.3.2 Walnut Exports and Imports in India

The exports of walnuts in-shell increased from 130 tonnes in 2010 to 333 tonnes in 2024, registering a CAGR of 6.93% (Table 2.12). By contrast, shelled walnut exports declined sharply, from 7133 tonnes in 2010 to 932 tonnes in 2024, with a CAGR of -13.53%. The

export value of walnuts in-shell increased modestly at 2.22% while it declined for shelled walnuts (-13.53%), suggesting a loss of India's competitiveness in shelled walnuts exports.

On the other hand, imports have increased substantially. In-shell walnuts imports surged from 17 tonnes in 2010 to 55448 tonnes in 2024 (78% CAGR). The imports of shelled walnuts was a mere 2 tonnes in 2010 which increased to 3786 tonnes in 2024 (73.1% CAGR). This suggests a rising domestic demand for walnuts, which is being met through imports. Further, the volume of in-shell walnut imports has remained significantly higher than shelled walnut imports, indicating that domestic processors increasingly depend on imported raw walnuts for shelling and value addition. In 2024, India ranked 4th among in-shell walnut importers and 25th among shelled walnuts importers globally.²¹ Chile and UAE emerged as the largest suppliers of walnuts to India during 2018-19 to 2022-23.²²

The trade balance in walnuts in-shell shifted from a small surplus of USD 0.33 million in 2010 to a large deficit of USD -84.9 million in 2024. Similarly, the shelled walnut trade surplus of USD 39.1 million in 2010 turned into a deficit of USD -14.2 million in 2024. These widening deficits highlight India's growing import dependence and the need for policy intervention to boost domestic production, improve productivity and enhance branding efforts to regain competitiveness.

Table 2.12: Trends in Export and Import of Walnuts (in-shell and shelled) in India

Year	Walnuts in shell					Walnuts shelled				
	Export quantity (tonnes)	Export value (USD million)	Import quantity (tonnes)	Import value (USD million)	Trade balance (USD million)	Export quantity (tonnes)	Export value (USD million)	Import quantity (tonnes)	Import value (USD million)	Trade balance (USD million)
2010	130	0.36	17	0.03	0.33	7133	39.11	2	0.01	39.10
2011	166	0.64	123	0.28	0.36	5393	43.84	28	0.15	43.68
2012	310	0.67	81	0.17	0.50	5305	38.86	28	0.12	38.75
2013	361	0.45	162	0.43	0.02	6809	55.53	113	0.61	54.91
2014	203	0.33	403	1.35	-1.02	3829	32.90	81	0.87	32.03
2015	41	0.16	4214	12.75	-12.59	2579	20.74	185	1.71	19.03
2016	163	0.36	7079	19.30	-18.93	2556	9.55	43	0.20	9.35
2017	725	2.00	21492	60.20	-58.20	2343	12.95	195	1.03	11.92
2018	114	0.31	15207	42.31	-42.00	2355	13.34	347	2.24	11.10
2019	169	0.41	14973	38.18	-37.77	1533	7.46	2215	12.04	-4.58
2020	73	0.23	23045	57.01	-56.78	1286	5.49	4949	28.25	-22.75
2021	703	1.55	37963	73.80	-72.25	1414	6.92	2844	12.67	-5.75
2022	383	0.88	30798	50.91	-50.02	979	4.40	2205	9.69	-5.30
2023	295	0.72	57288	78.78	-78.06	167	0.77	4847	15.13	-14.36
2024	333	0.49	55448	85.41	-84.92	932	5.13	3786	19.29	-14.16
CAGR (%) (2010-24)	6.93	2.22	78.52	74.70		-13.53	-13.51	73.09	69.97	

Source: UNCOMTRADE

21 World Integrated Trade Solution data base

22 <https://pib.gov.in/PressReleasePage.aspx?PRID=1956692#:~:text=This%20measure%20will%20not%20result%20in%20any,on%20domestic%20apple%2C%20walnut%20and%20almond%20producers.&text=Similarly%2C%20in%20the%20case%20of%20walnuts%2C%20the,UAE%20became%20the%20largest%20exporters%20to%20India.> (accessed on march 28th, 2025)

2.3.3 Almond Exports and Imports in India

India has been a net importer of almonds (both in-shell and shelled), and this trend has increased over the period 2010 to 2024 (Table 2.13). The import quantity of in-shell almonds expanded from 62,053 tonnes in 2010 to 269,522 tonnes in 2024, registering a CAGR of 11.06%. Import value of in-shell almonds rose at 10.60%, from USD 244.5 million in 2010 to over USD 1 billion in 2024. In 2024, India imported approximately 92% of the in-shell almonds from the USA and ranked 1st globally among in-shell almonds importing countries.²³ This surge reflects India's rising demand and presents potential opportunities for the domestic processing industry to expand value-addition. On the export side, in-shell almond exports remained negligible, despite a high growth rate, reaching 89 tonnes in 2024.

In contrast, import quantity of shelled almonds grew modestly at 4.42%, from 7,210 tonnes in 2010 to 13,207 tonnes in 2024 while the import value increased at 4.27%. Similar to the pattern observed for walnuts, the volume of in-shelled almond imports was higher than that of shelled almond imports. In 2024, India ranked 15th among global importers of shelled almonds, with major suppliers including Australia, Afghanistan and Iran. Exports of shelled almonds recorded growth in quantity (8.34%) and value (12.50%), rising from 78 tonnes (USD 0.35 million) in 2010 to 240 tonnes (USD 1.82 million) in 2024. However, exports remain marginal compared to import, highlighting India's limited role in the global almond market. As a result, the trade balance has remained negative over time, highlighting increased dependence on almond imports, particularly for in-shell almonds.

India's production of almonds is around 11000 tonnes, and about 91 % of the almond production comes from J&K alone. Ex-ante assessment of the crop can greatly help in increasing the production, which in turn can meet the domestic demand for almonds and thereby serve as a viable option for import substitution.

²³ <https://wits.worldbank.org/trade/comtrade/en/country/IND/year/2023/tradeflow/Imports/partner/ALL/product/080211#> (accessed on April 1st, 2025)

Table 2.13: Trends in Export and Import of Almonds (in-shell and shelled) in India

Year	Almonds in shell					Almonds shelled				
	Export quantity (tonnes)	Export value (USD million)	Import quantity (tonnes)	Import value (USD million)	Trade balance (USD million)	Export quantity (tonnes)	Export value (USD million)	Import quantity (tonnes)	Import value (USD million)	Trade balance (USD million)
2010	8	0.03	62053	244.49	-244.46	78	0.35	7210	46.73	-46.38
2011	18	0.02	78184	318.06	-318.04	69	0.41	8457	52.88	-52.47
2012	2	0.01	82134	344.88	-344.87	30	0.23	6645	44.33	-44.09
2013	1636	5.75	98420	503.12	-497.37	309	1.76	5577	43.21	-41.46
2014	46	0.12	91810	566.80	-566.69	306	2.60	6606	62.24	-59.64
2015	57	0.41	87217	650.90	-650.50	97	0.96	8800	89.52	-88.56
2016	164	1.10	120239	617.61	-616.51	132	0.82	8521	75.50	-74.68
2017	567	2.56	136112	699.75	-697.19	52	0.53	11563	101.14	-100.61
2018	390	2.21	149066	767.22	-765.00	156	1.57	6289	53.99	-52.42
2019	113	0.74	161652	802.88	-802.14	150	1.21	5248	47.84	-46.63
2020	93	0.56	218120	874.85	-874.29	113	0.94	5444	52.52	-51.58
2021	393	1.90	220392	864.00	-862.10	178	1.19	16137	114.42	-113.22
2022	317	1.61	233746	967.65	-966.04	473	3.02	6810	52.10	-49.07
2023	117	0.84	259744	937.91	-937.08	113	0.92	12160	81.60	-80.69
2024	89	0.86	269522	1002.05	-1001.19	240	1.82	13207	83.94	-82.13
CAGR (%) (2010-24)	18.53	27.40	11.06	10.60		8.34	12.50	4.42	4.27	

Source: UNCOMTRADE

2.3.4 Saffron Exports and Imports in India

In 2024, India ranked 3rd among the world's top saffron-importing countries, with an import value of USD 37.65 million, and a global import share of 11.74%.²⁴ The top position was held by the European Union with an import value of USD 77.12 million and a share of 24.06%. India primarily imports saffron from Afghanistan and Iran. On the export side, India ranked 5th among saffron exporting countries with a global export share of 2.6% in value terms. India's saffron is mainly exported to countries such as the UAE, the US and Australia, among others.²⁵

India's saffron trade exhibits a distinct pattern where the export quantity was consistently higher than import quantity between 2010 and 2017, yet the value of imports far exceeded exports (Table 2.14). After 2018, this trend reversed, with imports surpassing exports in both quantity and value, reflecting the dominance of premium imported saffron in the domestic market. The quantity of saffron exported rose from 0.43 tonnes in 2010 to 10.19 tonnes in 2024 registering a CAGR of 25.44%. However, export earnings increased only modestly, from USD 1.5 million to USD 3.61 million, at a CAGR of 6.49%, suggesting that Indian saffron is fetching lower unit value prices possibly due to weak branding and positioning.

Import quantity grew at 23.38%, from 3.06 tonnes in 2010 to 58.01 tonnes in 2024 whereas import value surged from USD 4.76 million to USD 37.65 million (15.92%). This indicates strong domestic demand for premium imported saffron varieties.

²⁴ <https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2024/tradeflow/Imports/partner/WLD/product/091020#> (accessed on December 20, 2025)

²⁵ <https://wits.worldbank.org/trade/comtrade/en/country/IND/year/2023/tradeflow/Exports/partner/ALL/product/091020> (accessed on April 1st, 2025)

India has remained a net importer in value terms, with the deficit widening from USD -3.26 million in 2010 to USD -34.04 million in 2024.

Since Kashmir saffron has been granted Geographical Indication (GI) for its unique attributes, enhancing its visibility and competitiveness is crucial. Initiatives such as the Indian International Kashmir Saffron Park and dedicated branding campaigns can help secure premium positioning in global markets. Strengthening domestic production by increasing area in non-traditional areas with the support of irrigation systems and improved planting material, enhancing quality, and improving market linkages could help boost India's share in the global saffron trade.

Table 2.14: Trends in Export and Import of Saffron in India

Year	Export quantity (tonnes)	Export value (USD million)	Import quantity (tonnes)	Import value (USD million)	Trade balance (USD million)
2010	0.43	1.50	3.06	4.76	-3.26
2011	5.58	1.52	5.56	8.35	-6.84
2012	8.38	2.17	5.39	6.13	-3.96
2013	116.59	1.88	5.20	6.94	-5.06
2014	62.22	1.85	7.61	10.82	-8.97
2015	109.62	1.60	5.62	9.67	-8.07
2016	33.30	1.39	8.67	14.91	-13.53
2017	74.47	1.55	11.28	16.58	-15.04
2018	6.12	0.83	17.71	18.36	-17.53
2019	20.98	1.00	22.15	18.35	-17.36
2020	32.71	1.65	35.78	23.02	-21.37
2021	42.95	0.97	48.59	21.73	-20.75
2022	27.09	1.11	62.03	18.51	-17.41
2023	15.09	0.63	87.68	36.07	-35.44
2024	10.19	3.61	58.01	37.65	-34.04
CAGR (%) (2010-24)	25.44	6.49	23.38	15.92	18.23

Source: UNCOMTRADE

Thus, to transform J&K's horticultural exports, India needs a two-pronged strategy:

- Strengthening domestic production and value addition for import substitutions and
- Enhancing export competitiveness through branding, quality improvement and market access.

2.4 Registered and Unregistered Food Processing Units Across the UT of J&K

The food processing industry in UT of J&K is at a nascent stage. According to the data from the District Industries Centre, there are around 2247 registered food processing units, while around 28089 units are unregistered. Considering both registered and unregistered/unincorporated units, the total number of micro/small food processing units in UT is pegged at 30336. It is also estimated that close to 95-97% of total units are micro units (Directorate of Horticulture, J&K).

Currently, there is no detailed data regarding the line of activity of these unregistered/unincorporated food processing enterprises. A comprehensive documentation indicating processing capacity, ownership structure, location, investment, employment strength, level of mechanisation, market outreach etc. should be created to map and understand these enterprises.

Unregistered units represent a dominant share of the sector, accounting for nearly 92.59 % (Fig. 2.4) of total food processing enterprises. Most of these units fall under the category of micro-manufacturing units in terms of their investment in plant and machinery and turnover. They mostly operate with traditional knowledge and lack availability of mechanisation/automation, contributing to inefficiencies and bottlenecks in the current food production and processing system.

Addressing these challenges requires a focused approach: supporting unregistered units through capacity-building initiatives, facilitating access to credit and technology, and creating incentives for voluntary registration over time. In addition, the establishment of food processing industries under national schemes such as PMFME (Pradhan Mantri Formalisation of Micro Food Processing Enterprises) and PMKSY (Pradhan Mantri Kisan SAMPADA Yojana) can provide a strong institutional framework for modernising the sector. These efforts will help to strengthen micro-entrepreneurs and enable their sustainable and inclusive integration into the formal economy.

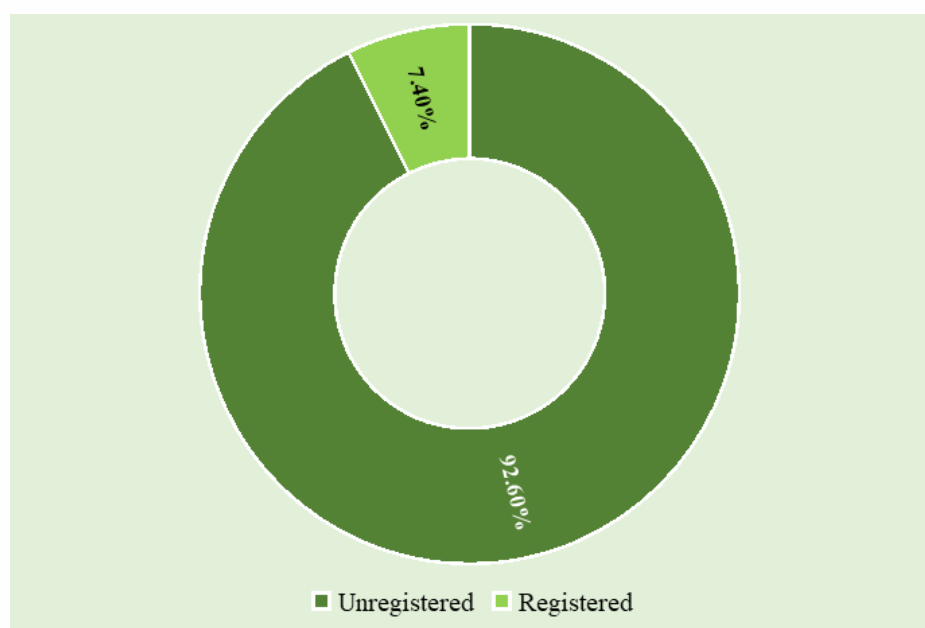


Fig. 2.7: Registered and Unregistered Food Processing Units Across the UT of J&K

Source: MOFPI website, DIC

2.4.1 Profiling of Existing Micro Enterprises Ecosystem

As per the District Industries Centres (DIC) data, the total number of registered food processing units in the UT are 2247, with 31% in Jammu followed by Srinagar (17%) and Anantnag (14.6%) (Table 2.15).

Table 2.15: District-wise Distribution of Food Processing Formally Registered Functional Units in J&K

S.No	District	Food Processing Units	S.No	District	Food Processing Units
1	Anantnag	328	11	Kulgam	40
2	Bandipora	48	12	Poonch	62
3	Baramulla	142	13	Pulwama	13
4	Budgam	175	14	Rajouri	60
5	Doda	51	15	Ramban	1
6	Ganderbal	41	16	Reasi	20
7	Jammu	689	17	Samba	25
8	Kathua	16	18	Shopian	22
9	Kishtwar	40	19	Srinagar	382
10	Kupwara	66	20	Udhampur	26
Total: 2247					

Source: Based on DIC (District Industries Centre) data & SLUP report prepared under PMFME scheme

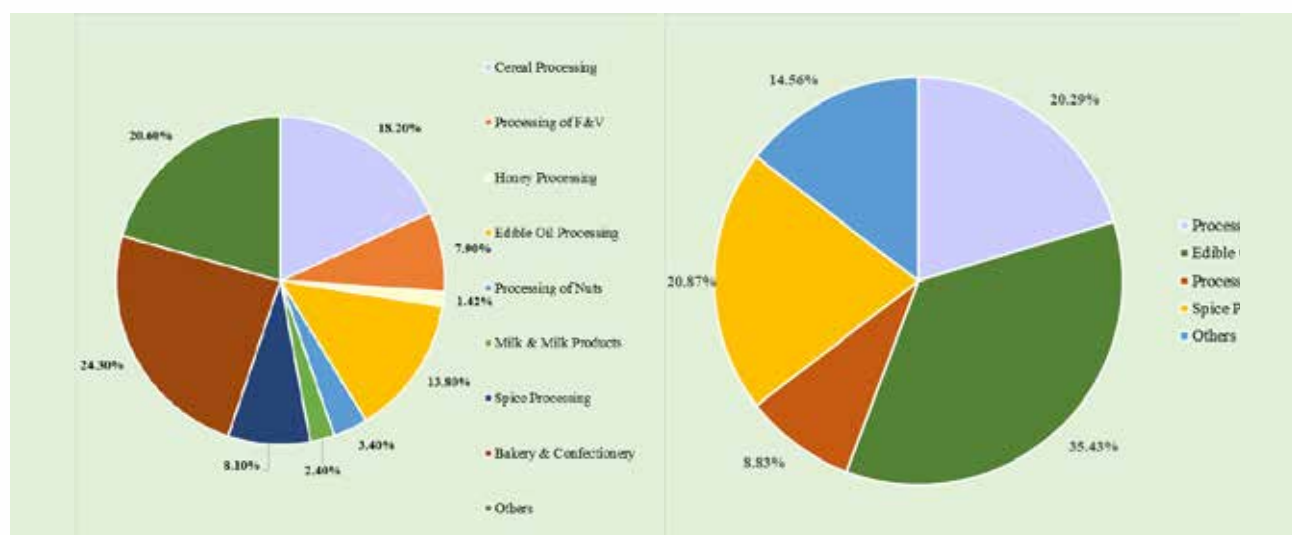


Fig. 2.8: Distribution of Total Registered Food Processing Units in J&K

Fig. 2.9: Share of Horticulture-based Food Processing Units Across J&K

Source: DIC (District Industries Centre) data & SLUP report

With 1375 registered units (61% of the total registered units) (Table 2.14), the non-horticultural sector dominates, indicating a robust presence of processing activities, possibly attributed to higher consumer demand and market dynamics. In contrast, the horticulture-based processing units, despite the region's strong production potential, represent only 39% (872 units) of the total registered units (Table 2.16). Within the horticulture-based enterprises, edible oil processing accounts for the largest share of 35.43% followed by spice processing (20.87 %) and processing of fruits and vegetables (20.29 %) in the distribution of horticulture-based enterprises in the UT (Fig. 2.5).

Table 2.16: Classification of Registered Food Processing Units of J&K Based on their Line of Activity

Horticulture based	Registered Units (Approx.)	Non-horticulture based	Registered Units (Approx.)
Edible oil processing	309	Bakery & Confectionery	545
Processing of nuts	77	Honey processing	32
Spice processing	182	Milk and milk products	55
Processing of Fruits & Vegetables	177	Cereal processing	408
Others	127	Others	335
Total	872	Total	1375

Source: Based on DIC (District Industries Centre) data & SLUP report

There is a significant untapped potential for growth in the processing segments of horticulture products like walnut/nuts, spices and fruits and vegetables for primary processing and diversified product development. Thus, a strategic focus on expanding processing capabilities in the horticulture sector is imperative to prevent post-harvest losses, meet the evolving demands of the market and leverage horticulture strengths, thereby increasing the UT's economy.

2.5 Existing Horticulture Infrastructure

The details about the existing horticulture infrastructure in J&K are provided in Table 2.17.

Table 2.17: Details on Existing Horticulture Infrastructure

Infrastructure	Details
Hi-Tech Nursery Infrastructure 	Department Nurseries 138 government nurseries (Kashmir: 70; Jammu: 68); mostly accredited by the National Horticulture Board (NHB). Private Nurseries: 316 registered private nurseries (Kashmir: 290; Jammu: 26); registered with the department, and around half are accredited Two Centres of Excellence for fruits (CoEs): - One CoE each in Kashmir and Jammu (Udheywala). - Equipped with facilities such as: » High-quality fruit plant production » Micro-irrigation systems » High-tech greenhouse technology » Tissue culture laboratory » Bio-control laboratory » Weather forecasting units - Serve as technology demonstration and training centres for farmers/growers. Mega Nurseries and New Initiatives: - One Mega Fruit Plant Nursery at Chakrohi, Jammu (40 ha area). - One Plant Entry Quarantine Facility being set up at Marta, District Udhampur, facilitates the import of fruit plants/rootstocks. - One Mega nursery for temperate fruits is under development at Sarthal Bani. - To meet demand for high-density plantations in 12 fruit crops and bring 5,500 ha under cultivation over the next 5 years
Food Parks 	2 sanctioned food parks - Located in District Srinagar and District Jammu. 3 proposed food parks - In Districts Baramulla, Pulwama, and Udhampur.
Industrial Parks 	10 industrial parks across the UT. - Designed to support clusters of commercial and industrial activity. - Serve as hubs for processing, manufacturing, and agri-industrial investments.

Infrastructure	Details
Agro-export Zone 	- J&K designated as an Agri Export Zone for apples and walnuts. J&K's dominance: » Over 90% of India's walnut production. » Around 77% of India's apple production.
Food Testing Labs 	3 operational food testing labs - Located in the Districts of Srinagar, Pulwama, and Jammu. Accreditation - Labs in Srinagar and Jammu were accredited by NABL in 2021 under ISO/IEC 17025:2017 (chemical testing only). Challenges - Limited accreditation and facilities. - Inadequate to meet the testing needs of all food processing units. - Need for improved quality assurance infrastructure.
Controlled Atmosphere Facility 	- J&K contributes over 70% of India's apple production. Major producing districts - South: Anantnag, Shopian, Kulgam, Pulwama. - North: Kupwara, Baramulla. Existing CA storage 60 units with a total capacity of 2.70 lakh tonnes. - Predominantly located in Southern Kashmir. Challenges - Inaccessible for growers in North and Central Kashmir. - Establish CA storage units in North and Central Kashmir to ensure balanced access.
Integration of mandis on eNAM 	Total Mandis: 24 functional mandis » 19 Terminal/Satellite Mandis » 5 Apni Mandis Integration status » All 17 functional wholesale mandis integrated with e-NAM by 2023-24. » All 5 functional wholesale mandis in the Jammu region integrated. » 13 mandis (6 Satellite and 7 Apni Mandis) in various stages of development/operation-alisation. » 2 new wholesale mandis to be integrated with e-NAM in 2024-25. - More mandi infrastructure in the Kashmir region than in Jammu as the Kashmir region produces the lion's share of fruit production.

Note: The list is indicative and not exhaustive.

2.6 Existing Schemes and their Performance for the Development of Horticulture in the UT

The UT has adopted a comprehensive approach to horticulture development, combining infrastructure creation, financial support, and digital services (Table 2.16). Key initiatives, such as MIDH and HADP, focus on strengthening the value chain, while schemes like PMFME and UT CAPEX promote youth-led enterprises. Integration with e-NAM, mobile apps, and online services has improved market access and service delivery. The high uptake of these schemes reflects strong implementation, with further potential for synergy and convergence across interventions.

Table 2.18: Details on Existing Schemes for Horticulture Development

Scheme/Initiative	Key Features	Performance/Outcomes
Mission for Integrated Development of Horticulture (MIDH)	Holistic support for horticulture value chain (including honey, bamboo)	Facilitating integrated growth and diversification in horticulture
HADP Project – Strengthening of Agricultural Marketing	₹426.62 crore investment approved - Creation of mandi infrastructure, compost units, induction of reefer/pickup vans, hi-tech grading lines, scientific packaging, creation of Agriculture branding centres/market intelligence envisaged.	CA storage (55,000 tonnes) & cold storage (12,000 tonnes) created
Subsidy for Grading & Packaging (UT CAPEX)	50% subsidy for modern grading & packaging techniques	682 unemployed youth benefited in 2022-23 and 2023-24
PM Formalisation of Micro Food Processing Enterprises (PMFME)	Credit-linked capital subsidy to micro food processing units	Boosts value addition and promotes rural entrepreneurship
e-NAM Integration	- Digital trading platform for agri/horti produce - Mandi digitalisation	17 Mandis onboarded - Over 51,000 growers/traders, commission agents, FPOs registered - Trade worth ₹450 crore conducted
Online Support Services	- Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) facilitates online registration for irrigation services - Sub-mission on Agriculture Mechanisation (SMAM) allows farmers to register online for agricultural machinery (tractors), Custom Hiring Centres (CHCs), and hi-tech machinery hubs. online applications for licensing of pesticides/ fertilisers. - Online registration for crop insurance through Pradhan Mantri Fasal Bima Yojana (PMFBY) and income support under Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)	- Range of online services aimed at benefiting farmers and agricultural stakeholders in J&K - The Directorate endeavours to enhance horticultural and agricultural productivity, promote sustainability, and support the livelihoods of farmers in J&K.
Mobile Apps (MKisan, AgriMarket)	Provides farmers with market information, weather forecasts, pest control advisories	Informed decision-making for planting, harvesting, and marketing

Note: The list is indicative and not exhaustive. Detailed information regarding various existing schemes is attached as Annexure III.





3

CHALLENGES AND OPPORTUNITIES



The horticulture sector serves as a crucial economic pillar for J&K. However, despite their historical reputation and high-quality attributes, the horticultural commodities face a range of challenges in production, processing, marketing and trade integration. Productivity constraints, post-harvest losses, rising imports, branding issues and limited global market access are key hurdles that have hindered their full potential.

At the same time, there are emerging opportunities driven by rising domestic consumption, global demand for high-quality food products, technological advancements in cultivation and processing, government support schemes, and increasing consumer preference for health-oriented foods. The GI recognition of Kashmir saffron, the growing popularity of high-density apple plantations, and rising interest in sustainable and organic production methods further offer strategic openings to reposition J&K's produce in both national and international markets.

The chapter examines the challenges and opportunities in order to enhance the competitiveness and resilience of J&K's horticultural economy.

3.1 Regional Constraints: Production to Post-Harvest Challenges

In Jammu division, fruit cultivation has the potential to become a highly viable economic activity, particularly with targeted interventions. However, the sector faces notable constraints:



High production costs coupled with a lack of assured irrigation, as over 70% area in Jammu region is rainfed.



Limited post-harvest management and processing facilities result in reduced economic returns, especially for small landholders.



Although there are vast underutilised areas, the lack of infrastructure and investment restricts the expansion and intensification of fruit crops such as walnut, apple, mango, citrus, and stone fruits.



High-value niche crops like strawberry, dragon fruit, kiwi, and cherry, though cultivated on a small scale, have transformational potential if appropriately scaled.

In the Kashmir region,



Most orchards are planted with seedling rootstocks at traditional spacing, which results in low productivity.



There is a pressing need for orchard rejuvenation, replacing old and senile orchards with modern high-density plantations using dwarf or exotic rootstocks.



Drip irrigation systems need to be scaled up to maximise water use efficiency to utilise limited irrigation water.

Additional systemic constraints across both regions include:



Land use shifts: Diversion of land towards other uses from agriculture.



Climate variability: Emerging as a serious concern, increasing risks for farmers.



Unscientific cultivation practices persist, including:

- Indiscriminate use of chemical inputs,
- Lack of adherence to proper pesticide application schedules,
- Inadequate awareness about chemical-free (organic and natural farming) produce demand in the international markets.

	Gaps in input support and extension services include: • Lack of access to quality seeds and planting materials. • Insufficient handholding for the scientific use of agri-inputs, particularly in guiding the judicious use of fertilisers and pesticides.
	Product testing and compliance with food safety norms are not widely practiced, and farmer awareness regarding residue testing remains very low.
	Weak value chain links: Poor coordination from production to marketing, with marketing arrangements often controlled by traders, with a limited role for FPOs or cooperatives or PACS.
	Post-harvest losses remain high due to poor handling practices, lack of timely domestic transportation, inadequate cold chain infrastructure, and limited CA storage facilities.
	Slow adoption of modern techniques: A sluggish transition to a high-density orcharding system and modern technology use.

3.2 Post-Harvest Losses of Major Horticulture Crops in J&K

Processing of major fruits is less than 1% overall²⁶; however, 2-3 % processing in apples, 12-16% in cherries and 30-40% in apricots is done in the region. Table 3.1 highlights significant post-harvest losses in J&K's major fruit crops, with apples and vegetables experiencing the highest absolute losses (5,00,000 tonnes each), resulting in monetary losses of ₹1500 crore and ₹1560 crore, respectively. Notably, cherries face the highest percentage losses (40-49%) while saffron, despite minimal quantity loss (0.48 tonnes), incurs a high monetary loss of ₹ 4.8 crore due to its premium value. Figs. 3.1 and 3.2 provide details about post-harvest losses at different stages of handling apples and walnuts, respectively.

Table 3.1: Post-Harvest Losses of Major Fruit Crops in J&K

S.No.	Crop	Post-harvest losses		
		%	Quantity (MT)	Monetary Value (Crores)
1.	Apple	20-25	500000	1500
2.	Pear	22-25	22125	55.31
3.	Peach	27-35	2362.5	4.725
4.	Plum	27-35	4760	9.52
5.	Apricot	20-25	2650	10.6
6.	Cherry	40-49	7595	45.57
7.	Vegetables	35-40	520000	1560
8.	Saffron	2-3	0.48	4.8
9.	Walnut	10-12	31476	629.52

Source: Directorate of Horticulture, Kashmir

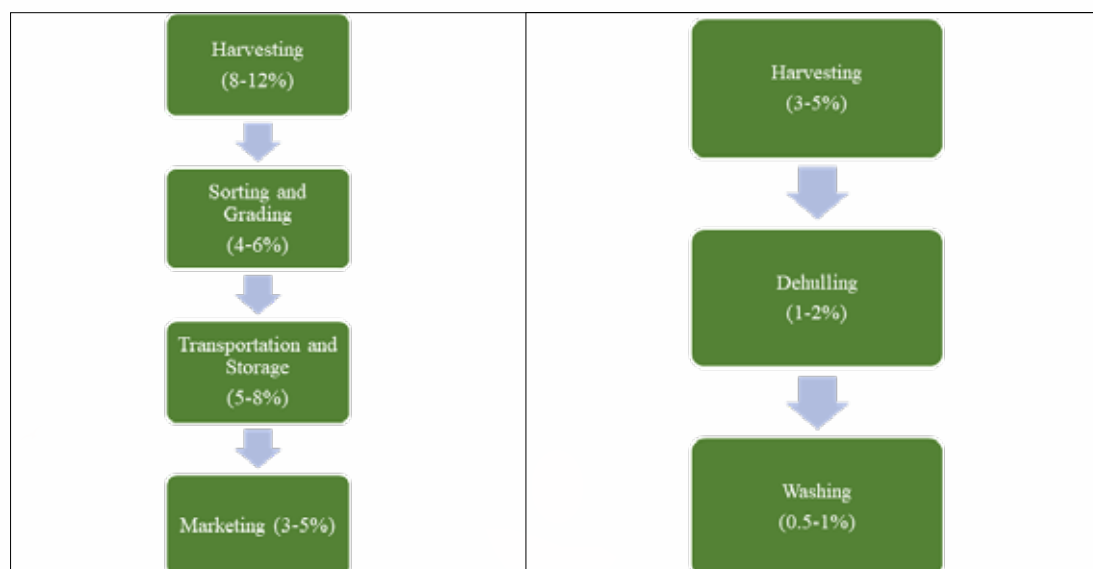


Fig. 3.1: Post-harvest Losses at Different Stages of Handling of Apples

Fig. 3.2: Share of Horticulture-based Food Processing Units Across J&K

The sector faces challenges such as a lack of awareness, poor accessibility to innovative and good agricultural practices (GAP), poor cold supply chain infrastructure, and market volatility, leading to the loss of around 35-40% of total production. Developing post-harvest technologies is essential to extend shelf life, enhance value addition, ensure wider consumer availability and tap export potential. Strengthening these technologies will also help to preserve surplus produce during glut periods, supporting horticulture growth. There is a very high degree of wastage due to improper handling, storage, marketing, and processing and distribution systems.

To reduce comparatively higher food losses in horticulture, the supply chain needs improvement, especially through village-level decentralised aggregation hubs to collect perishable fruits and vegetables. These hubs should have basic facilities like pre-conditioning and packaging systems, staging cold stores, reefer vehicles, etc.

3.3 Demand and Scope for Value Addition of Major Horticulture Crops in J&K

The demand for processed food is rising with population growth, urbanisation and changing consumer preferences.²⁷ Ethnic food products are gaining popularity, creating niche markets and investment opportunities in value-added activities, which can create jobs in food processing and related sectors such as transportation, distribution and retailing. India's food processing sector has been growing at an annual rate of around 5.35% during the last eight years ending 2022-23 and has made significant contribution to GVA (₹1.92 lakh crore), employment (20.68 lakh in 2021-22) and export (23.4% share in agri-food export in 2023-24).²⁸ However, processing levels remain low in India at 4.5% for fruits and 2.7% for vegetables compared to 30% of food processed in China, and 60-80% in Western countries.²⁹

²⁷ <https://face-cii.in/wp-content/uploads/2021/09/Food-Processing-Report-2019.pdf> (accessed on 3rd April 2025)

²⁸ <https://pib.gov.in/PressReleasePage.aspx?PRID=2036980> (accessed on 3rd April 2025)

²⁹ *Economic Survey, 2023-24, Government of India.*

J&K has significant potential for food processing, given its rich agricultural resources. There is significant potential for food processing units to produce juice concentrates, jams, jellies, marmalades, and other value-added products from apples, pears, cherries, plums, and apricots. Despite these opportunities, local producers often remain suppliers of primary products rather than diversifying into value-added goods.

3.3.1 Major Gaps and Challenges in Promoting Processing

Maximising the horticulture potential and improving the horticulture value chain requires addressing infrastructure gaps, technological limitations, quality control issues, financial constraints, skill gaps, and market access barriers. This calls for coordinated efforts involving government agencies, industry, financial institutions, research organisations, and development partners.

(i) Infrastructure Deficiency



Inadequate Cold Storage Facilities and Integrated Pack Houses:

- Out of the total apple production of 21.4 lakh metric tons in 2023, around 9-10 lakh tons were of A-class quality. About half of this was sold directly in mandis, while the rest was stored in cold storage.
- Existing facilities could not accommodate all the high-quality apples.
- J&K has around 60 CA (Controlled Atmosphere) Stores, all equipped with integrated packhouses and advanced graders.
- Additionally, around 5 standalone Integrated Pack Houses have been established.
- Efficient monitoring and expansion of storage and handling infrastructure are essential to optimise the value chain.



Lack of Advanced Machinery in Processing Units:

- Of the over 2,000 registered food processing units in J&K, only 11% are engaged in horticultural processing, focusing mainly on apples and walnuts.
- Processing units for spices and other horticultural products largely rely on traditional machinery and packaging systems.
- This often results in a decline in the quality of final products.



Deficiency in Transportation Networks and Cold Chain Logistics:

- Inadequate transportation infrastructure, especially for perishables, hampers timely and cost-effective distribution in domestic and export markets.
- Weak cold chain logistics and poor last-mile connectivity increase costs and product losses.
- Strengthening transportation networks (e.g., reefer vans) and cold chain logistics is crucial for expanding market reach and improving efficiency.



Lack of Aseptic Processing Facility:

- Absence of aseptic technology limits J&K's ability to preserve the quality and safety of horticultural produce.
- This results in higher contamination risks, spoilage, and post-harvest losses.
- Lack of such facilities impedes compliance with stringent quality standards and limits access to premium domestic and international markets.
- The shortage of modern facilities and trained personnel further complicates the implementation of efficient processing solutions.

(ii) Technology Adoption Challenges



High Initial Investment Costs:

- High costs of processing equipment (e.g., vacuum coolers, cryogenic grinding machines) deter adoption, especially among rural enterprises.
- Limited access to affordable financing, subsidies, and incentives hampers modernisation efforts.
- Long payback periods and inadequate servicing options in the Kashmir Valley further discourage investment in advanced technology.



Limited Technical Know-how:

- Lack of technical knowledge among small farmers and cooperatives restricts the use of modern processing techniques and proper equipment handling.
- Inadequate understanding of quality control measures affects productivity, product quality, and competitiveness.
- Targeted training programs, workshops, and access to technical resources are essential to enhance technology adoption.

(iii) Quality and Standards Compliance



Inadequate Quality Assurance Mechanisms:

- Ensuring consistent product quality and food safety is challenging, especially in small-scale and informal processing units.
- Limited access to quality testing facilities and certification programs hampers compliance with market standards.
- This limits consumer trust and restricts the marketability of processed horticultural products.



Barriers to Market Access and Certification:

- Compliance with international standards and certifications is complex and expensive for small processors.
- Lack of access to market intelligence, guidance on regulatory requirements, and efficient marketing channels restricts export opportunities.
- These limitations hinder market diversification and reduce potential revenue for horticultural enterprises.

(iv) Value Chain Coordination



Fragmented Value Chains:

- The horticulture value chain in J&K is fragmented, with weak linkages between producers, processors, traders, and retailers.
- Limited coordination leads to inefficiencies, information asymmetry, high transaction costs, and missed opportunities for value addition and market integration.
- These gaps often result in poor-quality produce and reduced profitability.



Supply Chain Logistics Issues:

- Inadequate logistics in storage, handling, transportation, and distribution hampers efficient delivery of processed products.
- Weak supply chain management leads to delays, product loss, and operational bottlenecks.
- Improved logistics planning, inventory management, and coordination among stakeholders can enhance overall supply chain efficiency.

(v) Market and Export Challenges



Lack of Market Information and Intelligence:

- Limited access to reliable market information, consumer preferences, and trends affects strategic decision-making and product positioning.
- Strengthening market intelligence systems, conducting market research, and improving linkages are vital for identifying opportunities and enhancing competitiveness.



Low Export Readiness:

- Exporters face challenges in meeting international standards related to product quality, packaging, labelling, and certifications.
- Lack of knowledge and support on export procedures limits access to global markets.
- Capacity-building, export promotion programs, and technical assistance are needed to improve export readiness and broaden market reach.

Addressing these major gaps and challenges in promoting processing in J&K's horticulture sector requires a comprehensive approach involving investments in infrastructure, technology, skills development, quality assurance systems, market access, value chain coordination, and export facilitation. Collaborative efforts between government agencies, industry stakeholders, research institutions, and development partners are essential to overcome these challenges and unlock the full potential of processing in enhancing value addition, market competitiveness, and sustainability in the horticulture value chain.

3.4 Potential of Horticultural Technologies and Adoption Challenges

3.4.1 Pre-Harvest



Plant Propagation Management:

- Several advanced propagation technologies are available in India and abroad, but adoption in J&K remains very low.
- Rootstock multiplication on a large scale is practiced in only 20-30 nurseries.
- Feathered plant development in apples is limited to just 10-15 nurseries.
- Walnut propagation under poly-house conditions (with over 80% success rate) is also adopted by only 10-15 nurseries.
- Olive plant production is confined to 3-5 nurseries.
- Strengthening technology transfer, commercialisation, and adoption through networking, collaboration, and viable business models is essential.



Soil and Crop Health Management:

- While fertilisers and pesticides are applied as per general recommendations, baseline diagnostics such as disease incidence and nutrient deficiency assessments are often overlooked.
- This reduces the precision and effectiveness of nutrient and pest management strategies.



Water Resource Management Practices:

- Technologies such as micro-irrigation, drip systems, and rainwater harvesting hold potential for improved water use efficiency. However, adoption is limited and mostly restricted to few crops.
- For example, micro-irrigation is recommended for high-density apple plantations but is not widely used for other horticultural crops.

**Pollination Management:**

- Standardised technologies for effective pollination (bee colony density, polliniser ratios, placement, mode of pollination, suitable species) exist for crops like apple, pear, almond, cherry, olive, and kiwifruit.
- Despite this, less than 5% of farmers in J&K are effectively implementing pollination management practices.

**Other Technologies:**

- A wide range of technologies in varietal development, varietal characterisation, germplasm conservation, biotechnology, micro-propagation, and post-harvest management are available.
- However, these technologies face significant adoption barriers, including awareness gaps, limited technical capacity, and a lack of support mechanisms.

3.4.2 Post-Harvest**(i) Existing Post-Harvest Handling Practices for Apples**

In J&K, apples are manually harvested using woven wicker baskets (up to 5 kg capacity) and iron ladders for taller trees. Apples are sorted and graded based on size and colour, often exposed to sunlight and rain due to limited shed availability. No pre-cooling is done to remove field heat. Fruits having 80% or above red colour are grouped under grade A and fruits with less than 80% colour are considered as grade B. A fruit with abnormal size, diseases, bruises and mechanical injuries is grouped under grade C and considered as culled fruit. Grades A and B are packed in 10-20 kg wooden boxes with paddy straw and used newspaper for cushioning. Stems are removed using cast iron scissors, except for the American Trel variety. Packed apples are manually loaded onto trucks. About 40% of apples are sold locally, while the rest 60% are sent to markets outside the UT. Only 2-3% of culled fruit is processed for concentrate production.

(ii) Scientific Post-Harvest Handling of Apples

- **Storage of Apples in CA Stores**

- ▶▶ **Pack House Operations:** Over the past seven years, the Horticulture Department Kashmir has constructed 3490 pack houses for cleaning, grading and packing their produce. However, these pack-houses are not constructed on scientific lines and lack proper facilities for pre-cooling, grading, sorting and packing. Therefore, the Department should work in consultation and coordination with the experts in the sector.
- ▶▶ **Modern CA Stores:** J&K has a 60 CA stores with a 2.70 Lakh tonnes capacity primarily for Grade A and B apples. The present CA storage capacity is insufficient, creating a bottleneck in the value chain.
- ▶▶ **Processing of Culled Apples:** About 15-20% of total production are culled and sold at a cheaper price, with many apples left un-harvested. Given the surplus, there is the potential for a mega plant to process 65,000-70,000 tonnes of C-grade apples in 80-90 days, producing 6,500-7,000 tonnes of concentrate and 50 kg of pectin daily, adding economic value.



High Tech Apple Grading Line



Pack-house Operations

Fig. 3.3: Overview of CA stores of J&K

(iii) Existing Post-Harvest Handling Practices in Walnuts

Traditional walnut harvesting involves beating branches using 15-16 foot wooden stick, leading to nut breakage, bud damage, and worker injuries. Nuts falling on wet ground develop discolouration, affecting marketability. Nuts dropping from 30-40 feet suffer additional breakage and loss due to the uneven, sloped terrain, making collection labour-intensive. Overall, 3-5% of nuts are lost due to breakage, mould growth and pilferage during harvesting and heaping.

De-hulling is done manually by rubbing walnuts together, beating with wooden logs or using knives, causing 1-2% breakage. This task, performed by 3-4 labourers, stains worker's hands with jugulone dye. Washing nuts in running water with wooden logs or by trampling causes 1-1.5% breakage.

Drying takes 7-10 days; and losses occur due to bird and rodent damage (0.5-1%). Traditional storage in gunny bags causes rancidity and darkening (0.5-1% loss). Pricing depends on size, shell thickness and colour. Overall, the traditional method is labour-intensive, unsafe, and results in significant product loss and quality issues.

(iv) **Scientific Post-Harvest Handling of Walnuts**

By scientifically handling and adding value to broken or dark-coloured walnut kernels through the production of walnut butter and oil, the system offers significant economic benefits. These high-value products can stabilise the rural economy and boost the walnut industry in J&K, creating employment opportunities and reducing post-harvest losses. The adoption of this modern processing approach ensures consistent quality and reduces the labour-intensive nature of traditional methods, fostering overall regional development.

To minimise post-harvest losses, maintain quality, and overcome the drudgery, boredom, and other constraints associated with traditional post-harvest handling of walnuts, a model walnut processing unit has been developed. The model walnut processing unit includes advanced equipment such as a walnut dehuller-cum-washer, grader, cracker, kernel grader, vacuum packaging, shrink wrapping machines, solar tunnel drier, cabinet dryer, walnut butter making machines, and oil extraction machines. This integrated system improves the efficiency of walnut processing and enhances the product's cosmetic value, leading to higher market prices.

(v) **Existing Post-Harvest Handling Practices for Saffron**

To produce 1 kg of dry saffron, 1,60,000 flowers (approx.) are needed, generating about 350 kg of petals. From 1 kg of fresh saffron flowers, only 15-20 grams of dried saffron is obtained. Cultivation requires about 210 man-days per hectare for corm digging and collection, and 170 man-days per hectare for flower harvesting and stigma separation. Farmers harvest flowers in woven baskets and sell them to traders, who handle post-harvest operations. Stigmas and styles are separated and dried indoors with a fan for 6-8 days to prevent colour fading. Petals are typically discarded. Conditioning involves spraying water for 17-18 hours. Stigmas are manually separated from styles, which are sometimes dyed for adulteration. Manual winnowing and hand rubbing are used to process stigmas, which are then packed in ½ to 5-gram plastic containers. During processing, 2% of saffron becomes powder (chura), and six labourers are needed to process 1.25 kg of saffron. Average post-harvest losses during various stages of saffron handling typically range from 2-3%.

(vi) Scientific Post-Harvest Handling of Saffron

To improve saffron processing and quality in J&K, the India International Kashmir Saffron Trading Centre (IIKSTC) at Dussu Pampore has been established under National Saffron Mission.³⁰ This high-tech saffron/spice park provides facilities for stigma separation, drying, grading, packaging and marketing, ensuring scientific handling and preventing adulteration. Additionally, an Advanced Research Station for Saffron and Seed Spices in SKUSAT, Kashmir focusses on developing and disseminating innovative saffron cultivation technologies.

Saffron growers should adopt modern drying techniques to preserve pigment concentration and maintain quality. Effective methods include solar saffron dryer, hot air dryer, solar tunnel saffron dryer. These methods achieve a temperature range of 40-50 °C , reducing drying time to 4-7 hours, ensuring superior saffron quality.

3.4.3 Constraints in the Adoption of Horticultural Technologies

	Technological and knowledge barriers: • Lack of location-specific and need-based technologies. • Lack of proper technical guidance and thus limited technical know-how
	Infrastructure and market challenges: • Lack of inputs for technology adoption in local markets. • Low market prices and high perishability of horticultural products
	Financial barriers: • High cost of technologies (e.g. High-Density Plantation of Apple Orchard: Initial cost of establishment > ₹ 39.70 lakh/ha). • Lack of need-based credit support system for technology adoption
	Environmental and climatic constraints: • Shortage of water at critical stages of irrigation; no monsoons and erratic rainfall • Severe winters with very low temperature and snow-covered fields

3.5 Availability and Prospects of NABL Accredited Food Testing Laboratories in the UT of J&K

J&K has limited number (three) of NABL accredited Food Testing Laboratories (Table 3.2). However, the region has been focusing on enhancing its food safety infrastructure, and recent efforts have seen some progress in establishing accredited labs.

Table 3.2: List of NABL accredited Food Testing Laboratories in J&K

S. No.	Name	Address	Govt./Private	Whether NABL Accredited	Whether FSSAI certified
1.	Food Testing Laboratory	Jammu	Govt.	Yes	Yes
2.	Food Testing Laboratory	Srinagar	Govt.	Yes	Yes
3.	Food Testing Laboratory	IUST-Awantipora	Govt.	Yes	No

30 <https://krishiscience.co.in/storage/app/finalpdf/Ha4NiAFakF1IS5g7Ui5E25LmGfbQIO3YDEcex75b.pdf> (accessed on April 3rd, 2025).

The existing laboratories are primarily focused on addressing the specific needs of the region, including testing for common contaminants and quality parameters of few locally produced food items. Various initiatives have been launched by the J&K Government, to ensure that the region's food products meet national and international safety standards.

Future Prospects of NABL Accredited Food Testing Laboratories in J&K

- | | |
|--|---|
| <ul style="list-style-type: none"> • Expansion of Laboratory Network • Upgradation of existing food testing laboratories • NABL accreditation • Focus on High-Value Crops • Improving Export Quality Compliance | <ul style="list-style-type: none"> • Enhancing Collaboration and Partnerships • Regulatory and Policy Support • Public Awareness and Education • Sustainable Practices • Training and Capacity Building • Collaboration with Educational Institutions |
|--|---|

It is proposed to establish one NABL accredited Food Testing lab in each Food Park, creating centralised testing facilities for nearby food processing units. Additionally, upgrading existing labs with better infrastructure, equipment, and manpower is essential to meet the Food Safety and Standards Act 2006 requirements, aligning them with top national testing and research institutions for quality assurance and consumer safety.

3.6 Vagaries of Weather and Climate Change

The frequency of Extreme Weather Events (EWEs) such as heavy rains, flash floods, heat waves, and thunderstorms has increased globally, including in J&K. Between 2010-2022, J&K experienced 2,863 EWEs.³¹ Erratic snowfall has caused major agricultural losses, notably in 2018 and 2019, destroying apple orchards and resulting in estimated damages of about ₹500 crore (2018) and ₹2,250 crore (2019).³² In 2023, unseasonal rainfall and hailstorms led to a 50% cherry crop loss.³³ Other horticultural crops have also suffered, impacting both yield and quality.

3.6.1 Impact of EWE and Importance of Early Warning System (EWS) in J&K

Climatic variability, including unseasonal snowfall, hailstorms, and strong winds, has severely impacted fruit growers by disrupting pollination, fruit set, and harvesting. These events also affect post-harvest activities like sorting, packaging, and marketing, causing tree damage and reduced yields. Accurate weather forecasting is crucial for protecting crops, livestock, and property. Short-term forecasts help farmers adapt daily operations, reducing weather-related losses, while long-term forecasts aid in crop selection and planning, improving farmers' livelihoods in regions with unpredictable rainfall.

The Agro-Meteorological Advisory Services (AAS) project, under the Gramin Krishi Mausam Sewa (GKMS) scheme, enhances agricultural productivity through localised weather advisories. Led by IMD under MoES, in collaboration with ICAR, IITs, and

³¹ <https://mausamjournal.imd.gov.in/index.php/MAUSAM/article/view/6147> (accessed on August 21, 2025)

³² https://www.researchgate.net/publication/345362260_Impacts_of_Erratic_Snowfall_on_Apple_Orchards_in_Kashmir_Valley_India#:~:text=Abstract%20and%20Figures,an%20average%20of%20~35%25. (accessed on August 21, 2025)

³³ https://www.deccanherald.com/india/weather-vagaries-cause-50-loss-to-cherry-production-in-kashmir-1228535.html?utm_source (accessed on August 21, 2025)

State Agricultural Universities, it integrates weather, soil, and crop data to help farmers make informed decisions. The project issues district to national-level advisories based on high-resolution forecasts from models like GFS and CFS. AAS bulletins (692 nos.), prepared by AMFUs and DAMUs in KVKs, offer crop-specific guidance on sowing, pesticide use, and irrigation. State Composite Bulletins help identify distressed regions, while National Bulletins, compiled by the National Agromet Advisory Service Centre, Pune, support policy decisions, benefiting millions of farmers.

3.6.2 Limited Availability of Irrigation Facilities

Irrigation is vital for horticulture, providing consistent water for optimal crop growth, stress management, and nutrient uptake. Micro irrigation like drip and sprinkler irrigation are preferred over conventional methods due to their efficiency, reduced water wastage, and environmental sustainability. Use of micro-irrigation enhanced water efficiency, crop quality, and year-round cultivation, particularly for high-value crops like apples and saffron in the UT.

However, in 2022-23, only 42.24 % of gross cropped area in J&K is irrigated³⁴. Between 2015-16 and 2023-24, the area covered under micro-irrigation in J&K was only 1,104 ha accounting for a mere 0.01% of the total area covered under micro-irrigation in the country, including both drip and sprinkler systems³⁵. Specifically, only 700 ha area is under micro-irrigation under High Density Plantation Scheme only, highlighting the need for greater adoption of mechanised irrigation in horticulture.

Despite the critical importance of irrigation, Fig. 3.4 shows stagnation in the expansion of net irrigated area, which has remained largely between 311 and 325 thousand hectares, with only a temporary spike in 2015-16 (356 thousand ha) during 2010-11 to 2023-24.³⁶ The recent plateau in irrigated area reinforces the urgency of promoting policy interventions like micro-irrigation to sustainably enhance irrigation coverage and efficiency. Mechanisation in irrigation remains minimal in J&K, largely due to limited farm power, fragmented land holdings, reliance on traditional water resources, and economic non-viability of advanced irrigation systems - further emphasising the need for targeted support and awareness among growers.

³⁴ Land Use Statistics at a Glance, 2023-24

³⁵ <https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=2003188&utm>

³⁶ Considering the sources of irrigation, analysis of the Land Use Statistics 2023-24 data reveals a decline in canal irrigation over the years, even though it continues to account for the major share (85%) of total irrigation.

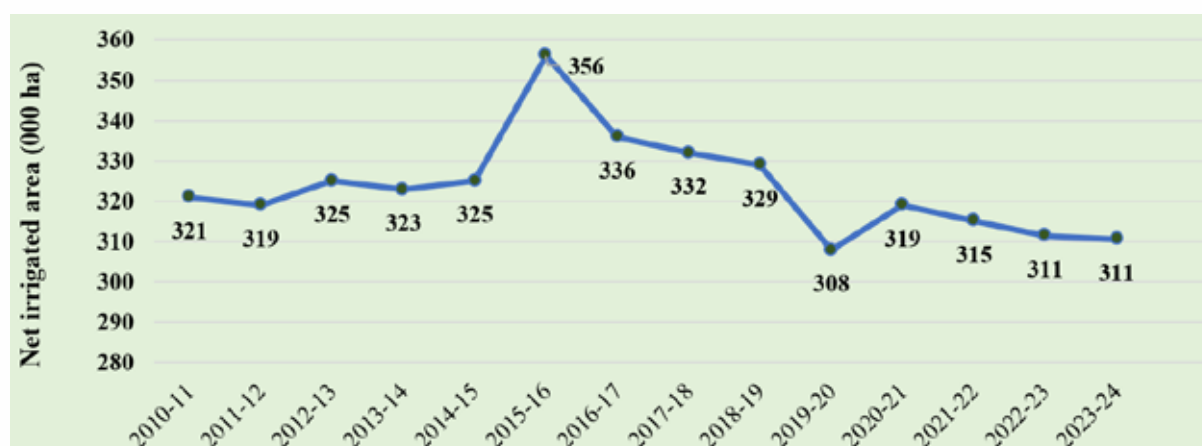


Fig. 3.4: Net irrigated area in the UT of J&K (2010-11 to 2023-24)

Source: Digest of Statistics (2023-24), Directorate of Economics and Statistics, J&K

3.7 SWOT Analysis for Horticulture in the UT of J&K

Strengths

- Unique temperate climate suitable for cultivating high value crops with offseason production window.
- Niche crop diversity/ specialty crops suitable for growing under Natural Farming conditions
- Climate diversity ranging from sub-tropical to temperate
- Huge national market and strategic proximity to global markets like Middle East Asia, Bangladesh, Sri Lanka which are fastest growing fruit importers.
- Climate change advantage with Himalayas acting as a buffer for changes and source for water in the form of perineal glaciers.
- GI branding and heritage products to dominate premium niche.

Weakness

- Old and traditional orchards with monopoly of few varieties having limited market demand and consumer acceptability.
- Inadequate production of quality plating material and thus rely on import of material from other countries.
- Non-descriptive varieties in crops like walnut, almond etc leading to non-uniformity of produce with high level of heterogeneity.
- Poor post-harvest handling leading to huge post-harvest losses and limited market.
- Lack of marketing strategies like packaging, branding, description, labelling, storage etc.
- Limited use of technology and high cost of adoption of modern technology.
- Lack of sufficient cold storage facilities and thus proper cold chain is not followed leading to narrow window for marketing.
- Lack of sale and export promotion activities.
- High transportation cost, exorbitant air freight cost and poor airfreight capacity.
- Less area under cultivation and unclassified regions based on crop suitability.

Opportunities

- A growing market for horticulture crops at national and international level in which demand exceeds the supply and the world demand is estimated to grow.
- The high production costs in developed countries provide opportunity as they rely largely on imports to meet their domestic demand.
- Huge diversity in existing germplasm of crops like walnut, almond, apple, pear, apricot etc can be harnessed for identifying and developing new high value and high demand varieties.
- Potential for domestic production of quality planting material support by Government for reducing import and making opportunities for export.
- Replacement of non-descriptive germplasm with new varieties having more commerce and acceptability.
- Improved consumption habits of fruits and vegetables due to nutritional benefits and thus create an opportunity for enhancing domestic consumption and market.
- Crop diversification in diverse regions like tropical, temperate, and sub-temperate as per the suitability.

Threats

- International competition in quality and prices of horticultural crops and thus leading to huge imports at lower prices.
- Extreme winters in Kashmir region leading to restriction of activities and limitation of crop production during that season.
- Climate change and its impact on disease and pest incidence, productivity, suitability for crop growth etc.
- Introduction of new diseases and pests by breaching Post Entry Quarantine measures during import of large quality of planting material.
- Limited export potential of produce due to poor quality and higher pesticide residues



4

STRATEGIC INTERVENTIONS FOR HORTICULTURE DEVELOPMENT IN J&K



This chapter explores strategic interventions proposed for transforming J&K's horticulture sector, focusing on modernisation, infrastructure development, technology adoption, and policy reforms. By leveraging high-density plantations, precision farming, improved cold storage, and enhanced market access, these initiatives aim to boost productivity, ensure sustainability, reduce import dependence and position J&K as a leading horticulture hub in national and global markets. The various strategies dealt are given in this chapter.

4.1 Strategy I: Productivity Enhancement through Varietal and Technological Shifts

In the face of global population growth and environmental challenges, enhancing productivity is crucial for horticultural crops. Advancements in plant breeding and technology, focusing on developing superior varieties and adopting innovative cultivation practices, are reshaping the sector.

4.1.1 Germplasm Management and Utilisation

Germplasm existing in the UT possesses some important traits which have not yet been utilised to its potential. To utilise the untapped germplasm wealth of horticultural crops and enrichment of resources following strategies may be followed:

	Collection of Indigenous Germplasm and its Use: Indigenous germplasm of horticultural crops needs to be collected, registered and protected. The collection should be done through ICAR-NBPGR, New Delhi, across the UT/ hot spot areas of diversity.
	Germplasm Conservation: Germplasm conservation (field / in-vitro / cryopreservation) at NAGS, ICAR-NBPGR, New Delhi, and crop-wise centres for excellence should be done in replicates. Germplasm conservation centres at two locations should be made for all horticultural crops to avoid the loss due to any natural calamity or climate change.
	Germplasm Introduction, Export and Exchange: Enrichment of trait-specific germplasm from countries of their origin/diversity should be done for their utilisation. Diversity in clonally propagated crops like saffron should be increased through introduction from countries like Iran, Afghanistan and Spain etc.
	Breeding for Trait Introgression and Exploitation of Phytonutrient Potential: Development of new varieties/hybrids by introgression of traits like fruit quality, disease resistance, abiotic stress tolerance, etc. should be done to ensure nutritional security and improved quality. Import of germplasm can be reduced significantly by developing varieties with specific traits fulfilling the requirements of consumer acceptability and market demand.
	Use of Crop Wild Relatives: Traits which have been lost through gene flow in commercial varieties need to be recovered through sue of wild relatives. Pan-genomic studies will ensure the recovery and tracing the genes related to disease resistance, adaptability etc., available in wild relatives of the horticultural crops.

4.1.2 Introduction of Best-Known Varieties and their Large-Scale Multiplication

Research institutions such as ICAR-CITH, Srinagar; SKUAST-K, Srinagar, etc., have evaluated and identified promising horticultural varieties with the highest consumer acceptability and market demand for Jammu (Table 4.1) and Kashmir's agro-climatic conditions (Table 4.2). These varieties should be prioritised for large-scale multiplication and commercialisation.

Table 4.1: Crop-wise Varieties Recommended for Large-scale Multiplication in Jammu

S.No.	Fruits	Five Best Varieties Identified	Yield Potential of Each Variety	Agro-Climatic Zone	Districts
1.	Apple	Red Chief ³⁷	17 kg/plant	Temperate	Kishtwar, Doda, Ramban, Udhampur, Rajouri
		Gala Redlum	20 kg/plant	Temperate	
		Gala Schniga-Schnico ³⁸	28 kg/plant	Temperate	
		Dark Baron Gala	50-60 t/ha	Temperate	
		King Roat ³⁹	23 kg/plant	Temperate	
2.	Pear	Max Red Bartlett ⁴⁰	36 kg/plant	Temperate	Ramban, Doda
		William ⁴¹	30-40 kg/plant	Temperate	Kishtwar, Doda, Ramban, Udhampur Rajouri
		Conference	25-30 t/ha	Temperate	
		Kashmiri Nakh	35-40 t/ha	Temperate	
		Flemish Beauty	37 kg/plant	Temperate	
3.	Plum	Santa Rosa	25-30 t/ha	Mid Hills	Udhampur, Reasi
		Mariposa ⁴²	58 kg/plant	Mid Hills	Poonch, Rajouri, Ramban
		Frontier	18-22 t/ha	Mid hills	
		Methley	15-20 t/ha	Mid hills	
		Kali Amritsari ⁴³	36 kg/plant	Subtropical areas	Doda, Kishtwar
4.	Sweet Cherry	Misri (Bigarreau Noir Grossa) ⁴⁴	7 t/ha	Temperate	
		Double (Bigarreau Napoleon)	10-12 t/ha	Temperate	
		Stella	8-12 t/ha	Temperate	
		Black heart		Temperate	
		Van/Sam	5-6 t/ha	Temperate	
5.	Apricot	New Castle	25 kg/tree	Temperate	Ramban, Doda,
		Early shiplay ⁴⁵	9.46 t/ha	Temperate	Udhamur, Reasi
		Kaisha ⁴⁶	23 kg/tree	Temperate	Rajouri, Poonch
		Saffaida	36 kg/tree	Temperate	
		Charmagaz	32 kg/tree	Temperate	
6.	Peach	July Elberta	18-20 t/ha	Temperate	Udhampur, Reasi
		Red Haven	20-25 t/ha	Temperate	Rajouri, Poonch
		Florda Sun ⁴⁷	75kg/plant	Temperate	
		Sharbati	100-120 kg/plant	Subtropical	
		Shan-e-Punjab	70 kg/plant	Subtropical	Jammu, Kathua

37 <https://doi.org/10.9734/ijpss/2024/v36i125201>

38 <https://www.mdpi.com/2073-4395/10/4/458?utm>

39 <https://krishikosh.egranth.ac.in/items/99f5f4ac-0c6a-45ea-a199-6918bac4d463>

40 <https://academicjournals.org/journal/AJAR/article-full-text/07B907A51184/1000>

41 https://agritech.tnau.ac.in/horticulture/horti_fruits_pear.html?utm

42 <https://www.tropicalplantresearch.com/archives/2018/vol5issue1/11.pdf>

43 <https://www.mdpi.com/2223-7747/11/22/3081>

44 <https://doi.org/10.24154/jhs.v14i1.694>

45 <https://epubs.icar.org.in/index.php/IJAgS/article/view/81594/33901>

46 <https://aatcc.peerjournals.net/wp-content/uploads/2025/07/Performance-of-some-Apricot-Prunus-armeniaca-L.-Germplasm-Accessions-for-Morphological-and-Physiological-Characters-under-Cold-Dry-Temperate-Conditions-of-Lahaul-and-Spiti-valley.pdf> (obtained yield potential for New Castle, Kaisha, Saffaida and Charmagaz)

47 https://agritech.tnau.ac.in/horticulture/pdf/tech_bulletin/national/Checklist_of_CommercialFruits-18-01-13.pdf

S.No.	Fruits	Five Best Varieties Identified	Yield Potential of Each Variety	Agro-Climatic Zone	Districts
7.	Al-mond	IXL		Temperate	Doda, Kishtwar
		Non Pariel	3-4 t/ha	Temperate	Rajouri, Udhampur
		Makhdoom	3-4 t/ha	Temperate	Ramban
		Parbat		Temperate	
		Govind		Temperate	Doda, Ramban
8.	Walnut	Chandler ⁴⁸	4-5 t/ha	Temperate	Kishtwar, Doda, Ramban, Udhampur rajouri
		CITH 1	3-4 t/ha	Temperate	
		CITH -2	3-4 t/ha	Temperate	
		Franquette	30-50 kg/plant	Temperate	
		Bhushan		Temperate	
9.	Mango	Pusa Arunima	50-60kg/plant	Subtropical	Jammu, Samba
		Pusa Shreshtha	50-60kg/plant	Subtropical	Kathua, Reasi
		Pusa Pitambar	40-50kg/plant	Subtropical	
		Mallika	60-80kg/plant	Subtropical	
		Chausa	60-80kg/plant	Subtropical	
10.	Guava	Taiwan Pink	150-160kg/plant	Subtropical	Jammu, Samba
		Lalit	120-125kg/plant	Subtropical	Kathua, Reasi
		Hisar safeda	120-125 kg/plant	Subtropical	Udhampur, Reasi
		Shweta	120-125 kg/plant	Subtropical	
		L-49	125-130 kg/plant	Subtropical	
11.	Mandarin	Kinnow	80kg/plant	Subtropical	Jammu, Samba
		Punjab kinnow-1	45-55kg/plant	Subtropical	Kathua
		Nagpur Mandarin	50-60kg/plant	Subtropical	Udhampur
		Daisy	50kg/plant	Subtropical	
		W murcott	50 kg/plant	Subtropical	
12.	Sweet Orange	Jaffa	50 kg/plant	Subtropical	Jammu, Samba
		Mausambi	40 kg/plant	Subtropical	Jammu, Samba
		Malta	40kg/plant	Subtropical	Kathua
		Blood red	45kg/plant	Subtropical	Udhampur
		Early Gold	45kg/plant	Subtropical	Rajouri, Reasi
13.	Lime	Kagzi Lime	60 kg/plant	Subtropical	Samba, Kathua
		Kagzi Kalan	50-60kg/plant	Subtropical	Rajouri, Reasi
		Promalin	50kg/plant	Subtropical	Reasi, Udhampur
		Pusa Udit	50 kg/plant	Subtropical	Ramban
		Pusa Abhinav	50kg/plant	Subtropical	
14.	Lemon	Baramasi	60-80 kg/plant	Subtropical/ Mid Hills	Jammu, Samba
		Eureka	60 kg/plant	Subtropical/ Mid Hills	Udhampur, Reasi
15.	Grape fruit	Duncan	100kg/plant	Subtropical	Jammu, Samba
		Foster	80-100 kg/plant	Subtropical	Kathua, Udhampur

⁴⁸ <https://www.walnuts-bulgaria.com/english/grafted-trees/chandler/>

S.No.	Fruits	Five Best Varieties Identified	Yield Potential of Each Variety	Agro-Climatic Zone	Districts
16.	Pecan nut	Mahan	40-60 kg/plant	Mid Hills	Poonch, Rajouri
		Burkett		Mid Hills	Udhampur
		Nellis		Mid Hills	
		Local selection SJP-		Mid Hills	
17.	Kiwi Fruit	Allison	45 kg/plant	Mid Hills	Poonch, Rajouri
		Hayward	30 kg/plant	Mid Hills	Udhampur
		Abbott	32 kg/plant	Mid Hills	
		Bruno	42 kg/plant	Mid Hills	
		Matua and Tomuri male ⁴⁹		Mid Hills	
18.	Pomegranate	Bhagwa	40-50 kg/plant	Mid Hills	Udhampur,
		Kandhari	40-50 kg/plant	Mid Hills	Reasi, Rajouri
		Ganesh	40-50 kg/plant	Mid Hills	Ramban
		Mridulla	40-50 kg/plant	Mid Hills	
		Jalore Seedless	40-50 kg/plant	Mid Hills	

Source: SKUAST- Jammu

In addition to the crops and their specific varieties suggested for adoption in the Jammu and Kashmir region, several other crops are emerging as high-potential options in the subtropical and mid-hill areas. These include dragon fruit in Jammu and Samba, strawberry in Kathua and Samba, Blueberry and Avocado in Rajouri and Reasi, and olives in Ramban and Kishtwar. These crops further strengthen the scope for crop diversification in the region.

Table 4.2: Crop-wise Varieties Recommended for Large-Scale Multiplication in Kashmir

S.No	Fruits	Five Best Varieties Identified	Yield Potential of Each Variety	Agro-Climatic Zone	Districts
1.	Apple	(i) Gala SchniCo Red	50-60 t/ha	Temperate	All districts Kashmir Zone
		(ii) Dark Baron Gala	50-60 t/ha	Temperate	All districts Kashmir Zone
		(iii) King Roat	45-50 t/ha	Temperate	All districts Kashmir Zone
		(iv) Jeromine	45-50 t/ha	Temperate	All districts Kashmir Zone
		(v) Zad 1	45-50 t/ha	Temperate	All districts Kashmir Zone
2.	Pear	(i) Carmine	25-30 t/ha	Temperate	All districts Kashmir Zone
		(ii) Red Bartlett	25-30 t/ha	Temperate	All districts Kashmir Zone
		(iii) Conference	25-30 t/ha	Temperate	All districts Kashmir Zone
		(iv) Doyenne-du Comice	25-30 t/ha	Temperate	All districts Kashmir Zone
		(v) Kashmiri Nakh	35-40 t/ha	Temperate/ Intermediate	All districts Kashmir Zone

⁴⁹ Tomuri (male) variety has been recommended as a pollinator for the high yielding kiwi cultivars [https://agrianic.com/guides/guide-to-kiwi-varieties/#:-:text=Tomuri%20\(Male%20Pollinator\),Why%20Grow%20Tomuri?](https://agrianic.com/guides/guide-to-kiwi-varieties/#:-:text=Tomuri%20(Male%20Pollinator),Why%20Grow%20Tomuri?)

S.No	Fruits	Five Best Varieties Identified	Yield Potential of Each Variety	Agro-Climatic Zone	Districts
3.	Plum	(i) Santa Rosa	20–25 t/ha	Temperate	All districts – Kashmir Zone
		(ii) Frontier	18–22 t/ha	Temperate	All districts – Kashmir Zone
		(iii) Stanley	20–25 t/ha	Temperate	All districts – Kashmir Zone
		(iv) Methley	15–20 t/ha	Temperate	All districts – Kashmir Zone
		(v) Black Amber	20–25 t/ha	Temperate	All districts – Kashmir Zone
4.	Sweet Cherry	(i) Stella	8–12 t/ha	Temperate	All districts – Kashmir Zone
		(ii) Bing	10–12 t/ha	Temperate	All districts – Kashmir Zone
		(iii) Rainier	8–10 t/ha	Temperate	All districts – Kashmir Zone
		(iv) Lapins	12–15 t/ha	Temperate	All districts – Kashmir Zone
		(v) Regina	10–12 t/ha	Temperate	All districts – Kashmir Zone
5.	Apricot	(i) CITH Apricot 1	15–18 t/ha	Temperate	All districts – Kashmir Zone
		(ii) CITH Apricot 2	18–20 t/ha	Temperate	All districts – Kashmir Zone
		(iii) New Castle	12–15 t/ha	Temperate	All districts – Kashmir Zone
		(iv) Harcot	12–15 t/ha	Temperate	All districts – Kashmir Zone
		(v) Rival	12–15 t/ha	Temperate	All districts – Kashmir Zone
6.	Peach	(i) Redhaven	20–25 t/ha	Temperate/ Intermediate	All districts – Kashmir Zone
		(ii) Elberta	18–22 t/ha	Temperate/ Intermediate	All districts – Kashmir Zone
		(iii) July Elberta	18–20 t/ha	Temperate/ Intermediate	All districts – Kashmir Zone
		(iv) JH Hale	15–20 t/ha	Temperate/ Intermediate	All districts – Kashmir Zone
		(v) Florida sun	15–18 t/ha	Temperate/ Intermediate	All districts – Kashmir Zone
7.	Almond	(i) Waris	3.0 - 4.0 t/ha	Temperate	All districts – Kashmir Zone
		(ii) Makhdoom	3.0 - 4.0 t/ha	Temperate	All districts – Kashmir Zone
		(iii) Pranyaj	3.0 - 4.0 t/ha	Temperate	All districts – Kashmir Zone
		(iv) Shalimar	3.0 - 4.0 t/ha	Temperate	All districts – Kashmir Zone
		(v) Non-pareil	3.0- 4.0 t/ha	Temperate	All districts – Kashmir Zone
8.	Walnut	(i) CITH-W1	3–4 t/ha	Temperate	All districts – Kashmir Zone
		(ii) CITH-W2	3–4 t/ha	Temperate	All districts – Kashmir Zone
		(iii) CITH-W3	3–4 t/ha	Temperate	All districts – Kashmir Zone
		(iv) Sulaiman	2.5–3.5 t/ha	Temperate	All districts – Kashmir Zone
		(v) Hamadan	2.5–3.5 t/ha	Temperate	All districts – Kashmir Zone

Source: SKUAST-Kashmir

4.1.3 Breeding for Introgression and Development of Desirable Traits in Commercial Varieties

In order to address the existing gaps in trait availability in horticultural crops, focused breeding programs may be undertaken. Trait-specific introgression is essential for developing varieties that address the issues related to disease resistance, climate adaptability, consumer

preferences and market demand. Special traits should be introgressed in crops like apple (scab resistance, enhanced shelf life), pear (scab resistance, self-fruitfulness), walnut (lateral bearing), almond (self-fruitfulness, late blooming), cherry (self-fruitfulness), apricot (sweet kernel, drying type varieties) etc. (Table 4.3).

Table 4.3: Traits available and Recommended for Introgression in Commercial Varieties of Different Crops Through Various Strategies

S. No	Crop	Trait	Gene	Source	Breeding strategy
1.	Apple	Scab resistance	Vf (Rvi6)	Prima, M. floribunda	MAB / Cisgenics
		Fire blight resistance	Dm-1	M. floribunda	Cisgenics
		Alternaria resistance	Alt-1	M. seiversii	Cisgenics
		Precocity	TFL	Not known	Genome editing
		Columnar nature	Co	Wijcik	MAB
		Woolly apple aphid resistance	Er	Northern Spy	Cisgenics
		Rosy apple aphid resistance	Smh	M. robusta	Cisgenics
		Rosy curling aphid resistance	Sd	Malus robusta, 'McIntosh	Cisgenics/MAB
2.	Pear	Scab resistance	Rvn/Rvi1	Pyrus ussuriensis, Bartlett (Williams), Beurre Hardy	MAB
		Pear psylla resistance	Py/Rvp1	Karamanka, Jerisbasma, Vodenjac	Hybridisation /MAB
3.	Walnut	Lateral bearing	L	Chandler, Fernor	Hybridisation/MAB
		Precocity	Jrhd1	Not known	MAB
4.	Almond	Self-fruitfulness	Sf	Independence, Shasta, Tuono	Hybridisation/MAB
		Late blooming	Lb	Tardy Nonpareil, Ferragnese, Ferralise	Hybridisation/MAB
		Sweet kernel	Ma/Sk	Prunus fenzliana	Cisgenics
5.	Cherry	Self-fruitfulness	Sf	Stella, Sweetheart, Lapins	Hybridisation/MAB
6.	Apricot	Sweet kernel	Ma/Sk	Prunus brigantina	Cisgenics

4.1.4 Use of Proven Technologies and Germplasm Exchange

Technological advancements play a pivotal role in driving innovation, enhancing productivity, and safeguarding genetic diversity. From production, protection, post-harvest management, structural engineering, precision breeding techniques, and advanced germplasm exchange networks, the integration of cutting-edge technologies enables fruit growers, breeders, and researchers to unlock new frontiers of excellence and sustainability. Technologies that have shown promise for enhancing the yield and quality of fruit crops are to be used and exchanged across the fruit-growing areas to ensure nutritional security (Table 4.4).

Modern technologies have transformed the field of horticulture in many ways, enabling farmers to improve efficiency, productivity, and sustainability.

	Precision Farming Technologies: GPS, drones and sensors help farmers to monitor and analyse their crops, soil, and weather conditions with high precision, leading to optimised crop yields and reduced waste.
	Automation and Robotics: Improve productivity, reduce labour costs, and minimise environmental impact.
	Biotechnology: Advances such as genome editing, marker-assisted breeding, molecular diagnosis and prognoses, allele mining, genetic fidelity testing, virus indexing, etc., have enabled farmers to produce crops that are more resistant to pests, diseases, and adverse environmental conditions, leading to higher crop yields and improved food quality and safety.
	Data analytics and artificial intelligence provide valuable insights and predictions about crop growth, yields, and disease outbreaks, helping farmers to make informed decisions.
	Sensors and IoT Devices: Electronic nose sensors, electrochemical sensors, and biosensors offer rapid and precise plant health assessments, enabling timely interventions.
	Cloud Computing and Big Data Analytics: Easy access to real-time data empowers farmers to make informed decisions, optimise inputs, reduce costs and increase profitability.

Moving forward, establishing robust germplasm exchange networks and partnerships with national and international research organisations will be crucial to access superior genetic material and best-in-class technologies.

Table 4.4: Status of Proven Technologies and Way Forward

Name of the Technology	Present Status of Adoption	Impact	Way-forward
High-Density Plantation	Adopted in apple (>3000 ha)	Increases yield (up to 50-60 t/ha) and quality	Application in other crops
Production of feathered plants	Developed for apple only	Improves plant canopy and induces precocity	Application in other crops
Clonal rootstock multiplication under protected conditions	Developed for apple clonal rootstock through air-layering and mounding	Increases multiplication rates five times, and hence the revenue.	Need large-scale commercialisation to reduce imports.
Propagation of walnut under polyhouse	Adopted by farmers and nurserymen	Increases the success rate by 85%	Need infrastructure support for farmers
Rejuvenation of old and senile orchards	Standardised for apple and almond	Improves yield and quality	Replacement of old varieties with new ones in other crops.
Virus diagnosis through multiplexing	Done for apple viruses (ApMV, ApNMV, ASPV & ASGV)	Simultaneous detection of multiple viruses and thus saves time and inputs.	Multiplexing for other viruses in other fruit crops

Name of the Technology	Present Status of Adoption	Impact	Way-forward
Canopy management of orchards	Specified for fruits and nuts, and timely refinements are being done with more advanced systems like Tall Spindle in apple; tatura trellis in peach; espalier system in grapes, apple, and pear; Kniffin system in grapes	Increases the yield and quality of fruits. The number of grade A fruits is increased with better market demand and consumer acceptability due to better light penetration and diffusion.	Adoption by the farmers and infrastructure support are required.
Pollination management	Number of pollinators and proportion of pollinisers standardised in cross-pollinated crops like apple, pear, almond, cherry etc.	Increases the yield and ensures better returns.	Awareness and support with respect to the exact requirements of pollinator and polliniser is needed.
Fruit load management	Technologies for thinning and fruit drop management standardised in crops like apple, pear, cherry, peach etc.	Optimum fruit size and quality	Recommendations for time and dosage of chemicals, and also for manual thinning SOPs and procedures, need to be developed.
Smart sprayer-Target-sensing sprayers	Standardised in apple in other apple-growing countries	Reduced application rates of pesticides and non-subject orchard soil deposition	The same system should be adopted in the apple-growing states of India
Use of artificial neural networks	Developed in apples in other apple-growing countries	Effective identification of pests by analysis of a model.	The same system should be adopted in India
Application of the plant protection product system with measurement sensing	All crops	Precise application of chemicals and directing the air flow and the dosage rate properly to each tree canopy.	New projects and programmes need to be initiated.
Use of robotics, sensors, AI and drones	Programmes initiated in India by ICAR, SAUs, IITs, and CDAC for apple harvesting, nutrient scheduling, pesticide application, etc.	Increases the production efficacy and saves inputs and labour.	Awareness, training, and a participatory approach in the PPP may be initiated.

Available and proven technologies should be scaled up, commercialised, popularised and adopted on a large scale with immediate action through public-private partnership, farmer participatory approaches, trainings, workshops, use of cooperatives, custom hiring centres for modern equipment access, etc. However, shortly, emphasis should be given on the development and use of modern technologies and machinery in horticulture through international and national collaborations, envisaging new projects, programmes

and schemes. Bridging critical gaps in productivity, quality, and domestic availability and export readiness hinges on targeted technological interventions.

4.2 Strategy II: Establishment and Upgradation of Hi-Tech Nurseries and Promoting Quality Seeds and Planting Materials

Nurseries are the backbone of horticulture, focusing on plant propagation and early-stage crop development. Most farmers use their own or local market seedlings, often leading to poor field performance. Further, the demand for quality planting material is expected to rise rapidly with replanting, expansion, and high-density plantation schemes. The establishment of hi-tech nurseries will optimise resource use, enhance crop turnover, foster innovation, and support sustainable pest management, significantly boosting productivity, quality, and sustainability in horticulture.

4.2.1 Setting up Hi-Tech Nurseries and Modern Facilities

Key Steps for Establishing Hi-Tech Nurseries:

	Site Selection and Infrastructure Development: Identify suitable sites and establish polyhouses/greenhouses, climate control systems, and advanced irrigation facilities.
	Integration of Modern Technologies: Incorporate sensor-based monitoring, automated rota, and controlled-environment systems. Follow biosecurity measures.
	Crop Selection and Propagation Systems: Focus on market-driven crops and adopt best practices in seedling and cutting propagation.
	Capacity Building and Continuous Improvement: Train nursery managers and workers, and regularly upgrade technologies and practices.

Modern Facilities in a Hi-Tech Nursery: Modern hi-tech nurseries need to be equipped with state-of-the-art facilities to ensure optimal propagation conditions, resource efficiency and automation:

	Irrigation system: Drip irrigation, sprinkler irrigation, boom irrigation, misting/fogging, flooding and draining table, capillary mat, hose pipe watering and hand watering unit.
	Sensors: Temperature sensor (thermostat, thermistor, circuitry), humidity sensor, light sensor, artificial leaf sensors, balance arm sensors and radiant energy sensors required.
	Fertigation unit: To apply water-soluble fertilisers to the plants through micro-irrigation (constant feed or intermittent application) using a venturi or multiple head injectors.
	Heating unit: Unit heaters (vertical or horizontal), heat convector, radiant heater (normal or infra-red), overhead forced air, bottom radiating, steam heater, heating stove, thermal screen, warm water pipes etc., controlled by thermostat. A warm water heating system or bench heating system is used for root zone heating. Nowadays, solar heating systems is gaining importance.
	Cooling unit: Fan-Pad systems, fan-tube ventilation, fogging/misting unit, evaporative swamp cooler, retractable roof, roll-up walls, shading, liquid shade paint, forced air ventilation system, horizontal airflow fans, etc.
	Agro-chemical application unit: Portable sprayer, duster, fumigator, ultra-volume applicators (mist blower, spinning disk ULV applicator, electrostatic ULV applicator), vibrajel, controlled droplet applicator, aerosol applicator, fogger, root media feeder, etc.
	Photoperiodic lighting: High-intensity discharge (HID) lamps and low-pressure sodium (LPS) lamps for controlled germination and flowering.
	Propagation and nursery tools: Budding and grafting knife, garden knife, secateurs, scissors, pruning shears, sprayers, spade, rake, water hose, watering can, hoe, weeder, soil scoop, trowel, etc.



Digital and automation technologies:

- Sensor and AI-based greenhouse automation
- Robotics and drones for greenhouse management, like weeding, harvesting, spraying
- Greenhouse and nursery management software: Use of IT tools for greenhouse operation, expert system and record keeping.

4.2.2 Ensuring Supply of Quality Planting Material

To ensure the supply of quality planting material following is needed:



Enforcement of the Nursery Registration Act: Enforcement of Nursery Registration Act is essential to be enforced and followed. The Department of Horticulture must exercise comprehensive oversight over both public and private nurseries to ensure the production and availability of quality planting material.



Accreditation: Each nursery needs to be accredited by a national-level accreditation agency, such as the National Horticulture Board, to standardise quality and operational practices. A dashboard may be developed to onboard all private and public nurseries and their online registration.



Establishment of Mother Orchards: Establishment of Mother Orchards for strengthening of bud wood.



Efficient Monitoring: Each nursery in the public sector should be headed by a Horticulture Development Officer, and he/she shall be responsible for monitoring the raising of the plant material in the private sector nurseries within their jurisdiction.



Optimum Infrastructure: Nurseries in the public as well as private sectors must be supported with essential infrastructure. The visits of experts must be mandatory at least twice a year for operating a nursery.



Mass Multiplication: Growing of plants by tissue culture technology must be prioritised both in the public as well as private sectors. Mass multiplication of plants is to be encouraged.



Establishment of Quality Control Labs, Disease Diagnosis, Soil and Water Analysis Labs: Facilities like plant material quality control labs, disease diagnosis, soil and water analysis labs must be developed to cater to different zones.



Implementation of a Robust Certification and Traceability System: An efficient certification system of the quality planting material needs to be developed for traceability.

4.2.3 Strategic Approach to Promote Quality Planting Material Production Hubs

Hi-tech Nurseries

- Production potential should be more than 1 lakh plants/year.
- Development of Mother blocks of new elite varieties (scion and rootstock varieties).
- Geo-tagging of all plants for traceability and genuineness.
- QR coding of each plant for real-time scanning of details.
- Registration with NHB/ Development departments and Clean Plant Programme (CPP) network (in future).
- Establishment of crop-specific nurseries (diverse crops including new generation crops like blueberry, plumcots, olive, kiwi fruit, prunes, etc.).

Micro Propagation or Tissue, or in Vitro Culture

- Protocols for large-scale production of virus-free planting material need to be applied in crops like apple, walnut and other crops having a huge demand for planting material.

Quality, Fidelity and Standard Testing

- Production of high-quality plants (feathered and knip trees in apple) should be tested before their commercialisation.
- The fidelity and true-to-type nature of plants need to be ensured by employing the latest molecular tools.

Disease Diagnosis and Management Facilities

- Laboratory facility with the art for virus indexing (immune molecular testing), disease diagnosis and prognosis.
- Disease management strategies/protocols for the production and supply of disease-free planting material.

Marketing and Record Management

- Current marketing systems for nursery plants are inadequate. To enhance value realisation:
- Nurserymen should emphasise production and quality of the planting materials (free from pests and diseases, uniform in size and high in vigour).
- Proper and attractive packing for graded saplings, accompanied by nice labelling with an attractive display for nursery plants at the sale counter, is necessary.
- Plants should be handled carefully during transport to avoid damage to the planting materials, to reach the customers in a better condition, which will fetch a better price.
- The nursery should supply the catalogue or pamphlets containing the detailed information related to planting, handling and management of the plants offered for sale (use of blockchain technology).
- Nurseries should be accredited by NHB.

To ensure year-round availability of disease-free, high-quality planting material, the following measures are proposed:



Establish modern (Hi-Tech) nurseries across districts, each spanning 40-50 ha.



Develop these nurseries integrating cutting-edge technologies like hydroponics, aquaponics, vertical farming, precision farming and tissue culture units.



Adoption of renewable energy solutions, including solar panels and biogas plants, to promote environmental sustainability.



Implement practices like rainwater harvesting and waste-to-energy conversion to reinforce the commitment to sustainable farming practices.

Planting material hubs in both regions (Jammu and Kashmir) are crucial for the region's horticulture development. These hubs serve as centres for the production and distribution of high-quality seeds, seedlings, and other planting materials to local farmers. They ensure that farmers have access to resilient and productive varieties of crops suited to the region's climate and soil conditions, ultimately boosting agricultural productivity and livelihoods in the area. These hubs also play a vital role in promoting sustainable farming practices and enhancing food security in the region.

4.3 Strategy III: Crop Diversification for Sustainable Horticulture Growth

Crop diversification is a multifaceted strategy that involves cultivating a variety of crops within a particular area/region rather than relying solely on a single crop. This approach offers numerous benefits to the farming communities, including reduced risk of crop failure due to pests, diseases, or adverse weather conditions, improved soil health, enhanced resilience to climate change, and increased economic returns through access to diverse markets. In J&K, where agro-climatic zones vary from temperate to sub-tropical, crop diversification can unlock significant ecological and economic benefits.

Implementing crop diversification requires a systematic approach, which involves careful planning, assessment of local conditions, market analysis, risk management, and collaboration among stakeholders. By leveraging local agro-climatic conditions, identifying potential clusters and

aligning with market opportunities, and stakeholder collaboration, farmers can promote sustainable agricultural development and enhance their economic returns over the long term.

4.3.1 Promoting Region-Specific Crop Diversification

The diverse agro-climatic zones of J&K offer a unique opportunity to expand and optimise horticulture across temperate, mid-hill and sub-tropical regions. By focusing on regionally suitable crops such as apples, saffron, walnuts, cherries, and apricots in the temperate zones, alongside promoting vegetables, flowers, and medicinal plants in the lower altitudes, the UT can capitalise on its natural strengths.

(i) Diversification Through Minor and Underutilised Fruit Crops

The identification, characterisation, conservation and sustainable utilisation of new and underutilised fruit species are key to improving productivity and sustainability. Variability in climatic conditions and increasing frequency of short-term aberrations have raised uncertainty, vulnerability and risk in horticultural investments. With rising temperatures due to climate change, meeting winter chill requirements critical for many temperate fruit and nut crops will become increasingly difficult to cultivate.

The agro-ecological/phyto-geographical diversity of Western Himalayan Regions supports a wide array of both cultivated, underutilised and wild temperate horticultural crops. This has led to the development of a rich natural population at both species and genotypic levels. In the present context of climate change, diversification through the cultivation of underutilised horticultural crops is one of the possible solutions, as their cultivation can bridge the gap between rising demand and limited supply.

Recommended Strategies for Promoting Minor and Underutilised Fruit Crops are:

	Planned exploration of minor temperate fruit species and wild taxa with commercial potential.
	Introduction of new crops and varieties with traits suited to local agro-climatic conditions.
	Development of agronomic practices tailored to minor fruit crops once established in field gene banks.
	Conservation strategies include both in situ and ex-situ approaches, such as field gene banks, in vitro conservation, and cryopreservation.
	Molecular characterisation of underutilised fruit species to identify useful genes and molecular markers for future breeding efforts.
	Exploration of value addition and product diversification to expand economic uses of minor crops.

Given the UT's climatic diversity, government support is essential for promoting high-value crops suited to specific regions. For instance:

- Blueberries in acidic soils (pH < 5)
- Almonds can be promoted in the Karewa areas
- Kiwi and olives in regions with extended summers (e.g., Ramban in Jammu, Uri in Kashmir)
- Kala Zeera in Gurez
- Saffron in Pulwama and Kishtwar

(ii) Crop Diversification Strategies

	Inclusion of new generation fruit crops: Introduce and promote crops like blueberry, hazelnut, pecan, pistachio, dragon fruit, persimmon, kiwifruit, olive, blackberry, gooseberry, ber, sea buckthorn etc. to the existing fruits crop profile including apple, pear, cherry, apricot, peach, plum, nectarine, prune, strawberry.
	Promotion of water-efficient, organic crops: Encourage crops that can be grown organically with limited water use, like olive, kiwi fruit, hazelnut, etc.
	Shift toward high-yielding, high-value crops that meet national and international market demands from low-yielding and low-value crops.
	Promotion of energy-efficient crops: Favour fruit crops that offer higher energy efficiency in production and post-harvest management.

Based on a comprehensive assessment of the key factors influencing crop selection for adoption across different agro-climatic zones of the Jammu and Kashmir region, the following recommendations are proposed, as presented in Tables 4.5 and 4.6.

Table 4.5: Proposed Crop Diversification Models in Jammu Region

S. No.	Key focus crops	Agro-climatic zone	Districts	Suggested coverage in next 5 years	Proposed Crop Diversification Models
1.	Mango	Subtropical zone	Jammu, Samba, Kathua, Udhampur	100 ha	Mango hybrids in high density 5X5m with seasonal vegetables/ strawberry as intercrops
2.	Guava	Subtropical and intermediate zone	Jammu, Samba, Kathua, Udhampur, Reasi, Rajouri	250 ha	Best Guava Cultivars with seasonal vegetables intercrops
3.	Citrus	Subtropical and intermediate zone	Jammu, Samba, Kathua, Udhampur, Reasi, Rajouri	250 ha	Sweet Orange cultivation, Lime cultivation, Kinnow in lower belts
4.	Walnut	Intermediate to temperate	Rajouri, Reasi Udhampur, Ramban, Kishtwar, Doda, Poonch and Kathua	100 ha	Lateral bearing cultivars grafted plants.
5.	Pecan nut	Intermediate zone	Rajouri, Reasi Udhampur, Ramban, Kishtwar, Doda, Poonch	50 ha	Fertile cultivars/Grafted plants
6.	Apple	Temperate areas/mid hills	Doda, Kishtwar, Rajouri, Reasi, Udhampur, Kathua	500 ha	High density and medium density orcharding on clonal rootstocks
7.	Pear	Temperate areas/mid hills	Doda, Kishtwar, Rajouri, Reasi, Udhampur, Kathua	100 ha	Best cultivars in higher densities
8.	Stone fruits	Temperate areas/mid hills	Doda, Kishtwar, Rajouri, Reasi, Udhampur, Kathua	100 ha	Peach/plum/apricots/ prunes
9.	Kiwi fruit	Mid Hills	Udhampur, Rajouri, Reasi, Kathua, Poonch, Ramban	100 ha	Best cultivars in higher densities

S. No.	Key focus crops	Agro-climatic zone	Districts	Suggested coverage in next 5 years	Proposed Crop Diversification Models
10.	Blue Berries	Mid hills	Reasi, Udhampur, Rajouri	10 ha	Imported varieties
11.	Almonds/ hazelnuts	Mid hills/ Temperate hills	Kishtwar/Udhampur, Rajouri, Ramban, Doda	10 ha	Imported cultivars
12.	Persimmon and Pomegranates	Mid hills	Rajouri, Udhampur, Ramban, Kathua, Reasi	25 ha	Best cultivars in higher densities
13.	Avocado	Mid hills	Rajouri, Udhampur, Ramban, Kathua, Reasi	10 ha	Imported varieties to be tried

Source: SKUAST- Jammu

Table 4.6: Proposed Crop Diversification Models in Kashmir Region

S. No.	Key focus crops	Agro-climatic zone	Districts	Suggested coverage in next 5 years	Proposed Crop Diversification Models
1.	Apple (High-density), apple traditional, Walnut, Pear	Temperate	Kashmir Valley: Srinagar, Budgam, Ganderbal, Baramulla, Kupwara, Anantnag, Kulgam, Shopian, Pulwama	Expand HD orchards by 25–30%, rejuvenate old orchards, introduce spur-type cultivars	Apple–Walnut–Pear integrated orchards; HD Apple + Berry hedgerows; Intercropping with shade-tolerant vegetables/herbs
2.	Cherry, Plum, Apricot	Temperate	Ganderbal, Srinagar, Baramulla, Kupwara, Tangdhar, Karnah	Increase area by 3000–4000 ha, develop cluster-based production	Stone fruit blocks; Cherry–Apricot–Plum rotational orchards; Off-season fresh fruit production
3.	Almond, Fig, Pecan, Persimmon	Intermediate/ Temperate Transition	Rajouri, Poonch, Udhampur, Ramban, Doda	Introduce new nut crops in 1500–2000 ha	Almond–Fig orchards; Dryland Nut Blocks; Persimmon + Fodder tree agroforestry
4.	Kiwifruit, Olive and stone fruits	Intermediate/ Temperate Transition	Ramban, Baramulla (Uri)	Introduce new varieties of kiwi and olive in about 150–200 ha	Kiwifruit–Olive–peach–plum
5.	Citrus (Kinnow, Lemon, Lime)	Subtropical	Jammu, Kathua, Samba, Udhampur, Reasi	Expand area under improved/certified planting material by 5000 ha	Citrus–Guava multi-tier system; Lemon + Vegetable + Citrus
6.	Guava, Aonla, Avacado, Ber, Pomegranate	Subtropical/ Dry	Jammu Division: Kathua, Samba, Jammu, Reasi	Increase area by 7000 ha	Arid Fruit Blocks; Ber–Guava–Pomegranate model; Pomegranate + Medicinal Plants

S. No.	Key focus crops	Agro-climatic zone	Districts	Suggested coverage in next 5 years	Proposed Crop Diversification Models
7.	Blueberries, blackberries, strawberry and other minor crops	Temperate	Foothills having soil pH range of <5.5 (for blueberries) and >6.5 for other minor crops.	Introduce berries in about 1000 ha (both open and controlled)	HD orchards with berry understory; Strawberry tunnels; Berry + floriculture integration
8.	Vegetables (Exotic, Off-season, Hydroponic/ Aquaponic)	All zones	All districts	Increase protected cultivation by 6000–8000 units	Floating vegetable gardens (Dal/Nigeen); Off-season polyhouse vegetables; Aquaponics + leafy greens
9.	Floriculture (Lavender, Marigold, Gladiolus)	Intermediate/ Temperate	Kulgam, Pulwama, Budgam, Doda, Kathua	Area expansion in 3000 ha	Lavender–Apple intercropping; Cut-flower clusters; flower gardens (Lavender, Marigold, Gladiolus)
10.	Saffron and High-value Spices	Temperate/ Intermediate	Pampore, Pulwama, Budgam, Kishtwar	Expand saffron to new uplands (1500 ha), strengthen GI value chain	Saffron–Almond–Rose spice model; Drip-based precision saffron blocks
11.	Kala Zeera, potato, vegetable root crops, early maturity crops	Temperate	Bandipora (Gurez)	200 ha	Kala zeera - potato - root vegetables - beans
12.	Spices, organic vegetables, subtropical horticultural crops including dragon fruit.	Subtropical/ Intermediate	Kathua, Jammu, Samba, Udhampur and Doda	500 ha	Species - vegetables - dragon fruit' Dragon fruit + Aloe vera (low-water intercrop

Source: SKUAST-Kashmir

4.4 Strategy-IV: Research and Innovation

In view of the evolving climate conditions, resource constraints, rising market demands, and rapid technological advancements, strengthening research and innovation is critical for achieving sustainable growth in J&K's horticulture sector and supporting farmers, including smallholders, in adapting to future challenges.

4.4.1 Promoting Advanced Crop Management Practices

Advanced crop management practices encompass a range of innovative techniques and strategies aimed at optimising crop yield, quality, and sustainability.

Some of the key advanced crop management practices for high yield and quality are:

- | | |
|---|--|
| <ul style="list-style-type: none"> • Precision Agriculture • Integrated Crop Management (ICM) • Conservation Agriculture • Smart Irrigation Techniques • Climate-Smart Agriculture | <ul style="list-style-type: none"> • Canopy Management • Pollination Management • Orchard Nutrition Management • Orchard Floor Management • Orchard Irrigation Management |
|---|--|

Key action areas include:

Promote the adoption of advanced crop management practices through Krishi Vigyan Kendras (KVKs), farmer field schools and local horticulture innovation hubs.

Build farmers' capacity through on-field demonstrations, targeted training programs and extension activities on best agronomic practices.

Facilitate access to affordable finance to enable farmers, particularly smallholders, to invest in advanced crop management practices.

4.4.2 Encouraging R&D with National and International Collaboration

Encouraging national and international collaborations in horticulture is crucial for leveraging digital technologies to transform the industry. By encouraging partnerships and sharing knowledge, stakeholders can enhance productivity, sustainability and resilience. Continued investment in collaborative R&D will be a key to addressing challenges of climate change, promoting sustainable practices and ensuring long-term viability.

(i) Pre-Harvest

Proposed Collaborations:

- | | |
|---|--|
|  | National Collaboration in Horticultural R&D: Foster partnerships among government agencies, research institutions, universities, extension services, industry associations, and farmers to facilitate knowledge exchange, capacity building, and technology transfer. |
|  | International Collaboration in Horticultural R&D: Promote cooperation among countries, research organisations, and development agencies via joint research projects, exchange programs, workshops, and technology transfer agreements. |
|  | Harnessing Digital Horticulture through Collaboration: Advance plant breeding, genetic engineering, and biotechnology to develop resilient, stress-tolerant, and nutritious plant varieties by jointly developing and validating digital tools tailored to local needs. |

(ii) Post-Harvest

R&D is crucial for advancing post-harvest processing in J&K's horticulture sector. It enhances product quality, extends shelf life, adds value through innovation, reduces waste, and improves market competitiveness. Key areas to enhance post-harvest processing are:

- | | |
|---|---|
|  | Infrastructure and Facility Improvement: Upgrade and modernise facilities like cold storage units, packaging centres and processing plants with energy-efficient technologies and automation. |
|  | Quality Enhancement and Preservation Techniques: Develop methods such as vacuum cooling, modified atmosphere packaging, and innovative preservation techniques. |
|  | Value Addition and Product Diversification: Promote research and innovation to create processed products like juices, jams, and dehydrated fruits to meet market demands and explore export opportunities. |

	Waste Reduction and By-product Utilisation: Minimise post-harvest losses and find innovative uses for by-products to enhance sustainability.
	Quality Standards and Certification: Establish and enforce standards for food safety, labelling, and traceability to build consumer trust and facilitate market access.
	Capacity Building and Knowledge Transfer: Provide training and support for stakeholders through extension programs and workshops.
	Innovation and Entrepreneurship: Foster innovation in horticulture through research grants, incubators, and support for Agri-tech startups.
	Digital Horticulture Initiatives: Implement IoT devices, digital platforms for quality assessment, blockchain for traceability, and data analytics for predictive modelling to optimise efficiency and reduce waste.
	International Collaboration: Bridge technological gaps and enhance knowledge exchange through global partnerships.

4.4.3 Integrating Innovative Technologies for Better Yield and Quality

Innovation has always been at the forefront of horticultural advancement, driving improvements in yield, quality, sustainability, traceability and market competitiveness. Key strategies include:

	Precision Agriculture: Use of GIS, GPS, drone technologies and soil sensors to optimise input application (e.g., water, fertilisers, pesticides) and maximise resource use efficiency.
	Biotechnology and Genetic Engineering: Apply advanced breeding techniques such as marker-assisted selection (MAS), gene editing (e.g., CRISPR-Cas9), and genetic modification (GM) to develop high-yielding, stress-tolerant horticultural crops.
	Digital Agriculture and Big Data Analytics: Deploy data-driven approaches and digital technologies such as remote sensing, Internet of Things (IoT), artificial intelligence (AI) and machine learning (ML) to optimise farming practices and decision-making processes. By collecting and analysing large volumes of data on soil, weather, crop health and machinery performance, digital agriculture enables farmers to make timely and informed decisions.
	Controlled Environment Horticulture (CEH): Promote hydroponics, vertical farming and climate-controlled greenhouse models to enhance year-round production and reduce climate vulnerability.
	Robotics and Automation: Integrate drone, robotic planters, harvesters and smart sprayers to ensure operational efficiency.
	Blockchain and Traceability: Establish end-to-end blockchain-based systems for tracking and tracing agricultural products throughout the supply chain. This enhances trust, transparency, and accountability, leading to improved market access, premium pricing, and consumer confidence in the quality and safety of agricultural products.

The integration of innovative technologies holds immense potential for transforming horticulture in J&K. By harnessing precision horticulture, biotechnology, digital agriculture, controlled environment horticulture, robotics and blockchain, farmers can optimise production practices, minimise risk, and meet the evolving demands of consumers and markets. Collaboration among stakeholders, supportive policies, and investments in research and development are essential for accelerating the adoption and integration of innovative technologies in agriculture.

4.4.4 Promoting Off-Season Cultivation

Promoting off-season cultivation in the UT is crucial for ensuring food security, enhancing farmer income and reducing reliance on seasonal crops. To achieve this, concerted efforts are needed across various fronts.

Collaborations with research institutions can drive the development of new crop varieties adaptable to off-season conditions. Knowledge dissemination on best practices and market linkages can ensure farmers have access to markets for their off-season produce. Supportive policies and regulations, such as favourable pricing mechanisms and tax incentives, can create an enabling environment for off-season cultivation. By implementing these strategies in a coordinated manner, the UT can harness the potential of off-season cultivation to mitigate climate risks, increase productivity, and improve livelihoods.

(i) Strategies to Promote Off-Season Cultivation

	Financial Incentives: Offer financial incentives such as subsidies, grants, and low-interest loans to farmers for investing in infrastructure for off-season cultivation, such as polyhouses, greenhouses, and drip irrigation systems.
	Technical Support: Provide farmers with technical assistance, training programs, and access to experts to help them adopt modern cultivation techniques suited for off-season production.
	Research and Development: Invest in R&D to develop new varieties of crops that are suitable for off-season cultivation and can thrive in controlled environments. Collaborate with agricultural universities and research institutions to conduct studies and trials.
	Extension Services: Strengthen agricultural extension services to disseminate information and best practices related to off-season cultivation. Conduct workshops, seminars, and field demonstrations to educate farmers about the benefits and methods of off-season production.
	Market Linkages: Facilitate market linkages for off-season produce by establishing partnerships with retailers, wholesalers, and food processing companies. Create marketing channels and distribution networks to ensure that farmers have access to markets for their off-season crops.
	Policy Support: Develop supportive policies and regulations that incentivise off-season cultivation, such as favourable pricing mechanisms, tax incentives, and insurance schemes to mitigate risks associated with climate variability.
	Awareness Campaigns: Launch awareness campaigns targeting farmers, policy makers, and consumers to highlight the importance of off-season cultivation in enhancing food security, generating income, and mitigating the effects of climate change.
	Demonstration Farms: Establish demonstration farms or model farms where farmers can observe first-hand benefits and techniques of off-season cultivation. These farms can serve as learning centres and hubs for knowledge exchange.
	Partnerships: Foster partnerships between government agencies, private sector stakeholders, research institutions, non-governmental organisations, and community groups to promote off-season cultivation collaboratively. Pool resources, expertise and networks to achieve common goals.
	Monitoring and Evaluation: Implement robust monitoring and evaluation mechanisms to track the progress and impact of off-season cultivation initiatives. Use data and feedback to refine strategies and allocate resources effectively.

There are several advantages to off-season farming for customers, producers, and environment. Farmers can raise their income and production by lengthening their growing

seasons. Furthermore, growing produce in off-season minimises the need to import it from distant locations, reducing transportation expenses and carbon emissions. Off-season farming also benefits local economies and fosters food security by offering a steady supply of fresh, locally grown produce. By promoting off-season cultivation as part of a broader innovation ecosystem in horticulture, J&K can improve climate resilience, diversify cropping systems and boost rural livelihoods through science-led, market-driven strategies.

4.4.5 Developing Circular Economy Models for Zero Waste

A circular economy minimises waste and maximises resource efficiency by keeping products and materials in use for as long as possible. Implementing a circular economy approach is crucial for holistic horticulture development in J&K. This strategy focuses on reducing waste, maximising resource efficiency, and promoting sustainability. Adopting horticultural waste valorisation in the form of bioactive products for use in pharma and cosmetic industries not only reduces environmental impact but also opens up high-value economic opportunities. It conserves resources, enhances resilience to climate change and supports national and global sustainability goals. Embracing circular economy principles also fosters community engagement and ensures long-term growth while preserving the region's unique ecosystems.

(i) Pre-requisites for Developing Circular Economy Models



Baseline Assessment and Stakeholder Engagement: Conduct a comprehensive assessment of current waste generation practices and management systems across the horticulture sector. Engage with key stakeholders, including farmers, processors, government agencies, and waste management experts, to understand existing practices, challenges and potential interventions.



Identification of Waste Streams and Valorisation Opportunities: Identify major waste streams generated across the horticulture value chain, such as crop residues, fruit and vegetable discards, packaging waste, etc. Assess the potential for valorisation through recycling, composting, bio-energy production, and other circular economy approaches.



Research and Innovation: Allocate resources for research and innovation to develop technologies and processes for the efficient utilisation of horticultural waste. Collaboration with research institutions, universities, and technology providers to explore innovative solutions for waste valorisation and resource recovery.



Capacity Building and Training: Develop training programs and capacity-building initiatives to educate stakeholders about circular economy principles and sustainable waste management. Support farmers, FPOs, processors, and waste management professionals through skill development and technical assistance for adopting zero-waste practices.



Policy and Regulatory Framework: Review and revise policies and regulations to encourage circular practices in horticulture. Introduce incentives for waste valorisation, enforce compliance with environmental standards and align with broader circular economy missions at national and global levels.



Demonstration Projects and Pilot Initiatives: Launch pilot projects to showcase viable circular models in key horticulture zones. These demonstration sites can serve as learning hubs, illustrating the benefits of zero-waste strategies and enabling replication across the UT.



Market Development and Value Chain Integration: Explore opportunities to integrate circular economy principles into horticulture value chains, including collaboration with agro-industrial clusters and food processing units. Promote the development of markets for recycled products, organic fertilisers, bio-energy, and other value-added products derived from horticultural waste.

-  **Resource Mobilisation and Investment:** Leverage government schemes, international development finance, CSR funding, and private investments to build infrastructure and technologies required for circular models. Offer financial incentives, credit access, and risk mitigation tools to encourage private participation.
-  **Monitoring and Evaluation:** Set up performance indicators (e.g., waste reduction rates, resource recovery levels, and carbon savings) to assess progress. Conduct periodic evaluations to identify gaps and recalibrate strategies as needed.
-  **Knowledge Sharing and Collaboration:** Foster multi-stakeholder collaboration through seminars, innovation challenges, and knowledge-sharing platforms. Promote successful case studies and enable cross-learning among districts and institutions.



Fig 4.1: Circular Economy Model

A circular economy model for apple valorisation illustrates how waste can be transformed into valuable co-products (Fig. 4.3). This includes the use of energy-efficient juicers, water recycling systems, and the conversion of apple pomace, seeds, and peels into bioactive compounds, dietary fibre, seed proteins, or bioactive peptides through green extraction procedures, or directly to animal feed or bio-fuels. Extracted polyphenols can be used in functional foods or dietary supplements, thus reducing environmental waste while generating high-value revenue streams and improving the sustainability of the apple industry.

By embedding circular economy principles in the horticulture sector, J&K can transform waste into wealth, drive innovation-led growth, and lead the way in sustainable agriculture transitions.

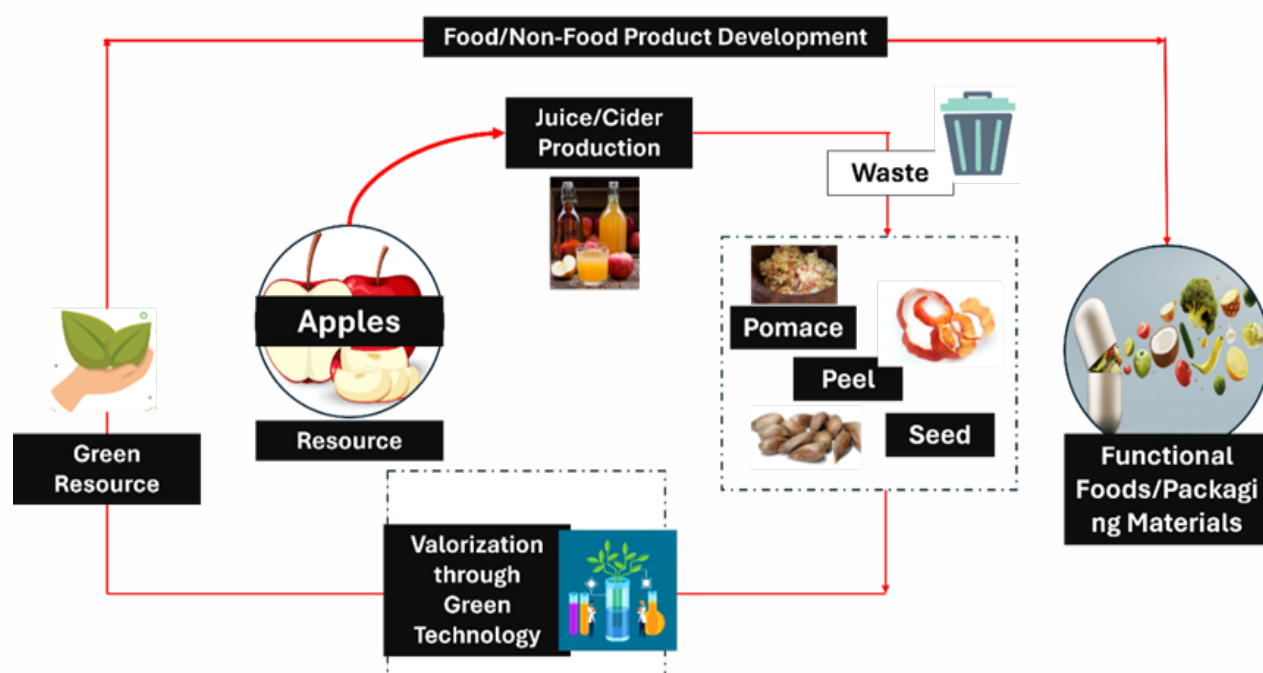


Fig. 4.2: Circular Economy Approach for the Valorisation of Apple Fruit

4.4.6 Innovative Product Development from Horticulture, including Niche Crops

There is a huge potential for processing and value addition of horticulture crops. By moving towards tertiary processing, new value-added products can be developed, which can yield high returns. Converting C-grade fruits into existing processed products or developing new ones can significantly boost the economy. A significant amount of agro-industrial waste from niche crops is generated, which can be utilised for the development of various value-added products in a circular economy approach. For e.g. Walnut shells can be converted to activated carbon, which fetches good prices in the local market. Similarly, various agro-wastes can be utilised for the development of innovative products based on economic and scientific feasibility. Some of the innovative value-added products developed from waste generated after the processing of niche crops are provided in Tables 4.7 and 4.8.

Table 4.7: Projected Cost Estimate of Innovative Products Developed

S. No.	Final product developed	Raw material utilised	Rate of raw material (₹. Per kg)	Recovery rate (%)	Amount of product developed (kg)	Rate of final processed product (₹ per kg)	Increase (%)
1	Apple Powder	25000 kg of C-grade apples	60	60	15,000	1000	90
2	Walnut Butter	7000 kg broken walnut kernel	800	80	5,600	1200	150
3	Activated Carbon	10,6,512 kg of walnut shell	-	70	75,000	200	—

**Table 4.8: Projected Cost Estimate Of Compounds Extracted From
By-products of Niche Horticultural Crops of J&K**

S. No.	Type of raw material used	Raw material utilised (tonnes)	Recovery rate (%)	The quantity of product developed (kg)	Final product developed	Rate of final processed product (₹ per kg)
1	Apple pomace	70,000	50	35,000	Apple Pectin	2000
2	Walnut hull	66570	40	26,628	Juglone dye	800
3	Saffron petals	1.76	50	0.875	Saffron extract powder	2000

4.4.7 Quality Improvement Strategies

To enhance the quality and marketability of horticultural produce in J&K, the following improvement framework is proposed:

	Baseline Assessment and Stakeholder Engagement: Assess current practices and challenges in quality management. Engage farmers, processors, researchers, and agencies to identify gaps and solutions.
	Identification of Priority Crops and Quality Parameters: Identify priority horticultural crops grown in the region, such as apples, cherries, saffron, almonds, walnuts, and citrus fruits. Define key quality metrics like size, colour, texture, nutritional value, and shelf-life.
	Research and Development: Allocate resources for R&D initiatives focused on improving the quality of horticultural crops. Collaborate with agricultural research institutions, universities, and industry experts to develop new varieties, cultivation techniques, and post-harvest management practices.
	Capacity Building and Training: Develop training programs and capacity-building initiatives farmers and stakeholders in Good Agricultural Practices (GAP), efficient irrigation, pest/disease management, harvesting methods and sustainable farming practices to enhance quality.
	Infrastructure Development: Invest in cold chains, processing units, transportation and packaging centers aligned with global standards.
	Quality Assurance and Certification: Establish quality assurance mechanisms throughout the horticulture value chain, including pre-harvest, harvest, post-harvest, and distribution stages. Encourage farmers and producers to obtain certifications such as Global GAP, Organic, and Fair Trade to ensure quality and sustainability.
	Branding and Market Access: Position J&K horticulture as a premium brand. Leverage GI tags and cultural value for differentiation in domestic and global markets.
	Monitoring and Evaluation: Establish monitoring and evaluation mechanisms to track the implementation and impact of quality improvement strategies. Regularly assess key performance indicators (crop yields, post-harvest losses, market acceptance, farmer income, consumer satisfaction).
	Policy Support and Collaboration: Advocate for supportive policies and regulatory frameworks that incentivise quality improvement initiatives and foster collaboration among stakeholders. Engage with government agencies, industry associations, and research organisations to coordinate efforts, share knowledge, and address systemic barriers to quality enhancement.

The framework for policy and support will focus on financing, insurance, and regulatory support tailored to smallholders, while establishing a dedicated regulatory body for quality standards.



Financing Support for Smallholders

- Offer subsidised loans through government schemes for smallholders to invest in inputs, irrigation systems, post-harvest infrastructure, and agroforestry models.
- Enable small and marginal farmers to access credit without land or high-value assets as collateral.
- Collaborate with regional banks and NGOs to introduce microcredit facilities for smallholder cooperatives.
- Provide grants for young and aspiring horticulturists to adopt innovative and climate-smart practices.
- Introduce mobile-based platforms for loan applications, insurance claims, and subsidy disbursements.



Crop Insurance and Risk Management

- Introducing weather-based crop insurance policies that protect farmers against climate-induced risks, such as frost, hailstorms, and erratic rainfall.
- Market-linked Insurance against price volatility to stabilise incomes when market prices fall below a threshold.
- Customisable Plans to offer insurance tailored to horticultural crops like apples, cherries, walnuts, and saffron, addressing their specific risks.



Regulatory Support and Quality Standards

- **Horticulture Development and Quality Standards Authority (HDQSA) to be established**
 - Regulate and enforce quality standards for produce, packaging, and processing.
 - Certify organic and sustainable farming practices to improve market competitiveness.
 - Monitor the use of pesticides and fertilisers to align with global safety norms.
 - Promote Geographical Indication (GI) tagging for regional products.
- **Quality Control Infrastructure**
 - Establish testing laboratories for soil, water, and produce quality at district levels.
 - Develop regional certification centers for organic and export-quality horticultural products.



Monitoring and Evaluation Framework

- Develop a performance monitoring system for policies and programs, tracking key indicators like productivity, farmer incomes, and adoption rates of sustainable practices.
- Set up grievance redressal mechanisms to address farmer concerns related to loans, insurance, or market access.

These strategies shall help the UT of J&K to implement effective quality improvement strategies for horticultural crops, enhancing the competitiveness, sustainability, and value of its horticulture sector.

4.5 Strategy-V: Infrastructure Development

There is a need to shift from an extensive system to an intensive cultivation system. All components of horticulture in the value chain, starting from seeds and planting materials till it reaches the consumers, must be upgraded, i.e., production of planting material, crop management practices, irrigation, crop protection, harvesting, post-harvest management, value addition, grading, packaging, marketing, branding and transportation.

4.5.1 Improving Irrigation Facilities

Irrigation is the backbone of successful orcharding. Almost 40% area in Kashmir and more than 70% area in the Jammu region is rain-fed. Under these tough conditions, plantings do not survive and do not attain optimal bearing. Augmenting existing irrigation infrastructure is the need of the hour, and it should include:

	Soil water conservation: Increase the use of plastic mulches to conserve soil moisture and suppress weed growth.
	Water storage solutions: Promote the creation of water harvesting ponds, small tanks and plastic water tanks for rainwater storage, ensuring water availability during dry periods. Incentives/aids must be provided to growers for establishing these structures in their enterprises.
	Micro-irrigation and use of advanced equipment: Facilitate the installation of low-cost drip irrigation and advanced delivery systems in orchards, enabling precise water management. These systems can be automated to apply water based on plant needs.

Alongside infrastructure support, thorough training must be provided to growers on the operation and maintenance of hi-tech irrigation equipment, ensuring sustainable and efficient usage.

4.5.2 Development of Processing Clusters

Due to a lack of awareness of scientific methods of harvesting, handling, processing and preservation practices, a major portion of the horticultural produce in J&K is either wasted or sold at throwaway prices. In order to reduce the post-harvest losses, it is imperative to introduce mechanisation within the available framework. Furthermore, there is a need to establish processing clusters in different districts of J&K for processing and value addition of horticultural produce (Table 4.9).

Table 4.9: Processing Clusters for Fruit Crops Proposed in each District of J&K

S.No	District	Commodities / Crops	Processing Cluster Proposed
1.	Anantnag	Walnut, Apple, Pear, Apricot, Peach, Plum, Cherry, Pomegranate	1
2.	Bandipora	Apple, Potato, Water Chestnut, Kaala Zeera, Walnut, Pomegranate, Pear, Apricot, Peach, Plum, Cherry	1
3.	Srinagar	Apple, Pear, Cherry, Saffron, Almond, plum, walnut, honey, Peach, Strawberry, Pomegranate, Quince,	1
4.	Baramulla	Apple, Pear, Walnut, Cherry, Vegetables, Apricot, Peach, Plum, Almond.	1
5.	Budgam	Apple, Pear, Walnut, Almond, Saffron, vegetables, Plum, Cherry, Pomegranate.	1
6.	Kupwara	Walnut, Apple, Pear, Apricot, Peach, Plum	1
7.	Shopian	Apple, Walnut, Cherry, Pear, vegetables, Peach, Plum, Grapes, Pomegranate	1
8.	Poonch	Apple, Pear, Plum, Peach, Apricot, Pomegranate, Amla	1
9.	Rajouri	Pear, Mango, Apricot, Plum, Lime, Lemon, Guava, Apple, Peach, Anola, Pomegranate, Fig, Walnut	1
10.	Jammu	Mango, Citrus, Strawberry, Anola, Ber, Vegetables, Honey, Guava, Plum, Litchi, Pomegranate, Jackfruit	1
11.	Udhampur	Mango, Citrus, Pear, Guava, Apple, Pear, Peach, Plum, Litchi, Ber, Anola, Pomegranate, Walnut	1
12.	Doda	Walnut, Apple, Pear, Apricot	1
13.	Kulgam	Apple, Walnut, Pear, Vegetables, Apricot, Peach, Plum, Cherry	1

S.No	District	Commodities / Crops	Processing Cluster Proposed
14.	Pulwama	Apple, Walnut, Pear, Saffron, Apricot, Peach, Plum, Cherry, Almond	1
15.	Kishtwar	Walnut, Apple, Apricot, Mushroom, Saffron, Pear, Peach, Plum	1
16.	Ganderbal	Apple, Cherry, Walnut, Pear, Vegetables, Apricot, Peach, Plum, Cherry, Grapes, Pomegranate	1
17.	Samba	Mushroom, Mango, Guava, Ber, Strawberry, Anola, Dragon fruit, Citrus	1
18.	Kathua	Spice crops, Mango, Citrus, Pear, Guava, Dragon fruit, Litchi, Apple, Peach, Grapes, Ber, Anola, Pomegranate, Walnut	1
19.	Ramban	Honey, Apple, Pear, Apricot, Peach, Plum, Pomegranate, Quince, Walnut	1
20.	Reasi	Spices, Citrus, Guava, Mango, Apple, Mushrooms, Pear, Peach, Plum, Mango, Ber, Guava, Walnut	1
	Total		20

4.5.3 Creation of Farmer-Friendly on-Farm Storage Structures/Collection Centres

Developing storage structures for horticultural produce is crucial to reduce postharvest losses, particularly for small farmers lacking on-farm storage and processing facilities (Table 4.10). For the UTs remotely located farmers, low-cost storage solutions are vital to manage gluts, stabilise prices, and mitigate shortages. The storage of horticultural produce is more complex than grain storage due to the high initial moisture content, which increases the risk of insect and fungal problems. Effective storage structures, from traditional clamps and cellars to modern evaporative cooling and solar-powered chambers, help maintain quality and freshness during transit. These structures reduce spoilage, preserve nutritional value, and minimise post-harvest losses, enhancing shelf life and reducing food waste. Implementing affordable, effective storage structures can significantly enhance productivity and economic stability for small farmers. Various types of storage systems for fresh produce are described below.

(i) Evaporative Cool Chambers

Evaporative cooling occurs when air passes over a wet surface, causing water to evaporate and absorb heat, thus lowering the surrounding temperature.



Pot-in-pot Cooler: A small pot placed inside a larger water-filled pot; food stored in the inner pot stays cool through evaporation.



Charcoal Cooler: A wooden frame with mesh and charcoal filling; water-soaked charcoal cools stored food. Mounted outdoors and designed to deter pests.



Evaporative Cool Chamber (ECC) / Zero Energy Cool Chamber (ZECC): An electricity-free, low-cost storage option made from bricks, sand, and bamboo, reduces temperature by 10-15°C and raises humidity to 90-95%, extending the shelf life of fruits and vegetables, ideal for marginal and small farmers in hot, dry areas.

Table 4.10: Cooling Technology Options for Small-scale Farmers in Developing Regions

Cooling Technology	Description	Temperature range	Energy options
Passive or evaporative cooling	Operates in areas of dry and low humidity	10-25°C	No fuel (does not require electricity); architectural measures (shade creation, fountains, etc.)
Absorption refrigeration	Thermal-driven technology	<10°C	Solar; kerosene
Refrigerators (Vapour compression)	Electricity-driven and, therefore, dependent on a reliable electricity supply	0°C	Grid; diesel; renewable sources (hydro, solar, batteries, etc.)

4.5.4 Establishment of Post-Harvest and Marketing Infrastructure for Fresh and Processed Products

Inefficiencies in marketing infrastructure lead to post-harvest losses, limited reach, and lower farmer incomes. Marketing systems are dynamic and competitive, requiring continuous improvement. Improving marketing chains will boost productivity, reduce cultivation/production costs, and drive employment, agricultural growth, farmer welfare, and economic prosperity in rural areas.

(i) Building the Pillars of a Strong Infrastructure

	Establishment of Cold Chain Network: Establish a network of cold storage, refrigerated warehouses, and reefer transportation to minimise spoilage and extend shelf life.
	Investment in Processing Units: Promote investments in food processing units to add value to produce, extend product life, create jobs and enhance farmers' incomes.
	Developing E-commerce Platforms for Agri-produce: Develop online marketplaces for fresh and processed produce to connect farmers directly to consumers and businesses, improving market access, enhancing transparency and ensuring better price realisation.
	Strengthening Market Institutions: Modernise existing Mandis (agricultural markets) with improved infrastructure, grading facilities, and market information systems to ensure fair pricing and efficient transactions.
	Promoting Farmers' Markets: Organise farmers' markets in strategic areas throughout J&K to provide farmers a direct avenue to market and sell their fresh produce to consumers. These markets facilitate the timely distribution and sale of fruits and vegetables, contributing to the farmers' income.
	Promoting Online Platforms: Creating mobile applications and dedicated websites for the sale of fresh produce, enhancing consumer access to locally grown produce and opening new marketing avenues for farmers.
	Strengthen Cooperative Marketing: Encourage the formation of farmer-producer groups and cooperatives to improve farmers' bargaining power, facilitate joint marketing initiatives, and enable investment in branding, packaging and promotion to differentiate their products.
	Quality Certification and Branding: Implement quality certification programs for fresh produce to build consumer trust regarding product quality and safety and to enhance brand value in both domestic and external markets.

4.5.5 Shift towards Innovative Packaging Strategies

Proper packaging protects produce from physical damage during transportation, handling, and storage, reducing post-harvest losses and maintaining quality. It also preserves the nutritional value, appearance, and flavour of fresh produce by controlling factors like

moisture, temperature, and air exposure. In addition to extending shelf life, good packaging helps prevent contamination and ensures food safety. A well-designed packaging improves marketability; functional packaging can appeal to consumers, convey product information, and fetch higher returns. Strategies to shift towards innovative packaging include:

	Assessment of Current Packaging Practices: Undertake a comprehensive assessment of existing packaging practices in the horticulture sector of J&K.
	Research & Development: Allocate resources for R&D, focused on innovative packaging materials and techniques. Collaborate with research institutions, universities, and industry experts to explore sustainable and cost-effective packaging solutions tailored to the region's horticulture produce.
	Identification of Key Packaging Requirements: Identify specific packaging requirements for various horticultural products, taking into account product characteristics, shelf-life, transportation constraints, and market demands.
	Promotion of Eco-Friendly Practices: Encourage the adoption of eco-friendly packaging materials such as biodegradable plastics, recyclable containers, and biobased films. Raise awareness among stakeholders about the environmental benefits of sustainable packaging options.
	Capacity Building and Training: Conduct training programs and workshops for horticulturalists, farmers and packaging professionals on best practices in packaging.
	Integration of Technology: Explore the integration of technology-driven solutions such as smart packaging sensors and blockchain for traceability and quality assurance. Invest in infrastructure for cold chain logistics and temperature-controlled storage facilities to maintain product freshness.
	Regulatory Framework and Standards: Develop and implement regulatory frameworks and quality standards for horticultural packaging in line with international best practices. Ensure compliance with food safety regulations and certification requirements to enhance credibility and market access.
	Partnership and Collaboration: Encourage partnerships with packaging industry stakeholders, including manufacturers, suppliers, and distributors, to support the adoption and scaling up of innovative packaging solutions.
	Branding and Market Access: Facilitate market access through improved packaging that meets the quality and aesthetic preferences of target consumers. Invest in branding and marketing to highlight the unique attributes of J&K's horticultural produce emphasising superior packaging and quality.
	Monitoring and Evaluation: Establish mechanisms for regular monitoring and evaluation of the implementation of innovative packaging strategies. Measure key performance indicators such as product quality, shelf-life extension, cost effectiveness, and environmental impact to assess the effectiveness.
	Establishment of Indian Institute of Packaging (IIP) Centre: Establish IIP centre in J&K dedicated to designing commodity-specific packaging materials for niche crops/commodities of J&K. This centre will serve as a hub for research, design, training and industry collaboration in packaging innovation.

4.6 Strategy-VI: Advancing Sustainable and Green Technology Interventions for Climate-Resilient Horticulture

4.6.1 Promoting Sustainable Horticulture Practices

Adopting sustainable horticulture practices enhances soil fertility, reduces dependence on chemical inputs, increases water-use efficiency, preserves biodiversity and strengthens rural livelihoods and provides better market opportunities.

The key strategic actions could include:

	Encourage the Widespread Adoption of environmentally responsible techniques such as: Organic Farming, Natural Farming, and Regenerative Agriculture; Integrated Pest Management (IPM); Water Conservation and Management; Soil Health Management Practices; Biodiversity Enhancement Initiatives; Precision Horticulture for optimising plant and soil health
	Capacity Building: Address knowledge gaps through targeted training programs, farmer field schools, and extension services.
	Financial Incentives: Provide subsidies, grants, or low-interest loans to ease the financial burden of transitioning to sustainable practices.
	Policy and Regulatory Support: Develop and implement enabling policies that encourage sustainable practices, provide certifications, and promote eco-friendly products.
	Research and Innovation: Invest in R&D to improve the understanding of long-term impacts, develop climate-resilient horticulture models, and harness technology for better resource management.
	Stakeholder Engagement: Foster collaboration among farmers, private sector players, research institutions, and government bodies to drive collective action toward sustainability.

4.6.2 Leveraging Green Technologies for Sustainable Horticulture

To ensure environmental conservation, enhance resource efficiency, and provide economic benefits in horticulture, a strategy focused on promoting green technologies is essential. This strategy seeks to optimise the use of water, soil, and energy resources, minimise chemical inputs, boost crop resilience and yields, and enhance food safety and nutritional quality. Green technologies enable a shift toward sustainable horticultural practices across both pre-harvest and post-harvest stages, contributing to a resilient and eco-friendly horticultural sector.

(i) Pre-Harvest Interventions:

Water Conservation: Promote drip irrigation, micro-sprinklers, rainwater harvesting, soil moisture sensors, and water recycling systems to enhance water-use efficiency and reduce dependency on freshwater sources.
Renewable Energy Adoption: Support the deployment of solar-powered pumps, greenhouses, and the exploration of bioenergy and wind energy sources to minimise carbon footprints and operational costs.
Soil and Crop Health Management: Scale up organic and natural farming methods, promote bio-fertilisers, Integrated Pest Management (IPM), crop rotation, intercropping, sanitation measures, netting, pheromone traps and, sticky traps and eco-friendly pest control technologies like neem oil and biopesticides to improve soil and ecosystem health.
Climate-Resilient Cropping Systems: Encourage adoption of drought- and temperature-tolerant crop varieties, greenhouse farming, and climate-smart agricultural practices to enhance resilience against environmental stresses.
Establishing Early Warning Systems: Facilitate real-time, data-driven decision-making through agro-meteorological stations, remote sensing, GIS technologies, mobile applications, and digital alert systems for pest, disease, and irrigation management.
Promotion of Organic/Natural Farming: Expand organic and natural farming practices adapted to regional contexts to improve ecological sustainability, reduce input costs, and enhance product quality. For example, the YS Parmar University of Horticulture and Forestry (YSPUH&F) in Solan, Himachal Pradesh, has developed a comprehensive natural farming package for apples, which has been shown to increase apple yields.

(ii) Post-Harvest Interventions:

Renewable Energy-Powered Systems: Promote solar drying (widely used for drying fruits like mangoes, apples, walnuts and apricots), solar-powered cold storage units⁵⁰, and the use of biogas and biomass in processing units to reduce energy costs and post-harvest losses.

Water and Energy Efficiency: Implement closed-loop water recycling systems (in apple juice processing plants), energy-efficient refrigeration, green refrigerants (CO₂, ammonia instead of Chlorofluorocarbons), and heat recovery technologies in processing plants (such as in fruit pulping and drying units) to minimise environmental impact.

Sustainable Packaging: Support the development and adoption of biodegradable, edible, and compostable packaging alternatives (e.g., corn starch and seaweed-based materials, banana leaves, bagasse-based containers) to reduce plastic waste in horticulture markets and processing industries.

Eco-friendly Preservation and Processing Techniques: Encourage the use of cold plasma, ozone treatment (for fresh cut fruits), and high-pressure processing (HPP) methods (eg. For fruit juices and purees) for food safety, preservation, and quality enhancement without chemical reliance.

Waste Reduction and By-product Utilisation: Promote zero-waste processing models by converting fruit waste into value-added products such as pectin⁵¹ (widely used in jam and jelly production), essential oils (for cosmetics and health products), animal feed, and compost, enhancing resource efficiency and profitability.

Thus, there is a need for the expansion of renewable energy-based processing units, particularly solar-powered cold storage and drying facilities in horticultural clusters in J&K. Scaling up sustainable packaging initiatives and replicating the best practices by implementing policies to phase out plastic packaging in the processed fruit industry is another important step. Promoting green technology in food processing ensures environmental sustainability while supporting economic growth.

4.7 Strategy-VII: Capacity Building and Training for Improving Skill and Enhancing Output

4.7.1 Farmer Training Programs on Modern Horticultural Practices

The objective is to empower farmers to effectively address their daily challenges. Capacity building brings improved food safety, diversified income sources, community development, rural-urban migration mitigation, resilience to climate change, market access and trade opportunities, poverty alleviation, women's empowerment, preservation of indigenous knowledge, incentives for youth, etc.

Some important areas for which training of farmers needs to be conducted for enhancing their know-how, skills and output are listed below:

⁵⁰ In Kashmir, solar-powered cold storage units have been introduced to store apples and cherries, reducing post-harvest losses.

⁵¹ In apple processing, pomace (the leftover pulp after juice extraction) is converted into pectin. In fact, a zero-waste apple processing unit in Himachal Pradesh utilises every part of the fruit, producing juice for beverages, apple fibre for food supplements, peels for pectin extraction, and seeds for oil production.

- | | |
|--|--|
| (a) Entrepreneurship and Leadership Development Programme for Horticulture Entrepreneurs | (i) HDP and canopy management (Plant Architectural Design) |
| (b) Protected cultivation of horticultural crops | (j) Good Agriculture Practices |
| (c) Modern Horticulture Intervention | (k) Horticulture-Based Integrated Farming System and Nursery Raising |
| (d) Natural Farming | (l) Agri-preneurship |
| (e) Improved production technology of fruit crops | (m) Community-Based Natural Resource Management |
| (f) Propagation techniques | (n) Integrated Farming System |
| (g) Post-harvest handling and value addition of temperate fruits | (o) Value Chain Development |
| (h) Business development, entrepreneurship and market linkages | (p) Post-harvest management and value addition |

4.7.2 Strengthen Extension Services through Digital and Expert Advisory Services

The integration of digital platforms in agriculture has revolutionised extension services, providing farmers with unprecedented access to information and support. Through mobile apps, SMS services, and online portals, farmers can access knowledge on crop cultivation, market trends, and weather forecasts, empowering them to make informed decisions and improve productivity. Direct communication with experts and virtual workshops promotes collaboration and inclusivity, reaching farmers in remote areas. The key focus areas include

	Access to Information: Provide farmers with real-time updates on weather, prices, crop management and best practices via mobile apps, SMS and online portals.
	Market Access: Facilitate direct communication between farmers and buyers, improving price transparency and farmers' bargaining power.
	Financial Inclusion: Promote digital financial services such as mobile banking, insurance and credit products for improved risk management.
	Extension Services: Deliver personalised advisory services, including direct expert consultations and virtual workshops, overcoming geographical barriers and promoting sustainable practices.
	Data Collection and Analysis: Utilise mobile technology for real-time data collection to support evidence-based decision-making and planning.

Challenges such as connectivity, affordability, and digital literacy must be addressed to ensure all farmers benefit from mobile technology for agricultural development and inclusive growth. Furthermore, data-driven decision-making enhances the effectiveness and sustainability of agricultural practices.

4.7.3 Empowerment of Women and Youth in Horticulture

The objective is to empower women and youth by equipping them with technical, entrepreneurial, and financial skills to actively participate in the horticulture sector. Enhancing their capacity will not only create employment and self-reliance but also foster innovation and leadership in horticulture. Targeted initiatives will help women and youth transition from farm workers to farm entrepreneurs and agribusiness owners.

The key focus areas include:

	Skill Development: Training on modern horticultural practices, value addition, organic farming, nursery management, and integrated farming systems.
	Entrepreneurship Development: Capacity-building programs on business planning, value chain management, marketing strategies, and start-up creation.
	Access to Credit and Finance: Facilitation of credit linkages through government schemes (e.g., PM Formalisation of Micro Food Processing Enterprises (PM-FME), Stand-Up India, MUDRA Yojana).
	Exposure and Confidence Building: Organise visits to trade fairs, successful enterprises, and centres of excellence to enhance exposure to best practices.
	Start-up Promotion: Mentorship and handholding support for women- and youth-led horticulture start-ups.

4.8 Strategy VIII: Market Linkages and Value Chain Development - Ensuring Higher Income and Access

4.8.1 Strengthening Market Connections

Strengthening market connections for farmers will ensure food security, empower rural communities, and develop a more sustainable agricultural ecosystem. A strong market can provide a pathway to a higher income as well as quality inputs that can give better yields.

(i) Strategies for Stronger Market Connections

	Farmer Collectives and Cooperatives: Facilitate the formation of strong FARMER- PRODUCER ORGANISATIONS (FPOs) to pool resources, negotiate better prices, ensure quality control and develop collective marketing channels.
	Cluster-based Farming: Promote cluster-based farming models to ensure guaranteed prices, technical support and secure market access for farmers.
	Direct Marketing Channels: Enable farmers to access farmers' markets, establish local marketing outlets and leverage e-commerce platforms like eNAM to widen their customer base.
	Value Addition and Branding: Train farmers in basic processing, packaging and branding techniques to extend shelf life, create value-added products and command premium prices. Promote Geographical Indications (GI) registration for unique local produce.
	Capacity Building and Training: Provide training in marketing skills, negotiation, post-harvest management, accounting and digital literacy.
	Optimising the Value Chain: Develop infrastructure for post-harvest handling, cold storage, transportation and logistics to minimise spoilage and improve delivery efficiency.
	Information and Branding: Support farmers in using digital marketing tools (social media platforms/well-designed websites), establish traceability systems and build strong brand identities (creating logo, using consistent messaging, emphasising unique qualities of the produce) linked to quality and sustainability.

(ii) Linking Farmers/FPOs with the Markets

Empowering producer organisations to overcome scale disadvantages is also key to enhancing smallholders' participation in various marketing schemes. Strategies to connect farmers and FPOs with markets, which will promote a more equitable and profitable ecosystem.

	Leverage Government Support Programs: - Utilise the Central Sector Scheme for Formation and Promotion of 10,000 FPOs to establish new FPOs in horticulture and allied sectors in J&K.⁵² - Access credit and capacity-building support through NABARD's initiatives, including the Rs. 1,000 crore Credit Guarantee Fund for collateral-free loans.
	FPOs as Catalysts for Horticulture Growth: - Identify and nurture product-specific FPOs (e.g., saffron, walnuts, basmati rice) in high-potential districts. - Promote mechanisation, quality enhancement, and area expansion through targeted support to these FPOs.
	Design and Execute Comprehensive Marketing Strategies: - Help FPOs develop marketing and logistics plans, including setting up warehouses, pack-houses, and cold chains. - Guide FPOs on developing credit policies, managing post-sales services, and establishing direct buyer linkages.
	Support from Government Departments and Corporates for market linkages: - Facilitate FPO participation in government preferential procurement programs (e.g., under MIDH, PMFME) - Connect FPOs with corporate buyers for direct procurement or buy-back arrangements.

Overcoming these challenges requires a multi-pronged approach involving capacity building of FPOs, fostering trust with market players, and investing in rural infrastructure. The future of the agricultural sector depends on the success of FPOs, which can transform marginal and smallholder farming into market-oriented commercial enterprises with dedicated support. The UT's agricultural policy had identified the potential to create 300 FPOs across the region.⁵³ Linking farmers / FPOs to markets is crucial for improving farm incomes, reducing post-harvest losses, and ensuring food security. By adopting the given strategies, stakeholders can bridge the gap between producers and consumers, creating a more efficient, profitable and equitable agricultural market system.

4.8.2 Carbon Financing for Tree Crops

The horticulture sector in J&K holds significant potential for carbon financing, combining economic gains for farmers with environmental benefits. By assigning value to carbon emissions, carbon financing can promote climate-smart practices, improve soil health, and create additional income streams through carbon credit trading. The region's rich diversity of fruit crops positions it well to benefit from carbon markets.

The Ministry of Agriculture and Farmers Welfare (2024) has introduced a framework to encourage small and marginal farmers to participate in Voluntary Carbon Markets (VCM).⁵⁴ While global and domestic interest in carbon trading is growing, as seen in initiatives like Agro Forestry in Araku Valley, Andhra Pradesh; Vivo Certified Project by VCCSL in India focusing on Mango cultivation, etc., challenges remain in scaling VCM effectively. A strong market-based mechanism is essential to unlock the sector's full potential.

⁵² NABARD has promoted around 80 FPOs in J&K, benefiting approximately 10,000 farmers. These FPOs are involved in a variety of products such as saffron, walnut, almond, maize, basmati rice, mushroom, organic vegetables, and honey.

⁵³ <https://jkrajbhawan.nic.in/pdf/prrel/pdf/Lt%20Governor%20Announces%20Three%20New%20Schemes-%20Holistic%20Development%20of%20Agriculture%20&%20Allied%20Sectors,%20Aspirational%20Towns%20and%20Aspirational%20Panchayat.pdf> (accessed on 5th May, 2025)

⁵⁴ <https://faolex.fao.org/docs/pdf/IND227223.pdf>

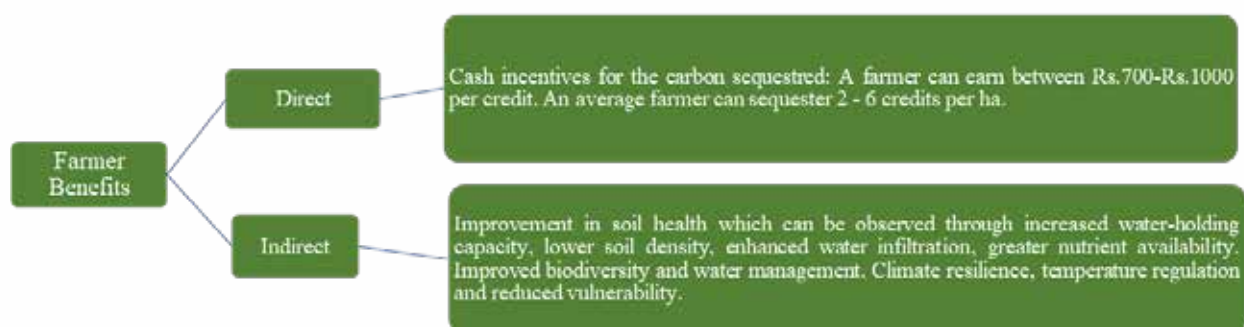


Fig 4.3: Benefits for Farmers through VCM

(i) Strategies for Promoting VCM

	Empowering Smallholder Farmers: Strengthen FPOs, CBOs, NGOs, and private entrepreneurs to enable collective action, improve access to training, credit, and markets, and facilitate farmer aggregation for VCM participation.
	Leveraging CSR: Mobilise CSR funds from companies for carbon sequestration initiatives, fostering partnerships between enterprises, NGOs, and farming communities.
	Government Collaboration: Align efforts with ministries like MoEFCC, MNRE, MoRD, and MoJS for policy support, regulatory frameworks, and enabling conditions for carbon projects.
	Capacity Building for Carbon Projects: Conduct training programs for farmers, field staff, and project developers to ensure technical expertise, trust-building, and adherence to carbon market standards.
	KVKs as VCM Hubs: Position KVKs to lead VCM initiatives, disseminate technologies, raise awareness, and standardise carbon practices across agro-climatic zones.
	Developing a Domestic VCM: Establish a J&K Voluntary Carbon Market with transparent trading systems to drive farmer participation. A multi-stakeholder accelerator, including agri-companies, NABARD, and foundations, can support financing, implementation, and capacity building.
	Incentivising Best Practices: Promote sustainable agricultural practices through incentives and robust monitoring to enhance soil organic carbon and optimise resource use.
	Carbon Offset Program: Support creation of large-scale, verifiable carbon credits through government-backed programs ensuring farmer participation.
	Addressing Challenges: Tackle adoption, monitoring, and credit calculation barriers at farm and aggregate levels to operationalise farm-level VCM projects effectively.

These comprehensive approaches aim to establish a robust carbon financing model tailored to the J&K horticultural sector, promoting sustainability and resilience against climate change. Adoption of proposed strategies can position J&K at the forefront of sustainable agricultural practices, ensuring resilient livelihoods and contributing positively to global climate goals.

4.8.3 Branding of the Products - Geographical Indication (GI) Tag

GIs play a key role in protecting products from specific regions, enhancing national branding, and preventing un-authorised use or imitation. GIs safeguard products' identity, preserve traditional knowledge, and provide economic benefits by empowering local communities and preserving cultural heritage. India's Geographical Indications of Goods Act, 1999, ensures GI registration and protection.

	Establish a Unique Brand Identity: Develop a distinctive visual identity for each GI product that highlights its unique origin and characteristics. This should include a well-recognised logo, specific colours, and typographic styles that convey the product's heritage and quality.
	Create and Promote a Common GI Seal: Implement a standardised GI seal that can be used across all GI-tagged products.
	Develop Product-Specific Campaigns: Tailor marketing campaigns to the specific attributes and stories of each GI product. Emphasise unique production methods, cultural heritage, and the local environment's influence on the product's characteristics.
	Enhance Online Presence: Build dedicated websites for each GI product category to provide detailed information, stories, and the historical context of the products. Utilise e-commerce platforms to facilitate direct sales and reduce the reliance on intermediaries.
	Utilise Mass Media and Awareness Campaigns: Run awareness campaigns about GI value and its socio-economic impact.
	Engage with Consumers through Events: Participate in national and international exhibitions, craft fairs, and <i>haats</i> (local markets) to directly engage with consumers. Use these platforms for live demonstrations, tasting sessions, and interactive storytelling about the GI products.
	Collaborate with Retail and Design Partners: Partner with retailers and designers to create exclusive lines featuring GI products for broadening market reach and position GI products within premium segments.
	Encourage Community engagement: Involve local producers and artisans in the branding process to ensure that it represents their culture and craftsmanship. This participatory approach helps in maintaining the authenticity of the branding strategy.
	Strengthen Legal Protection: Monitor and act against misuse by setting up a dedicated legal cell to handle infringements effectively.
	Continuous Quality Assurance: Implement rigorous quality control measures, including self-audits and third-party checks, to ensure that all GI-tagged products meet specified standards consistently.
	Educate and Train Producers: Organise workshops and training sessions for producers on best practices in production, branding, and marketing. Introduce technology upgrades and innovations in packaging to enhance product appeal and shelf-life.
	Leverage Technology and Innovation: Employ modern marketing techniques such as augmented reality, interactive web experiences and storytelling to create engaging consumer interactions.

By implementing these branding strategies, GI-tagged products can enhance their market visibility, build consumer trust, and ultimately achieve a premium positioning both in domestic and international markets. Also, GI products can build strong brands that not only attract but also retain customer loyalty, thereby securing a sustainable market share and enhancing the livelihoods of the local communities involved.

4.8.4 Promoting Horti-Tourism and Developing Horti-Tourism Circuits

Promoting horticulture tourism in J&K will provide farmers with new revenue streams, promote eco-friendly tourism, and strengthen the region's economy. Developing horti-tourism circuits in the horticultural landscapes of J&K involves creating interconnected routes that showcase the region's diverse horticultural offerings while providing memorable experiences for tourists.

- **Focus Areas:** could include Apple orchards (Sopore, Shopian), saffron fields (Pampore), and citrus/mango belts (Kathua, Samba, Udampur).

- **Activities:** Farm visits, fruit picking, orchard stays, culinary workshops, harvest festivals, and natural farming / organic farming demonstrations.

(i) **Strategic Components for Promoting Horti-tourism Circuits:**

	Infrastructure Development: On-farm guesthouses, farm cafes, rural road connectivity, signage, interpretive centres highlighting horticultural heritage.
	Tourism Experience: Integrated horticulture, cultural programs (music, crafts, cuisine), hiking, and nature walks.
	Product Development: Orchard tours, Apple and Saffron Festivals, local produce markets, hands-on farming experiences.
	Marketing: Branding J&K's horti-tourism, digital campaigns, collaboration with travel agencies, participation in tourism expos.
	Community Participation: Farmer training in hospitality, promotion of women-led enterprises, and cooperatives for service management.
	Sustainability Measures: Promotion of natural farming/ organic farming, waste management systems, eco-friendly tourism practices.
	Monitoring and Evaluation: Track tourist footfall, community benefits, and feedback to refine circuits and strategies.
	Policy Advocacy and Support: Advocate for supportive policies like tax incentives, grants, and infrastructure funding for horti-tourism. Develop long-term growth plans and integrate horticulture tourism into J&K's broader tourism strategy. Offer subsidies, low-interest loans, and incentives for eco-friendly initiatives. Ensure coordination across agriculture, horticulture, and tourism departments.
	Scaling Up and Replication: Document and share successful horti-tourism models, expand projects to new regions, and align with national tourism campaigns to attract wider audiences. Promote inter-state collaborations for integrated horticulture-tourism networks.

Promoting horticulture tourism in J&K has the potential to transform the region's economy by merging its rich horticultural heritage with eco-tourism. By implementing these strategies, J&K can attract a new class of tourists interested in sustainable tourism and cultural experiences, while providing economic benefits and preserving the unique traditions of the region.

4.9 Strategy-IX: Strengthening of Export Potential

4.9.1 Unlocking Export Opportunities through Infrastructure and Quality Standards

(i) **Strategies For Enhancing the Export of the Produce are Given Below:**

	Market analysis and intelligence: Conduct comprehensive market research to understand demand patterns, consumer preferences, regulatory requirements and competition in target export markets.
	Infrastructure development: Strengthen transportation networks, build cold chain systems, and enhance storage and packaging capacities to maintain the quality and shelf life of produce.
	Cluster formation and supply chain optimisation: Organise producers into clusters to streamline operations, achieve economies of scale, and improve market access, particularly for small and marginal farmers.
	Value addition and quality enhancement: Promote setting up of facilities for cleaning, grading, packaging, and minimal processing as per international standards to enhance product value and competitiveness.

	Certification and quality assurance: Facilitate certification of products through schemes like the National Programme for Organic Production (NPOP) and international food safety certifications to differentiate products and build consumer trust.
	Trade facilitation services: Establish export facilitation centres at hubs to support exporters with customs clearance, documentation, financial assistance and real-time market intelligence.
	Capacity building and skill development: Conduct regular training programs for farmers, exporters and other stakeholders on global quality standards, export procedures and best practices.
	Government incentives and policy support: Facilitate trade through government incentives including reductions in air cargo tariffs, support through export-promotion schemes, and funding for infrastructure development etc.

4.9.2 Creation of Integrated Export Hubs

To enhance the export competitiveness of horticultural products and stimulate rural economic activity, a focused strategy on the creation of **district-level Export Hubs** is proposed. These hubs will serve as integrated centres for aggregation, value addition, quality assurance, and market access.

Creation of Export Hubs: Establish warehousing facilities at each District Headquarters (under one roof) with integrated services like cooling, grading, packaging, processing, testing and transportation, especially for unattended but high-value products such as saffron, honey, cherry, lavender, apricot, peach, besides other fresh produce.

This integrated approach will not only improve the quality and volume of exports but also strengthen the rural economy and position J&K as a key player in the global horticultural trade.

4.10 Strategy-X: Foster Public-Private Partnership (PPP) for Horticulture Development

4.10.1 Potential Areas for PPP Implementation in the Horticulture Value Chain

PPPs can play a transformative role in J&K's horticulture sector by improving efficiency, reducing post-harvest losses, enhancing value addition, and ensuring better market access. Strategic PPP interventions along the horticulture value chain (from input supply to final market access) are outlined below:

	Pre-Harvest and Production Support: Private investment in certified nurseries and tissue culture labs can provide high-quality planting materials, ensuring better yields and disease resistance.
	Mechanisation and Custom Hiring Centres: The establishment of mechanisation and custom hiring centres for services such as pruning, grading, and irrigation can reduce labour costs and improve efficiency.
	Climate-Resilient Farming and Precision Agriculture: Climate-resilient farming techniques, including precision agriculture, AI-based farm advisories, and IoT-enabled irrigation, can further enhance productivity while optimising resource use.
	Post-Harvest Management and Value Addition: Private sector participation in cold chain development, storage infrastructure, and food processing units is crucial to reducing losses and enhancing value addition. Private companies can also collaborate with farmer cooperatives to establish branding and packaging solutions.



Market Linkages and Export Promotion: Private sector investment in online marketplaces, e-commerce platforms, and blockchain-enabled traceability solutions can connect J&K's horticulture products with national and international buyers. Developing export-oriented infrastructure, such as residue testing labs, irradiation units, and certified export houses, can facilitate compliance with global quality standards, enhancing the competitiveness of J&K's horticulture produce in foreign markets.

4.10.1 PPP Mechanisms for Horticulture Development

(i) Institutional Framework for PPP Implementation



Policy and Regulatory Support: A robust institutional framework must be established, beginning with strong policy and regulatory support.

- Develop a J&K Horticulture PPP Policy which clearly defines the roles and responsibilities of stakeholders, investment incentives, and operational guidelines with clear investment guidelines.
- A single-window clearance system can further enhance the ease of doing business by facilitating quick approvals for private investments in horticulture.



Key Stakeholders: Effective PPP implementation requires coordinated efforts from government agencies, private enterprises, farmer organisations and research institutions.

- **Government agencies:** Departments such as the J&K Horticulture Department, J&K Agriculture Production Department and bodies such as J&K Horticulture Produce Marketing and Processing Corporation (JKHPMC) can play a key role in guiding, monitoring and supporting PPP initiatives.
- **Private sector:** Agri-tech firms, input suppliers, logistics providers, and food processing companies play a crucial role in bringing in investments in modern technologies and market linkages.
- **Farmers Organisations:** Farmer participation, particularly through FPOs, is essential to ensure that PPP initiatives benefit small and marginal farmers while promoting inclusive growth.
- *Research institutions*, such as ICAR, SKUAST-K, SKUAST-J, and KVKs, can contribute through scientific expertise, improved farming techniques, and climate-resilient solutions and capacity building.

(ii) PPP Models for Horticulture Development

Various **PPP models** can be adopted to enhance horticulture development in J&K, tailored to different aspects of the value chain.



Build-Operate-Transfer (BOT) model: Useful for establishing cold chains, storage units, and food processing facilities, where private companies invest, operate the infrastructure for a designated period with farmer cooperatives.



Viability Gap Funding (VGF) model: The government provides partial financial assistance to private firms investing in essential but commercially less attractive infrastructure, such as rural agri-markets and decentralised pack houses.



Joint Venture (JV) Model: Joint ventures between the government and private sector can be utilised to develop high-tech horticulture projects, including tissue culture labs for disease-free planting materials.



Cluster-based farming and buyback agreements: Provide farmers with assured procurement, ensuring stable incomes and reduced market risks.

(iii) Financial Support and Incentives



Government support: The government can offer capital subsidies for infrastructure development, low-interest loans through NABARD and tax benefits for horticulture-based processed products to encourage private participation.



Incentives: Private sector stakeholders can be incentivised through revenue-sharing models, concessional land leasing arrangements, and fast-track approval mechanisms for PPP projects.

(iv) Governance and Monitoring Mechanism

A **robust governance and monitoring mechanism** is essential to ensure transparency, accountability, and the effective implementation of PPP projects.



Establish a *State-Level PPP Monitoring Committee* that can oversee project execution, coordinate among stakeholders, track investments, and ensure timely interventions when required.



Engage *independent performance auditing agencies* to periodically assess the impact and operational efficiency of PPP initiatives.



Set up a *farmer grievance redressal mechanism* to promptly address issues faced by farmers, ensuring transparency and safeguarding farmer interests throughout the project lifecycle.





IMPLEMENTATION ROADMAP



To translate the strategic interventions into measurable and impactful outcomes, a clear and actionable implementation roadmap is essential. This chapter outlines a three-phased implementation plan structured around short, medium and long-term intervention horizons, detailing key identified components, priority actions, indicative timelines and institutional mechanisms required for the successful realisation of the proposed strategies. The roadmap emphasises building capacities, ensuring stakeholder coordination, integrating digital technologies, mobilising diverse financial resources (including PPPs), and creating a supportive policy environment. It also places strong focus on fostering innovation, smallholder inclusion, sustainability, skill development and climate resilience across the horticultural value chain. The roadmap also includes the proposed mission framework “Operation Golden Greens” for horticultural transformation in J&K. It aims to implement the integrated phase-wise action plan through five sub-missions, dedicated to i) dry fruits, ii) fresh fruits, iii) vegetables, iv) floriculture and v) minor crops.

The implementation plan is organised into three phases - Phase 1 (2026-30), Phase 2 (2030-35) and Phase 3 (2035-47). These phases align with interventions grouped into three time horizons: short-term (2026-28) and medium-term (2028-30) actions fall within Phase 1, while long-term actions (2031 onwards) are implemented through Phases 2 and 3. This phased approach provides flexibility to adapt interventions based on emerging priorities, technological advancements and institutional readiness. Through this approach, the roadmap aims to drive sustainable transformation of the horticulture sector, ensure inclusive growth, enhance competitiveness in domestic and international markets and build resilience against emerging challenges.

By 2047, the horticulture sector in J&K will be positioned as a key driver of economic growth, rural income generation, and employment (Fig. 5.1). The region, endowed with rich soil and diverse agro-climatic conditions, will focus on expanding its horticulture output (fruits, vegetables, floriculture, medicinal and aromatic plants, spices etc.) while ensuring sustainable agricultural practices and the adoption of modern technologies.

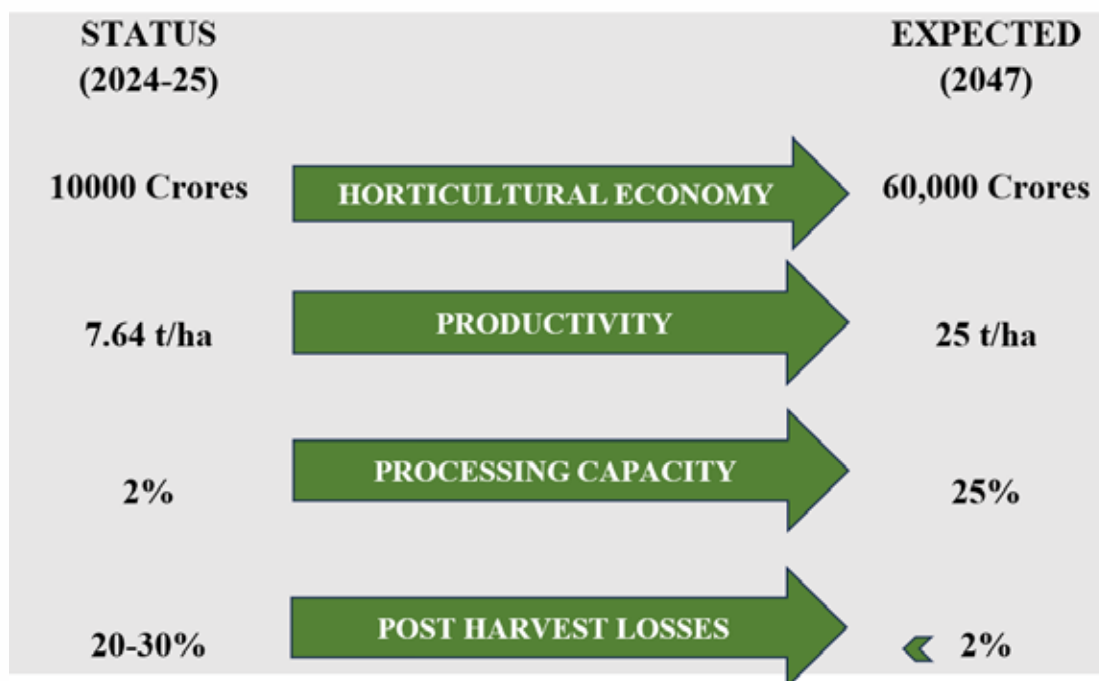
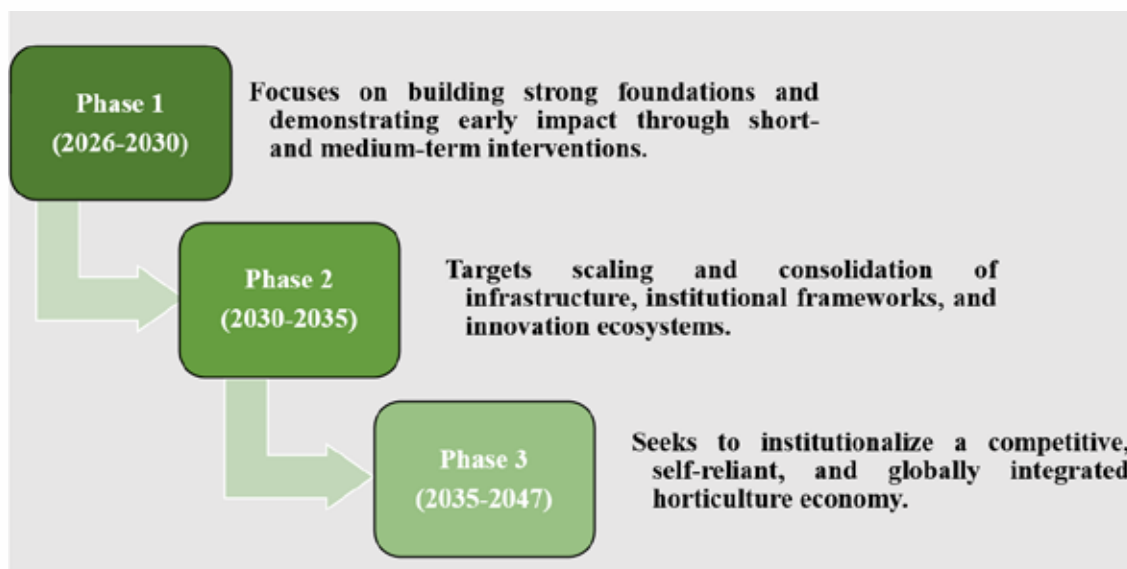


Fig. 5.1: Timeline of action for the development of Horticulture in J&K @2047

5.1 Phase-Wise Action Plan Aligned with Strategic Interventions

The implementation roadmap is structured around three strategic phases:



Within this phased structure, interventions are grouped into the following time horizons:

- **Short-Term (0-2 years | 2026-28)** – *Strengthen foundational systems and initiate quick-impact interventions*

Focus areas include initiating comprehensive baseline mapping, establishing regulatory clarity, improving access to quality planting materials, and launching targeted support schemes (such as subsidies, crop insurance, and credit access) to ease input-side constraints.

- **Medium-Term (3-5 years | 2028-30)** – *Expand infrastructure, consolidate value chains, and scale innovation*

The emphasis shifts to enhancing productivity and market linkages through the expansion of critical infrastructure (pack houses, cold chains), promoting farmer aggregation via FPOs, fostering value addition and processing, and encouraging adoption of sustainable and climate-resilient practices (e.g., natural farming).

- **Long-Term (6+ years | 2031 onwards)** – *Institutionalise transformation and enhance resilience*

The objective is to build a competitive, self-sufficient, inclusive, and export-ready horticulture economy. It will focus on integrating with national and global markets, securing farmer incomes, leveraging digital technologies, fostering innovation, and ensuring environmental sustainability throughout the value chain.

5.1.1 Alignment of Phases with Intervention Horizons

Each phase incorporates interventions grouped by three-time horizons, wherein Phase 1 includes short and medium-term intervention horizons, whereas Phases 2 and 3 are consolidated into a single long-term (2031 onwards) intervention horizon (Table 5.1).

Table 5.1: Alignment of Phases with Intervention Horizons

Phases (Macro)	Intervention Horizons (Micro)	Purpose
Phase 1: 2026–2030	Short-term (0–2 years) → 2026–2028	<i>Lay the foundation and initiate the transformation</i>
	Medium-term (3–5 years) → 2028–2030	
Phase 2: 2030–2035	Long-term (6+ years from start) → overlaps with Phase 2	<i>Consolidate infrastructure, institutionalise reforms, and build scale</i>
Phase 3: 2035–2047	Long-term (continuation)	<i>Deepen resilience, innovation, and global competitiveness</i>

5.1.2 Key Identified Components

Further, implementation actions across the phases are organised under the following key identified components:



Assessment and planning: All key actions under this component are planned for the short-term, indicating that Phase 1 is foundational and focuses on establishing a robust baseline, planning framework, and institutional alignment. These interventions are designed to lay the groundwork for medium- and long-term strategies in other components.



Research and innovation: Research and innovation are designed as a continuous process, starting in Phase 1 and scaling over time through Phases 2 and 3. The short-term and medium-term actions focus on setting up foundational infrastructure like CoEs, SOPs, and training centres. Long-term interventions emphasise partnerships, scaling of innovations, AI-based tools, and climate-smart research. The approach combines institutional capacity-building, technology development, and farmer participation, aiming for widespread adoption and long-term resilience.



Skill development and capacity building: This component supports Phases 1, 2, and 3 by focusing on training, extension services, and empowerment of women and youth in the horticulture sector. The strategy aims to build a skilled and inclusive horticulture workforce. Short-term actions focus on launching training, startup incubation, and mobile extension services. Medium- and long-term actions deepen technical training, introduce cutting-edge agri-tech certifications, and strengthen institutional support (e.g., CRCs).



Quality planting material, nurseries and germplasm self-reliance: This component targets self-sufficiency in quality planting material, reducing reliance on imports and raising domestic standards. Phase 1 focusses on foundational infrastructure: modern nurseries, tissue culture labs, clean plant centres, and regulatory groundwork. Phase 2 and 3 emphasise scaling systems, regulatory enforcement, and developing export readiness. There's a strong push for technology adoption, public-private partnerships, and nursery accreditation to meet future demand with traceability and quality. Regulatory reforms like a Nursery Act are central to sustaining quality and managing imports.



Hi-tech horticulture production: This component focuses on modernising horticulture practices through technology integration, resource-efficient systems, and automation. The short and medium term is geared toward piloting and demonstrating technologies like automated nurseries, greenhouses, micro-irrigation, and orchard rejuvenation. The long-term focus is on scaling successful models, increasing adoption, and mechanising key operations to reduce drudgery and enhance productivity. There is also a strong emphasis on demonstration-based learning, institutional support through custom hiring centres, and collaboration with private sector innovators.



Crop diversification and high-value crop promotion: aims at broadening the horticulture base to reduce dependence on a few crops and tap into high-value, niche, and off-season markets through strategic promotion of traditional, emerging, and sub-tropical crops. The short term emphasises reviving traditional crops, saffron and olive promotion, and laying groundwork for vegetable and flower value chains. Medium- and long-term target emerging crops like nuts, berries, and temperate fruits, along with TOP crops positioning and processing infrastructure. A key feature is linking production to value chains through packhouses, branding, and export readiness, with a strong role for FPOs/SHGs.



Digital technology integration: focuses on mainstreaming digital tools and platforms across the horticulture value chain in J&K. This component aims to digitally empower farmers, enable real-time decision-making, and enhance transparency and traceability in the horticulture supply chain. The short-term focus is on laying the foundation: introducing traceability tools in select crops and digitising KKGs. The medium and long-term goals include operationalising early warning systems, launching e-market platforms, and ensuring produce compliance with domestic and international quality norms via testing labs. This digital integration supports other roadmap components like high-tech production, exports, extension, and value chain traceability.



Infrastructure development: This component aims to upgrade post-harvest, logistics, renewable energy, and R&D ecosystems across the UT. It aims to close key infrastructural gaps from production to export. Phase 1 focuses on foundational infrastructure (cold storages, warehouses, processing units, solar integration, mechanisation). Phases 2 and 3 introduce advanced facilities like CA/ULO storage, testing labs, export logistics, and decentralised renewable grids. The inclusion of renewables, ICT, and quality assurance systems aligns with the circular economy and export-readiness goals. R&D infrastructure (labs, advisory systems, packaging institute) reflects a forward-looking approach to product quality and market competitiveness.



Market access: is aimed at improving both domestic and international market integration for farmers and FPOs in Jammu & Kashmir, through infrastructure, capacity building and certification systems. Short-term goals include foundational work: establishing direct markets, enabling e-commerce, initiating branding and certification, and basic export facilitation. Medium and long-term phases focus on scaling up through EPZs, export hubs, intelligence systems, and deeper global integration. Integration with digital platforms (eNAM, e-commerce), branding, and logistics modernisation is central to linking producers to value chains. Export competitiveness is aimed to be enhanced through certification systems, testing labs, and training programs, aligned with international standards.



Value addition: The component focuses on enhancing value addition through the establishment of small-scale processing units, industry-scale processing facilities, and branding initiatives for key products. Short-term and medium-term goals involve setting up small processing units, developing branding for key horticultural products (e.g., apple, saffron, walnut), and initiating geographical indication (GI) registration. Long-term phases focus on scaling up processing capacity through PPPs, continuing brand development, and further promotion of products both nationally and internationally. A significant emphasis is placed on horti-tourism, integrating tourism circuits with horticultural production, creating new revenue streams for farmers while promoting regional products. The goal is to promote branding, certification, and market linkages that enhance the competitive edge of local horticultural products in both domestic and international markets.



Financial access and support: aims to improve financial access for horticultural stakeholders, with a focus on smallholders, FPOs, and agripreneurs. Short-term and medium-term emphasises facilitating easy access to credit, including concessional loans, collateral-free loans via NABARD's Credit Guarantee Fund, and subsidised interest schemes for horticulture loans. Additionally, the creation of a dedicated financing window through cooperative banks, SHGs, and MFIs is crucial for smallholder support. Long-term actions focus on further investment promotion, such as establishing a Horticulture Development Fund to support high-density planting, post-harvest units, and Public-Private Partnerships (PPPs) for infrastructure and R&D.



Sustainability and environmental management: The component aims to integrate sustainability at all levels, focusing on regulatory compliance, sustainable farming practices, climate resilience, and a circular economy approach. It aims for transitioning to organic, climate-smart, and waste-reducing practices, with a focus on long-term sustainability, climate adaptation, and environmental stewardship.

Effective coordination and integration across these components are essential to ensure sustainable growth and maximise impact.

5.1.3 Operation Golden Greens: A Mission Framework for Horticultural Transformation in J&K

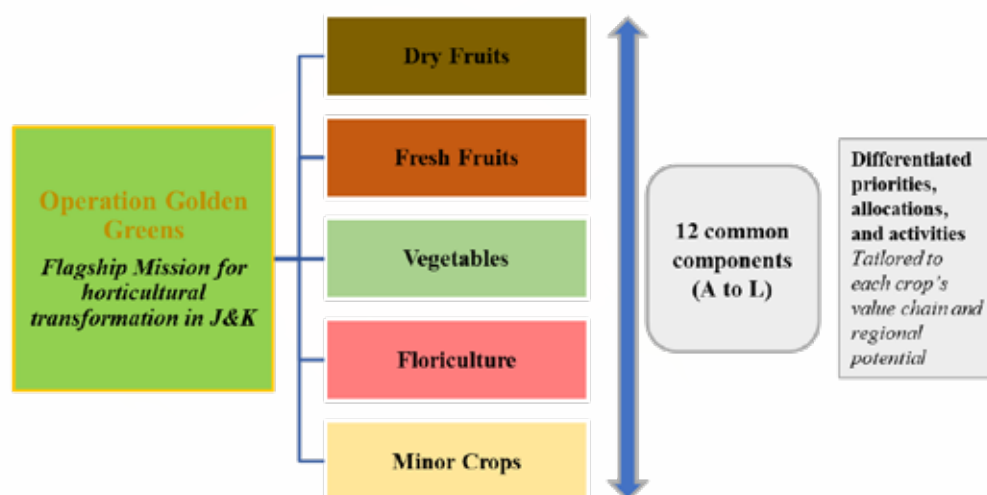
“Operation Golden Greens” is proposed as a flagship mission to drive horticultural transformation across J&K, fostering sustainable growth, boosting rural livelihoods and enhancing ecological resilience. It aims to strengthen end-to-end value chains from

germplasm to market and is inclusive of all key horticultural segments, namely i) dry fruits, ii) fresh fruits, iii) vegetables, iv) floriculture and v) minor crops.

The umbrella mission is structured around five crop-specific sub-missions, each aligned to the aforementioned ten strategies and implemented through twelve common components (as identified in section 5.1.2). This integrated approach aligns with the existing national/ state frameworks, including the Mission for Integrated Development for Horticulture (MIDH)⁵⁵, Holistic Agriculture Development Programme (HADP)⁵⁶, National Centre for Cold-Chain Development guidelines⁵⁷.

By leveraging existing institutional strengths and tailoring interventions to regional agro-climatic diversity, Operation Golden Greens aims to position Jammu and Kashmir as a hub of high-value, climate-resilient horticulture, with a strong focus on empowering local communities and strengthening rural economies.

Mission Structure



The details of the sub-missions under Operation Golden Greens (Table 5.2) are as follows:

Table 5.2: Sub-Missions under Operation Golden Greens

Sub-Missions	Focus Area
 Sub-Mission on Dry Fruits: Focussed on Walnuts, Almonds, Hazelnuts, Chestnuts, Pecan Nuts, Pistachios, etc.	Dry fruits (26.8% of horticultural area) require intense focus on post-harvest handling and processing due to their high value and low volume. This sub-mission focuses on strengthening the production, processing and export potential of key dry fruits through varietal improvement, value addition and GI-based branding to enhance global competitiveness.
 Sub-Mission on Fresh Fruits: Targeting Apple, Pear, Apricot, Cherry, Plum, Peach, Mango, Pomegranate, Guava, Grapes, Kiwi, Olives etc.	Fresh fruits being the dominant sector (73.2% of area), the mission is geared toward doubling productivity via High Density Plantation and strengthening export logistics. It supports integrated orchard management, cold-chain expansion, digital traceability to improve quality, reduce losses and boost farmers' incomes.

⁵⁵ <https://nhb.gov.in/writereaddata/082825102800MIDH%20Guideline%202025.pdf>

⁵⁶ <https://hadp.jk.gov.in/pdfs/ig.pdf>

⁵⁷ https://nccd.gov.in/uploads/ENGINEERING_GUIDELINES_AND_MINIMUM_SYSTEM_STANDARDS_FOR_IMPLEMENTATION_IN_COLD_CHAIN_COMPONENTS_Second_Print_2d4bc6727d.pdf

 Sub-Mission on Vegetables: Covering protected and open-field cultivation of vegetables	This mission focuses on enhancing nutritional security and achieving year-round supply through intensive protected cultivation and local cluster development. It promotes improved seed systems, efficient resource use and aggregation models to strengthen value chains and market access.
 Sub-Mission on Floriculture: Promoting flowers, bulbs and decorative plants	Floriculture is a high-priority, employment-generating sector requiring highly specialised planting material and logistics. This sub-mission supports cut flower and ornamental plant cultivation, nursery infrastructure, post-harvest handling, market development- with a focus on women-led enterprises and eco-tourism linkages.
 Sub-Mission on Minor Crops: including Kala Zeera, Singhara (water chestnut), Lotus stem, Saffron (convergent with the National Saffron Mission), Medicinal and Aromatic Plants (MAPs), Honey, etc.	Leveraging niche, high-value crops require higher investment in research and processing infrastructure. This sub-mission targets resilient value chains for niche crops, MAPs, apiculture products through scientific cultivation, quality certification and market access- especially benefitting tribal and remote communities.

All sub-missions under Operation Golden Greens adopts the standardised set of 12 components (A to L). The proportional budgetary allocation has been adjusted to reflect the unique value chain needs and comparative advantages of each horticultural sector (Table 5.3). Using standardised Components allows each sub-mission to allocate varying weights and financial support to common elements based on local priorities and sectoral needs. For example, the Sub-Mission on Dry Fruits may place greater emphasis on Component J (Value Addition), while the Sub-Mission on Fresh Fruits would prioritise Component E (Hi-Tech Production), despite both utilising all 12 common components. Particularly, the allocation prioritises capital-intensive areas like infrastructure development, quality planting materials and hi-tech production, which could be expected to have immediate impact on productivity and value chain enhancement.

Importantly, the component-wise allocation is flexible and may deviate from the indicative proportions outlined in the mission's allocation matrix, allowing for adaptive planning based on evolving sectoral needs, ground-level realities and stakeholder inputs.

Table 5.3: Component-wise Allocation Matrix

S. No	Component (A-L)	Dry Fruits (%)	Fresh Fruits (%)	Vegetables (%)	Floriculture (%)	Minor Crops (%)
A.	Assessment and planning	3	2	3	4	3
B.	Research and Innovation	4	3	5	15	10
C.	Skill development and capacity building	5	5	10	10	5
D.	Quality planting material, nurseries and germplasm self-reliance	15	20	10	25	15
E.	Hi-Tech horticulture production	10	25	20	15	5

S. No	Component (A-L)	Dry Fruits (%)	Fresh Fruits (%)	Vegetables (%)	Floriculture (%)	Minor Crops (%)
F.	Crop diversification and high-value crop promotion	3	1	5	1	15
G.	Digital technology integration	4	4	4	2	4
H.	Infrastructure development	30	20	15	10	10
I.	Market access	10	10	15	10	10
J.	Value addition	14	5	10	5	20
K.	Financial access and support	1	1	2	1	1
L.	Sustainability and environmental management	1	4	1	2	2
	Total	100	100	100	100	100

Table 5.4 outlines the sub-mission wise convergence of national and UT level schemes to support the holistic development of the horticulture sector. It identifies key programmes that can be leveraged together to strengthen infrastructure, enhance productivity and promote value addition across different crop segments.

Table 5.4: Convergence of Schemes Across Horticulture Sub-Missions (2026-47)

S.No.	Sub-Mission	Relevant Schemes for Convergence
I	 Dry Fruits	HADP, MIDH, Agriculture Infrastructure Fund (AIF), Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PMFME), J&K Rural Employment Generation Programme (REGP), J&K Competitiveness Improvement Project (JKCIP), NHB
II	 Fresh Fruits	HADP, MIDH, PMFME, AIF, National Horticulture Board (NHB) schemes, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Sub-Mission on Agricultural Mechanisation (SMAM), JKCIP
III	 Vegetables	HADP, MIDH, PMFME, AIF, Agricultural Marketing Infrastructure (AMI), PMKSY, J&K Rural Livelihoods Mission (UMEED- JKRLM), JKCIP
IV	 Floriculture	HADP, MIDH, PMFME, AIF, Sub-Mission on Seed and Planting Material (SMSP), Rashtriya Krishi Vikas Yojana (RKVY), UMEED- JKRLM, JKCIP, CSIR-Aroma Mission, National Skill Development Mission (NSDM), Tourism Convergence (State/UT schemes)
V	 Minor Crops	HADP, MIDH, PMFME, AIF, RKVY, Dedicated MAPs Project Fund, CAPEX, UMEED- JKRLM, National Beekeeping and Honey Mission (NBHM), Tribal Sub-Plan (TSP), National Saffron Mission (NSM), National Ayush Mission (NAM), JKCIP

5.1.4 Integrated Phase-wise Action Plan

The integrated phase-wise action plan provides a consolidated view of interventions across all key components. Table 5.5 provides detailed short-term, medium-term and long-term interventions across the identified components along with the corresponding lead agencies/departments. These are mapped to the broader strategic phases as outlined in Table 5.1.

It is important to note this integrated plan is sector-wise in scope and not specific to any individual sub-mission. Each sub-mission adopts the same twelve components (A-L) but with differentiated priorities, allocations and activities aligned to its respective value chain and regional potential (as shown in Table 5.3).

Table 5.5: Integrated Phase-wise Action Plan

(i) **Component:** Assessment and Planning

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
Assessment	Conduct baseline surveys and mapping of horticulture potential in major districts	√		
Land zoning	Identify and categorise land suitable for horticulture expansion (district-wise zoning)	√		
Seeds and Planting Material Needs Assessment	Assess future requirements of seeds and planting material for all horticultural crops as per the State Horticulture Plan	√		
Policy Reforms	Formulate and notify updated horticulture policies and land use regulations	√		
Institutional restructuring	Bring all horticulture-related crops and activities (fruits, vegetables, spices, floriculture, saffron, medicinal and aromatic plants, protected cultivation, seed and planting material management) under respective Directorate of Horticulture for Jammu and Kashmir regions	√		
Lead Agencies / Departments	Department of Horticulture (DoH), State Planning Development & Monitoring Department, Ministry of Agriculture & Farmers Welfare			

(ii) **Component:** Research and Innovation

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Centre of Excellence</i>	Strengthen, network and functionalise existing Centres of Excellence (COEs) as district-level innovation hubs.	√	√	
	Collaborate with national/international institutions for research-led CoEs through joint projects/MoUs (e.g. Indo-Israeli Agriculture Project (IIAP), Indo-Dutch projects etc.)		√	√
	Define quality norms for CoEs and new technologies setting standardised criteria for infrastructure, planting material, training and extension.	√	√	
	Expand specialised CoEs focussed on climate-smart technologies and global R&D partnerships		√	√
<i>Technology scaling and innovation</i>	Establish at least 2 regional incubators along with incubation support mechanisms (through linkages with RKVY-RAFTAAR, NIF), to promote farmer-led innovations and integrate structured farmer feedback loops into the R&D system.	√	√	
	Scale up region-specific technologies for production, post-harvest handling, and value addition with 50% adoption of select technologies in target districts.		√	√
	Develop and implement crop-specific Standard Operating Procedures (SOPs) and Package of Practices (POPs) covering cultivation, disease management and post-harvest care, tailored to agro-climatic zones.	√	√	√
	Support the development and field-testing of advanced precision tools and AI (e.g., pest detection for walnuts, harvesting tools for saffron, moisture sensors for apples), in collaboration with research institutes and start-ups.		√	√
	Develop and operationalise predictive crop models for at least 3 key crops, using integrated climate, pest and soil health data, to enable location-specific advisories for farmers.		√	√
	Set up permanent innovation platforms and rapid response systems for climate/pest shocks in most vulnerable districts under National Innovations on Climate Resilient Agriculture (NICRA) program.		√	√
<i>Training and extension on new technologies</i>	Establish at least one training centre and agri-clinic centre in each district, with additional centres in 25 high-potential horticulture blocks. Integrate with existing KVKs and agri-extension networks to deliver hands-on training, advisory services, and digital agri-clinic support.	√	√	

Lead Agencies / Departments	ICAR, SKUST-K, SKUAST-J, Department of Horticulture, Ministry of Agriculture & Farmers Welfare
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(iii) **Component:** Skill Development and Capacity Building

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Training Programs</i>	Conduct at least 100 regular training programs annually on modern nursery management, GAP, IPM, post-harvest management.	√	√	√
	Train at least 1000 agri-entrepreneurs across all districts and facilitate the incubation of 100 horticulture-based startups through state-run/partnered incubation hubs.	√	√	√
	Upskill extension officers in AI, drones, pest management, and satellite monitoring; offer certification programs in partnership with tech institutions		√	√
<i>Extension Services</i>	Deploy over 50 mobile agri-advisory vans for on-site farmer support, demonstrations and best practice dissemination across all districts, with emphasis on remote and underserved areas.	√	√	√
	Establish at least one Community Resource Centre per high-potential horticulture clusters equipped with training and IT facilities		√	√
<i>Empowering women and youth</i>	Design targeted training programs to engage women and youth in agri-business, horticulture startups, and post-harvest management ensuring at least 40% female/youth participation.	√	√	√
	Provide financial and technical support for women and youth-led enterprises in horticulture, focusing on access to markets, technology, and credit with over 100 enterprises supported annually.	√	√	√
	Foster women and youth leadership roles in extension services, agri-entrepreneurship, and decision-making forums through targeted training and mentorship.		√	√
Lead Agencies / Departments	Agricultural Technology Management Agency (ATMA), DoH, ICAR, Ministry of Skill Development & Entrepreneurship (MSDE), KVKs, State Agriculture Department			

(iv) **Component:** Quality Planting Material, Nurseries, and Germplasm Self-reliance

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Regulatory reforms</i>	Amend and strengthen the existing Nursery Act to align with the Model Seed Act, through the State Legislature, to regulate seed quality, traceability, variety imports, and rootstock propagation.	√	√	
<i>Modern Nurseries</i>	Establish modern nurseries (40-50 ha) in each district with hydroponics, aquaponics, vertical farming, precision farming (automation, micro irrigation), tissue culture and renewable energy practices.	√	√	√
<i>Tissue culture labs</i>	Establish at least one tissue culture lab in each agro-climatic zone	√	√	
<i>Zero-import strategy</i>	Identify major crops and varieties dependent on imports; develop and scale germplasm through R&D institutions and certified nurseries	√	√	
<i>Clean Plant Programme implementation</i>	Operationalise clean plant centres for priority crops, ensure supply of pathogen-free, certified geotag planting material to nurseries and farmers.	√	√	√
<i>Propagation technology adoption</i>	Scale up proven propagation technologies (e.g. rootstock multiplication, feathered apple plants, walnut/olive propagation) via model nurseries and demonstrations, with an adoption by at least 50% of the nurseries.	√	√	
<i>Accredited Nurseries</i>	Upgrade nurseries to meet certification standards for high-density planting systems and climate-resilient crops.	√	√	√
<i>Seed villages and model nurseries</i>	Develop around 3 cluster-based model nurseries and 7 seed villages in PPP mode involving KVKs, private nurseries and FPOs, to meet region-specific planting material demands	√	√	√
<i>Quality assurance</i>	Set up third-party inspection and nursery rating systems to ensure compliance and traceability	√	√	√
<i>Export-Ready Systems</i>	Develop and implement export protocols, phytosanitary certification and targeted market outreach programs for planting material exports, in collaboration with DoH, export promotion councils and certification agencies.		√	√
Lead Agencies / Departments	Department of Horticulture (DoH), NHB, SKUAST, ICAR institutes, MIDH, Directorate of Plant Protection, Quarantine and Storage, APEDA, Private sector partners			

(v) **Component:** Hi-Tech Horticulture Production

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Hi Tech Horticulture implementation</i>	Pilot automated nursery units in 2 districts and scale to 10 districts by the medium term, and expand to all districts in the long term	√	√	√
	Deploy greenhouse, hydroponics, vertical farming models and precision horticulture practices on at least 100 demonstration plots in the state	√	√	√
	Implement orchard rejuvenation programs for old and senile orchards through farmer training programs, expert consultation services and community-based approaches.	√	√	√
	Expand micro-irrigation systems across horticulture areas to cover 50% of the total horticulture area by the medium term and 75% by the long term	√	√	√
	Strengthen and expand the Custom Hiring Centre (CHC) network by a) Establishing 100 additional horticulture-focused centres in underserved clusters, and b) Upgrading 387 existing CHCs with orchard-specific machinery, and promoting digital access, skilling, and targeted subsidies under Sub-Mission on Agricultural Mechanisation (SMAM).	√	√	√
Lead Agencies / Departments	Department of Horticulture (DoH), Ministry of Food Processing Industries (MoFPI), ICAR Institutes, Private Sector Partners			

(vi) **Component:** Crop Diversification and High-value Crop Promotion

Focus Area	Key Actions	Phase 1		Phase 2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Conservation of Traditional and Extinct Crops (e.g., kala zeera, singhara (water chestnut), lotus stem, asafoetida, mushroom)</i>	Initiate a focused revival program for traditional and lost crops through: germplasm conservation, targeted cultivation in North Kashmir, research trials in partnership with SKUSAT, market promotion campaigns and community-based approaches.	√	√	√

Focus Area	Key Actions	Phase 1		Phase 2 & 3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Saffron Expansion</i>	Enhance saffron productivity to around 7.8 kg/ha by: - installing improved sprinkler/drip irrigation systems across 2,000 hectares; - distributing better planting materials (high-yielding corms) to at least 10,000 farmers; and - piloting saffron cultivation in non-traditional areas such as Poonch, Bandipora, with phased expansion over the next 5 years.	√	√	√
<i>Olive Value Chain Development</i>	Develop a complete olive value chain, covering plantation, processing, and marketing, by establishing oil extraction infrastructure and support systems to revive and expand olive cultivation in potential regions such as Udhampur, Reasi, Rajouri, Ramban, Doda, Kishtwar, and Baramulla (Uri).	√	√	
<i>Diversification into New Nut and Berry Crops</i>	Introduce and scale up cultivation of high-value nuts and berry crops (such as hazelnut, chestnut, pecan nut, pistachio, blueberry, raspberry) through active involvement of SHGs/FPOs.		√	√
<i>Development of Temperate Fruit Clusters</i>	Establish grapes and kiwi production clusters in suitable agro-climatic zones (e.g., Ganderbal, Baramulla, Ramban, Udhampur, Kathua) supported by packhouses and cold storage.		√	√
<i>Strategic Promotion of TOP Crops (Tomato, Onion, Potato)</i>	Develop and implement a marketing strategy to position J&K as the key supplier of summer TOP crops to northern markets under Operation Greens.		√	√
<i>Vegetable Production and Seed Hubs</i>	Establish 3-5 vegetable seed production hubs, develop high-value vegetable production clusters, and set up minimal processing units in key agro-climatic zones.	√	√	
<i>Kharif Onion and Garlic Promotion</i>	Promote commercial-scale kharif onion and garlic cultivation in identified suitable zones by establishing post-harvest storage units and securing market tie-ups for off-season supply.	√	√	
<i>Sub-Tropical Fruit Value Addition</i>	Facilitate development of value addition and processing infrastructure for local fruits (e.g., mango, pomegranate, guava) with branding and shelf-life extension technologies in key production clusters.	√	√	

Focus Area	Key Actions	Phase 1		Phase 2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Flower Crop Technology Standardisation</i>	Standardise bulb production technology for high-value flowers like tulip, gladiolus, iris, and saffron through collaboration with SKUAST and extension to nurseries and farmers.	√	√	
<i>Medicinal and Aromatic Crop Promotion</i>	Promote commercial cultivation of high-value medicinal and aromatic crops for traditional and alternative medicine markets across key agroclimatic zones under the J&K Aroma Arogya Gram (JAAG) project.	√	√	
Lead Agencies / Departments	Department of Horticulture (DoH), JK Horticulture Produce Marketing and Processing Corporation (JKHPMC), NHB, SKUAST, ICAR institutes, MIDH,			

(vii) **Component:** Digital Technology Integration

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
Early warning systems	Establish real-time early warning systems for pest, disease and weather threats in all districts using remote sensing, AI & IoT tools		√	√
Traceability	Deploy precision farming technologies and traceability systems (blockchain, QR codes) in at least three major horticulture value chains (apple, walnut, saffron)	√	√	√
	Set up regional quality control units and testing labs (chemical residue, MRLs, phytosanitary norms) in key horticulture clusters.		√	√
Digital Platforms	Develop and operationalise digital platforms to support e-marketing of fresh and processed produce, tailored to the needs of farmers, FPOs and local agribusinesses.		√	√
	Strengthen Kisan Khidmat Ghars (KKGs) at the panchayat level as digital information hubs and integrate them with farmer-centric mobile apps to deliver real-time updates on prices, weather, pest alerts and best practices	√	√	√
Lead Agencies / Departments	Ministry of Electronics and Information Technology (MeitY), DoH, ICAR, Indian Meteorological Department (IMD), State Agri Depts, FSSAI, NIC, Ministry of Agriculture & Farmers Welfare, State IT Departments			

(viii) **Component:** Infrastructure Development

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Cold Storage and Warehousing</i>	Develop basic cold storage (0-5°C) and packhouse infrastructure strategically located in key production areas at the block and district level.	√		
	Establish at least 5 integrated cold chain hubs in high-value horticulture clusters, each with linkages to processing units and export terminals.	√	√	
	Develop modern warehousing facilities with grading and sorting facilities across major horticulture clusters.	√	√	
	Set up advanced CA and ULO storage facilities in at least 3 key production clusters under Agri Infra Fund in North and Central Kashmir, ensuring regional balance and equitable access.		√	√
	Promote crop-specific mechanisation across the value chain, including pre-harvest, harvest, post-harvest handling, processing, and preservation in targeted horticulture clusters through FPOs.	√		
	Establish processing clusters for the fruit crops proposed in each district	√	√	
<i>Transportation and Logistics</i>	Strengthen first- and last-mile road and rail connectivity to major horticulture clusters by prioritising them under PM Gati Shakti and state-level infrastructure planning	√	√	√
	Promote air freight support and cargo handling for perishables through incentives and infrastructure at airports	√	√	√
<i>Renewable energy integration</i>	Install solar-powered cold storage, irrigation pumps and packhouses across the districts, prioritising high-production clusters and leveraging schemes like PM-KUSUM and Agri-Infra Fund.	√	√	√
	Promote decentralised renewable energy grids in production clusters and nurseries		√	√

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Knowledge and R&D infrastructure</i>	Develop ICT-enabled knowledge dissemination systems (advisory platforms, mobile-based systems)	√	√	√
	Establish 5–6 regional lab testing and diagnostic centres in key horticulture clusters and 2–3 agro-processing R&D units linked to SKUASTs to support quality assurance, pathogen detection, and value-added product development.	√	√	
	Establish NABL-accredited Food Testing Labs in each Food Park and upgrade existing labs to meet FSSAI 2006 standards; align with national testing institutions for quality assurance and consumer safety		√	√
	Establish an Indian Institute of Packaging Centre to design commodity-specific packaging materials for niche crops and facilitate research, training, and industry collaboration.		√	
Lead Agencies / Departments	Ministry of Food Processing Industries (MoFPI), NHB, State Horticulture Department, Ministry of Road, Transport and Highways, Ministry of Civil Aviation, APEDA, Ministry of New and Renewable Energy (MNRE), Food Safety and Standards Authority of India (FSSAI), National Accreditation Board for Testing and Calibration Laboratories (NABL)			

(ix) **Component: Market Access**

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Domestic market linkages</i>	Establish direct marketing channels by promoting farmer markets (at least 2 in each district), FPO/ cooperatives-led markets in key urban and rural/peri-urban areas.	√	√	√
	Facilitate the onboarding of farmers/FPOs onto e-commerce platforms such as Open Network for Digital Commerce (ONDC) for direct sales	√	√	√
	Upgrade existing price discovery mechanisms by expanding real-time digital platforms such as e-NAM, integrating them across mandis (remaining 7), FPOs (around 318), and e-commerce channels.	√	√	
	Develop regional branding initiatives and certification schemes – such as GI and organic labels - with the involvement of local communities, FPOs.	√	√	√

Focus Area	Key Actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
Export facilitation	<i>Foundational infrastructure and services</i>			
	Establish export facilitation centres one each in Jammu and Kashmir region, with customs clearance, documentation, financial assistance and real-time market intelligence; streamline logistics for export promotion.	√	√	√
	Set up export certification centres (for MRL testing, GAP certification, etc.) and compliance systems in both Jammu and Kashmir regions.	√	√	
	Facilitate product certification (through NPOP, organic, and international food safety standards)	√	√	√
	<i>Institutional and knowledge systems</i>			
	Conduct regular capacity building for farmers/exporters (at least 1000 annually) on global standards and export procedures tailoring modules by crops and regions.	√	√	√
	Establish intelligence hubs for global demand forecasting, price trends and quality standard requirements		√	√
	<i>Export infrastructure scaling up</i>			
	Develop integrated export hubs at the district level (warehousing, aggregation, processing of high-value crops)	√	√	√
	Set up integrated Export-Oriented Processing Zones (EPZs) with processing, cold storage, packaging, quality labs and customs clearance support		√	√
Lead Agencies / Departments	APEDA, Jammu Kashmir Trade Promotion Organisation (JKTPO), Small Farmers' Agribusiness Consortium (SFAC), J&K Horticultural Produce Marketing & Processing Corporation Ltd (JKHPMC), DoH, Ministry of Commerce and Industry, MoFPI, State Agriculture Marketing Board, eNAM			

(x) **Component: Value Addition**

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Value Addition and Branding</i>	Establish over 100 small-scale minimal processing units (e.g. grading, dehydration, pulp extraction) across key clusters	√	√	
	Set up industry-scale horticulture processing units in high-potential districts (such as Anantnag, Baramulla, Pulwama, Jammu, Kathua) through PPPs and Agri Infra Fund		√	
	Continue development of brand (e.g for apple, saffron, walnut, cherry) and quality certification programs	√	√	√
	Facilitate GI registration for key products and promote them nationally and internationally.	√	√	
<i>Tourism and experience-based value addition</i>	Develop horti-tourism circuits in key production districts by partnering with local communities/cooperatives and the tourism department, and promote regional products.	√	√	√
Lead Agencies / Departments	MoFPI, DoH, APEDA, FSSSAI, Ministry of Micro, Small and Medium Enterprises, State Agro Industries Development Corporation, Department of Tourism (J&K).			

(xi) **Component: Financial Access and Support**

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Credit Facilities</i>	Facilitate easy access to loans at concessional rates, especially for smallholders and FPOs, by expanding KCC coverage and strengthening partnerships with banks and NBFCs.	√	√	√
	Leverage NABARD's Credit Guarantee Fund (₹1,000 crore) to facilitate collateral-free loans for SHGs, FPOs, and individual farmers	√	√	
	Provide subsidised interest schemes for horticulture loans	√	√	
	Create a dedicated smallholder financing window through cooperative banks, SHGs and MFIs	√	√	√
<i>Insurance</i>	Design and implement crop-specific insurance schemes for major horticulture crops across the districts.	√	√	√
	Target 100% farmer enrolment, with special outreach and premium support for marginal and small farmers	√	√	√

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Investment Promotion</i>	Create and operationalise a dedicated Horticulture Development Fund, including support for high-density planting, post-harvest and processing units	√	√	
	Promote Public-Private Partnerships models for infrastructure, R&D and processing investments	√	√	√
	Encourage private investment through targeted mechanisms and incentives (e.g., viability gap funding)		√	√
	Attract Foreign Direct Investment for high-tech horticulture and export-oriented units by organising investment summits, offering policy incentives and improving ease of doing business.		√	√
Lead Agencies / Departments	NABARD, DoH, Ministry of Agriculture & Farmers Welfare, Department for Promotion of Industry and Internal Trade (DPIIT), MoFPI, Small Industries Development Bank of India (SIDBI), State Agri Depts, Private Partners			

(xii) **Component:** Sustainability and Environmental Management

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Land use regulation and environmental compliance</i>	Draft amendments to the State Forest Act to permit the removal of old/unproductive trees for orchard rejuvenation	√		
	Conduct quarterly awareness programs for farmers and forest officials on revised regulations, best practices for orchard rejuvenation, and compliance requirements, led by horticulture and forest departments.	√	√	
	Establish a regulatory mechanism to oversee the implementation of amendments, ensuring adherence to environmental guidelines and sustainable land use practices.	√	√	√
<i>Sustainable Practices</i>	Promote organic farming/natural farming models and certification schemes Achieve a 50% reduction in pesticide usage across target areas; bring 40-50% of agricultural land under chemical-free crops in the long term.	√	√	√
	Implement micro-irrigation, water harvesting and efficient irrigation systems Increase the area under micro-irrigation to at least 2% of total horticulture area, focussing on high-density plantation areas (around 10,000 ha)	√	√	√
	Incentivise sustainable practices (carbon farming and eco-labelling) and integrate into FPOs through capacity building and certification assistance.	√	√	√

Focus area	Key actions	Phase 1		Phase2 &3
		Short-term (2026-28)	Medium-term (2028-30)	Long-term (2031 onwards)
<i>Climate Resilience</i>	Develop and promote climate-resilient varieties suited for local agro-climatic zones	✓	✓	✓
	Mainstream integrated pest management, nutrient management and conservation farming	✓	✓	✓
	Develop district-level disaster management plans	✓	✓	✓
	Establish early warning systems for extreme weather and pest outbreaks in horticulture clusters	✓	✓	
	Create climate-resilient farming zones through agro-climatic mapping and targeted crop planning	✓	✓	
	Scale up agroforestry and mixed farming models combining fruit trees with underutilised crops	✓	✓	
	Develop carbon sequestration programs as part of a broader climate-smart transition		✓	✓
<i>Circular economy</i>	Promote composting and vermicomposting units using horticultural and organic waste in key horticultural clusters by providing technical training and market linkages for compost products through FPOs, SHGs and rural entrepreneurs.	✓	✓	
	Facilitate R&D and pilot projects through FPOs/cooperatives/SHGs on converting pruning waste and biomass into biochar or biogas.		✓	✓
	Promote cooperative-led value chains for waste-to-wealth enterprises (e.g., fruit pulp waste to pectin or animal feed) through capacity building and financial support in key horticulture clusters.		✓	✓
	Develop policy incentives for circular practices in horticulture (reuse, recovery, recycling)		✓	✓
Lead Agencies / Departments	Department of Horticulture (DoH), National Centre for Organic Farming (NCOF), ICAR, Ministry of Environment, Forest and Climate Change (MoEFCC), Pradhan Mantri Kisan Sinchai Yojana (PMKSY), State Agriculture & Irrigation Departments			

5.1.5 Indicative Indicators of Progress for the Sub-missions

Given the long-term horizon and agro-climatic diversity of Jammu & Kashmir, the following indicative progress indicators are proposed to track both outputs (e.g. infrastructure created, services delivered) and outcomes (e.g. productivity gains, income improvements), enabling phased monitoring and adaptive implementation of the sub-missions (Table 5.6).

Table 5.6: Indicators of Progress for the Sub-missions (indicative)

(i) Dry fruits

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
A.	Assessment and Planning	• Districts with completed profiling and crop suitability maps (% of total dry-fruit districts).		
B.	Research and Innovation	• Germplasm accessions evaluated (no.) and varietal trials initiated (no. locations/cultivars). • Formal collaborations/ MoUs with ICAR/NBPGR and SKUAST (no)	• Promising varieties released/recommended (no.) and area under new cultivars (ha, % of dry-fruit area). • On-farm research-demonstration plots established (no)	• Productivity gain over baseline for key dry fruits (%). • Share of area under climate-resilient / improved cultivars (%).
C.	Skill Development & Capacity Building	• Farmers, women, and youth trained (no., sex-disaggregated). • Functional Farmer Field Schools / learning sites (no.)	• Producers certified in good agricultural practices/post-harvest (% of dry-fruit farmers). • Active local trainers / master trainers developed (no.)	• Share of farmers regularly adopting recommended practices (%). • Increase in average farmer income from dry fruits compared to baseline (%).
D.	Quality Planting Material, Nurseries & Germplasm Self-Reliance	• Hi-tech nurseries and mother orchards established/upgraded (no.). • Annual certified planting material production (no. plants) vs. estimated demand (% met)	• Nurseries meeting quality certification standards (%). • Share of planting material sourced within J&K (% self-reliance)	• Export-quality planting material lines developed (no.). • Sustained replacement rate of old orchards with certified material (% area per year)
E.	Hi-Tech Horticulture Production	• Area of old almond/walnut orchards rejuvenated (ha). • New high-density plantations established (ha) and polyhouse area (ha)	• Average yield per hectare in rejuvenated and high-density orchards vs. baseline (% increase). • Share of dry-fruit area under hi-tech practices (%).	• Reduced yield variability over years (%). • Share of total dry-fruit output from high-density / rejuvenated orchards (%).
F.	Crop Diversification & High-Value Crop Promotion	• Additional area brought under diversified dry-fruit and associated high-value crops (ha). • Number of diversification demonstration plots and farmer groups engaged	• Proportion of farm income from diversified crops vs. traditional monocrops (%). • Districts with established diversification clusters (no.).	• Share of diversified crops in total dry-fruit export/value (%). • Risk reduction in farmer income (year-to-year income variability %).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
G.	Digital Technology Integration	- Digital advisory/extension app users (no. dry-fruit farmers) - Pilot orchards with sensor-based monitoring / precision plant protection (no.).	- Coverage of digital advisories (% of dry-fruit area under digital services). - Reduction in pesticide use or spray frequency due to precision tools (%).	- Integrated digital traceability for dry-fruit value chains (share of export consignments traceable %). - Decision-support tools institutionalised within DoH (no. tools in regular use).
H.	Infrastructure Development	- Pack houses, village aggregation hubs and cold rooms installed (no., MT capacity). - Reefer vehicles deployed for dry fruits (no.).	- Share of marketed dry fruits routed through improved infrastructure (% of marketed surplus). - Reduction in post-harvest losses for dry fruits (% vs. baseline).	- Export hubs operating at or above planned utilisation (% capacity use). - Private investments leveraged in storage and logistics (₹ or % of total investment)
I.	Market Access	- Dry-fruit FPOs formed/strengthened (no., active membership). - Mandis and e-platforms offering dedicated dry-fruit trading channels (no.).	- Direct market / organised buyer linkages for FPOs (no. contracts, volume handled). - Share of farmers selling through FPOs or digital platforms (%).	- Realised farm-gate price increase for major dry fruits over baseline (%). - Share of dry-fruit output entering premium or export markets (%).
J.	Value Addition	- New/modernised dry-fruit processing and grading–packing units (no., installed capacity). - Farmer/SHG groups engaged in value-addition activities (no.).	- Proportion of dry-fruit production processed or graded–packed (% of volume). - New branded/value-added products launched (no.).	- Share of value-added products in total dry-fruit revenue (%). - Increase in per-unit value realisation compared to raw, unprocessed produce (%).
K.	Financial Access & Support	- Dry-fruit farmers linked to institutional credit (no., loan volume). - Insurance pilots launched (no. schemes, farmers covered).	Insurance penetration among dry-fruit farmers (% of eligible farmers).	- Sustained credit flow to dry-fruit sector (₹ per year, CAGR). - Share of losses compensated through risk/insurance instruments (% of reported losses).
L.	Sustainability & Environmental Management	- State Forest Act amended to permit removal of old/unproductive trees for orchard rejuvenation. - Area under micro/drip irrigation in dry-fruit orchards (ha). - Demonstration plots of climate-resilient/organic management (no.).	- Share of dry-fruit area under climate-resilient varieties and water-efficient systems (%). - Certified organic or residue-safe dry-fruit area (ha).	- Long-term improvement in water-use efficiency and soil health indicators in orchards (% change from baseline). - Share of dry-fruit exports meeting international sustainability organic standards (%).

(ii) Fresh fruits

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
A	Assessment and Planning	% of fresh-fruit districts with completed GIS based orchard surveys and resource maps.		
B	Research and Innovation	Number of collaborative R&D projects with ICAR/NBPGR/IIHR and SKUAST.	- Number of climate-resilient and high-yielding varieties released/recommended for J&K. % of fresh-fruit area under released / recommended cultivars.	Productivity gain over baseline for major fruits (% increase in tons/ha).
C	Skill Development & Capacity Building	- Farmers trained through FFS, KVK demos, and exposure visits (no., sex- and youth-disaggregated). - Number of FPO leaders and orchard managers receiving certified skills in production and post-harvest.	% of orchardists adopting recommended GAP/INM/IPM and scientific post-harvest practices. - Number of certified master trainers functioning at district/block level.	- Increase in average net income per fruit grower over baseline (%). % of FPOs and producer groups with professional management and technical staff.
D	Quality Planting Material, Nurseries & Germplasm Self-Reliance	- Number of hi-tech nurseries, tissue-culture labs, and clonal rootstock units established/upgraded. - Annual production of certified planting material vs. total requirement (% demand met).	% of nurseries accredited / certified under national or UT standards. - Share of fresh-fruit planting material sourced from accredited J&K nurseries (% self-reliance).	- Annual share of new/replanted orchards using certified planting material (% of area). - Number of export-compliant planting material lines or elite rootstocks maintained.
E	Hi-Tech Horticulture Production	- Area brought under high-density plantations and rejuvenated orchards (ha). - Area under mechanised operations, precision irrigation, and fertigation (ha).	- Average yield in high-density and rejuvenated orchards vs. traditional systems (% increase). % of total fresh-fruit area under hi-tech production packages.	- Stability of production (reduction in inter-annual yield variability %). - Share of total fruit output from hi-tech orchards (% of production).
F	Crop Diversification & High-Value Crop Promotion	- Additional area under kiwi, and other promoted fruits (ha). - Number of climate-resilient varietal trials and diversification demonstrations conducted.	- Share of diversified/ high-value fruits in total fresh-fruit area and value (%). - Number of functional diversification clusters with input, advisory, and market arrangements.	- Share of diversified/ high-value fruits in export volume/value (%). - Reduction in income volatility for diversified growers compared to baseline (%).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
G	Digital Technology Integration	- Number of farmers registered on e-extension, weather advisory, and traceability apps. - Number of orchards using IoT-based monitoring or real-time pest-disease alert systems.	- Coverage of digital advisories (% of fresh-fruit area or farmers). - Reduction in pesticide applications or input costs due to decision-support tools (%).	% of export consignments or premium-market lots with end-to-end digital traceability. - Number of digital platforms integrated with department Management Information System (MIS) for routine planning and monitoring.
H	Infrastructure Development	- New CA stores, pack houses, pre-cooling units, NABL labs, and aggregation centres established (no., total MT capacity). - Number of reefer vans operational and mandis upgraded for fresh-fruit handling.	- Share of marketed fruit volume routed through improved cold-chain and pack-house infrastructure (%). - Reduction in post-harvest losses for apples and other key fruits compared to baseline (%).	- Capacity utilisation of CA, cold-chain, and labs (%). - Private and PPP investment mobilised in post-harvest and logistics (₹ or % of total).
I	Market Access	- Fresh-fruit FPOs formed/strengthened (no., active members and business turnover). - Number of e-commerce linkages, rural/satellite mandis, and brand campaigns initiated.	% of fresh-fruit output marketed through FPOs, organised buyers, or digital platforms. - Number and volume of export facilitation transactions supported.	- Average farm-gate price realisation vs. baseline (% increase) for major fruits. - Share of produce entering premium domestic and export markets (%).
J	Value Addition	- Number and installed capacity of modern processing units and micro-processing enterprises. - Number of PMFME/PMKSY-linked fresh-fruit processing projects sanctioned and operational.	- Share of fresh-fruit production processed (pulp, juice, dehydration, etc.) as % of total volume. - Number of branded/value-added products launched and actively marketed.	- Share of processing and value-added products in total sector revenue (%). - Increase in per-unit value realisation compared to sale of raw fruit (%).
K	Financial Access & Support	- Volume of horticulture loans disbursed and beneficiaries covered under interest-subvention / credit-linked schemes. - Number of technology-financing and insurance products customised for orchards.	% of fresh-fruit farmers with active institutional credit and/or insurance cover. - Claims settled under horticulture insurance as % of reported eligible losses.	- Sustained annual credit flow to fresh-fruit horticulture (₹, growth rate). - Share of sectoral risk managed through formal financial instruments (%).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
L	Sustainability & Environmental Management	- Area under organic or low-chemical fresh-fruit production and micro-irrigation (ha). - Number of pilots on waste utilisation (pomace, pruning biomass) and biodiversity conservation sites.	% of fresh-fruit area under certified/verified sustainable or organic standards. - Reduction in water use and chemical load per unit of production (% vs. baseline).	- Number of operational carbon/biodiversity certification projects and total area covered (ha). - Share of certified sustainable/organic fruit in export and premium domestic markets (%).

(iii) Vegetables

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
A	Assessment and Planning	Districts with mapped vegetable clusters and crop-suitability layers (% of districts).		
B	Research and Innovation	- New high-yield, short-cycle, disease-resistant and climate-resilient varieties/lines under testing (no.). - Joint trials with ICAR–IIHR, SKUAST and private firms initiated (no. of collaborative trials).	- Released/recommended varieties for open-field and protected cultivation (no.). - Area under recommended varieties (% of vegetable area).	- Yield gain in key vegetables over baseline (% increase). - Share of area under climate-resilient/disease-tolerant varieties (%).
C	Skill Development & Capacity Building	- Farmers (women, youth) trained in protected cultivation, post-harvest and marketing (no.). - Farmer field schools and demo farms established (no.).	- Certified skilled growers and entrepreneurs under PMFME/other schemes (no.). - Adoption of recommended practices in clusters (% of trained farmers).	- Increase in average net income from vegetables per participating household (%). - Share of FPO/SHG members with advanced skills or certification (%).
D	Quality Planting Material, Nurseries & Germplasm Self-Reliance	- Seed villages established (no.) and hybrid seed production volume (tons). - Functional nurseries and community seed banks (no.).	- Share of seed demand met from local quality seed/nursery systems (%). - Nurseries meeting quality certification/accreditation standards (%).	- Stability of seed supply - Share of vegetable area sown with certified/improved seed (%).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
E	Hi-Tech Horticulture Production	- Area under polyhouses, shade nets and drip/fertigation (ha). - Number of climate-resilient production demonstrations established.	- Yield improvement in protected vs open-field systems (%). % of cluster area under hi-tech production packages.	- Share of total vegetable production originating from hi-tech/protected systems (%). - Reduction in production variability due to weather shocks (%).
F	Crop Diversification & High-Value Crop Promotion	- Area under high-value vegetables and off-season production (ha). - Number of crop-rotation pilots with pulses and spices.	- Share of high-value vegetables in total vegetable area and value (%). - Number of functional diversification clusters with input, advisory, and market arrangements.	- Share of high-value vegetables in export volume/value (%). - Reduction in income volatility for diversified growers compared to baseline (%).
G	Digital Technology Integration	- Number of farmers registered on e-extension, weather advisory, and traceability apps. - Number of farms/protected units using IoT-based monitoring or real-time pest-disease alert systems.	- Coverage of digital advisories (% of vegetables area or farmers). - Reduction in pesticide applications or input costs due to decision-support tools (%).	% of export consignments or premium-market lots with end-to-end digital traceability. - Number of digital platforms integrated with department MIS for routine planning and monitoring.
H	Infrastructure Development	- Cold-chain, pack houses, pre-cooling units, NABL labs, and aggregation centres established (no., total MT capacity). - Number of reefer vans operational and mandis upgraded for vegetables handling.	- Share of marketed vegetables volume routed through improved cold-chain and pack-house infrastructure (%). - Reduction in post-harvest losses for vegetables compared to baseline (%).	- Capacity utilisation of CA, cold-chain, and labs (%). - Private and PPP investment mobilised in post-harvest and logistics (₹ or % of total).
I	Market Access	- Vegetables FPOs formed/strengthened (no., active members and business turnover). - Number of e-commerce linkages, rural/satellite mandis, and brand campaigns initiated.	% of vegetables marketed through FPOs, organised buyers, or digital platforms. - Number and volume of export facilitation transactions supported.	- Average farm-gate price realisation vs. baseline (% increase) for major vegetables. - Share of produce entering premium domestic and export markets (%) such as organic or processed vegetable markets.

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
J	Value Addition	Number and installed capacity of modern processing units and micro-processing enterprises.	- Share of fresh-vegetable production processed (frozen, canned, dehydration, etc.) as % of total volume. - Number of branded/ value-added products launched and actively marketed.	- Share of processing and value-added products in total sector revenue (%). - Increase in per-unit value realisation compared to sale of raw vegetables (%).
K	Financial Access & Support	- Volume of horticulture loans disbursed and beneficiaries covered under interest-subsidy / credit-linked schemes. - Number of technology-financing and insurance products customised for vegetable crops/protected cultivation units.	% of vegetables farmers with active institutional credit and/ or insurance cover. - Claims settled under horticulture insurance as % of reported eligible losses.	- Sustained annual credit flow to vegetables (Rs, growth rate). - Share of sectoral risk managed through formal financial instruments (%).
L	Sustainability & Environmental Management	- Area under organic or low-chemical vegetables production and micro-irrigation (ha). - Number of pilots on vegetable waste utilisation and biodiversity conservation sites.	% of vegetables area under certified/verified sustainable or organic standards. - Quantified reduction in water use and chemical load per unit of production (% vs. baseline).	- Number of operational carbon/biodiversity certification projects and total area covered (ha). - Share of certified sustainable/organic vegetables in export and premium domestic markets (%).

(iv) Floriculture

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
A	Assessment and Planning	Districts with floriculture baseline surveys completed (% of potential districts).		
B	Research and Innovation	- Flower species/varieties evaluated under local conditions (no.). - MoUs with ICAR-IIHR, CSIR-National Botanical Research Institute (NBRI), SKUAST, private breeders (no.).	- New varieties/hybrids recommended (no.) and area under improved varieties (ha, %). - Demonstration of climate-controlled production systems (no.).	- Yield and quality improvement over baseline (% stem length, vase life, bud size). - Share of climate-resilient / low-input flower varieties (% area).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
C	Skill Development & Capacity Building	- Farmers/SHGs trained in floriculture practices (no., % women). - Certified master trainers / nursery technicians developed (no.).	Producers certified in GAP / post-harvest handling (% of flower growers).	- Share of growers consistently adopting recommended practices (%). - Increase in average income from floriculture over baseline (%).
D	Hi-Tech Horticulture Production	- Area under protected cultivation (polyhouse, net house) (ha). - Open-field floriculture clusters developed (no.).	- Yield and quality improvement in protected vs open systems (%). - Share of floriculture area under hi-tech practices (%).	- Reduction in seasonal variability (%). - Share of export-grade flowers in total output (%).
E	Crop Diversification & High-Value Crop Promotion	- Area diversified into high-value cut flowers, bulbs, ornamentals (ha). - Number of floriculture-based enterprises (nursery, landscaping, bouquet units).	- Share of income from diversified floriculture activities (%). - Eco-tourism-linked flower clusters established (no.).	- Risk reduction in farmer income (% variability). - Share of non-traditional flowers in total floriculture value (%).
F	Digital Technology Integration	- Growers using digital advisories / market apps (no.). - Pilot units with sensor-based climate control (no.).	- Area under digital monitoring and advisory services (%). - Reduction in input use (water, fertiliser) due to precision systems (%).	Digital traceability for premium/export flower consignments (%).
G	Infrastructure Development	- Flower pack houses, grading units, pre-cooling facilities established (no.). - Cold-chain capacity created (MT).	- Share of marketed flowers routed through cold-chain (%). - Reduction in post-harvest losses (%).	- Export-oriented flower logistics hubs operational (% utilisation). - Private investment leveraged (₹ or % of total).
H	Market Access	- Floriculture FPOs/SHGs formed or strengthened (no.). - Dedicated flower mandis / auction platforms created (no.).	- Organised buyer contracts secured (no., volume). - Share of growers selling through collective platforms (%).	- Farm-gate price improvement over baseline (%). - Share of output sold in premium/export markets (%).
I	Value Addition	- Units for bouquet-making, drying, essential oils, decorative products (no.). - SHGs engaged in floriculture value addition (no.).	- Share of floriculture output value-added (%). - New branded floriculture products launched (no.).	- Share of value-added products in total floriculture revenue (%). - Increase in per-unit value realisation (%).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
J	Financial Access & Support	- Floriculture enterprises linked to credit (no., ₹). - Insurance / risk pilots launched (no.).	Insurance coverage among floriculture growers (%).	- Sustained credit flow to floriculture sector (₹ CAGR). - Share of losses compensated through insurance (%).
K	Sustainability & Environmental Management	- Area under water-efficient irrigation systems (ha). - Women-led floriculture enterprises supported (no.).	Certified organic / residue-safe flower area (ha).	- Reduction in water and chemical use (%). - Share of floriculture exports meeting sustainability standards (%).

(v) **Minor Crops**

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
A	Assessment and Planning	- Baseline mapping of minor crops by agro-ecology and community (% districts). - Crop-specific development plans notified (no.).		
B	Research and Innovation	- Germplasm accessions characterised (no.). - Research partnerships with CSIR– (Central Institute of Medicinal and Aromatic Plants (CIMAP), SKUAST, universities (no.).	- Improved varieties / cultivation protocols released (no.). - Area under improved practices (%).	- Productivity gains over baseline (%). - Share of climate-resilient / low-input varieties (%).
C	Skill Development & Capacity Building	- Farmers/collectors trained (no., % tribal/women). - Community resource persons developed (no.).	Producers certified in GAP / organic / MAP standards (%).	- Adoption of recommended practices (%). - Income increase from minor crops over baseline (%).
D	Quality Planting Material, Nurseries & Germplasm Self-Reliance	- MAP nurseries, saffron corm units, kala zeera seed systems established (no.). - Beekeeping colonies supported (no.).	- Share of quality-certified inputs (%). - Local self-reliance in planting material / colonies (%).	Sustained replacement and quality maintenance rate (%).
E	Hi-Tech Horticulture Production	- Area under scientific cultivation / managed collection (ha). - Demonstration plots established (no.).	Yield improvement over baseline (%).	Share of total output from scientific systems (%).
F	Crop Diversification & High-Value Crop Promotion	- Area integrated with farming systems (ha). - Number of households adopting minor crops (no.).	Share of household income from minor crops (%).	Reduction in livelihood risk (% income variability).
G	Digital Technology Integration	- Digital registries for producers and collectors (no.). - Pilot traceability systems for saffron, MAPs, honey (no.).	Coverage of digital traceability (% production).	Export consignments fully traceable (%).

S. No.	Components	Phase 1 (2026-30)	Phase 2 (2030-35)	Phase 3 (2035-47)
H	Infrastructure Development	Primary processing units (drying, distillation, grading) established (no.).	Reduction in post-harvest losses (%).	Processing capacity utilisation (%).
I	Market Access	- FPOs / producer collectives formed (no.). - GI / branding initiatives supported (no.).	- Direct buyer/export linkages established (no.). - Share of produce sold through organised channels (%).	- Price premium over baseline (%). - Share of production entering premium/export markets (%).
J	Value Addition	Value-added units (essential oils, extracts, honey processing) established (no.).	Share of minor crops processed/value-added (%).	Increase in value realisation (%).
K	Financial Access & Support	Producers linked to credit and grants (no., ₹).	Insurance / price-support coverage (%).	Sustained investment flow into minor crop sector (₹, CAGR).
L	Sustainability & Environmental Management	- Area under organic / sustainable certification (ha). - Tribal and women beneficiaries (%).	Biodiversity conservation indicators (no. species conserved).	Long-term livelihood and ecosystem resilience indicators (% improvement).

5.1.6 Institutional Mechanisms For Monitoring And Review

To ensure alignment with the roadmap's goals and to assess implementation effectiveness, regular progress reviews and strategy recalibration should be conducted every 3 to 5 years. These reviews could be anchored in the indicative progress indicators outlined in section 5.1.5 and informed by emerging evidence, field-level learning, and evolving market and climatic conditions. The Department of Horticulture may serve as the nodal agency for monitoring and review, in coordination with the State Planning Development and Monitoring Department, and NABARD, among others.





WAY FORWARD



Jammu & Kashmir's horticulture sector thrives on unique heterogeneity spanning subtropical Jammu plains ideal for TOP vegetables and off-season crops, temperate Kashmir Valley dominating apples, walnuts, and saffron, and high-altitude zones suited for berries and medicinal plants. This geographic and agro-climatic diversity creates unparalleled opportunities for year-round production, climate-resilient diversification, and premium exports, but also requires tailored interventions to fully unlock this potential.

The report presents a comprehensive strategy for advancing this sector through advanced technologies, robust infrastructure, and enhanced market linkages. These multifaceted interventions will not only improve productivity and profitability but also ensure that the horticultural industry in J&K remains competitive and sustainable in the global market. Importantly, these efforts also include targeted support for smallholders, ensuring that they benefit from capacity-building, access to resources, and market linkages.

Through this phased, inclusive, and innovation-driven approach, the roadmap envisions transforming J&K into a national and global leader in high-value horticulture by 2047, contributing to India's vision of Viksit Bharat.

Major recommendations structured thematically, with geographic and agro-climatic differentiation embedded within each theme, wherever relevant, are outlined as follows:

S. No.	Theme	Action	Geographic and Agro-Climatic Application
A	Institutional and Policy Reforms (Statewide framework Zone-sensitive implementation)	• Unify all horticulture-related activities (fruits, vegetables, floriculture, spices, plantation crops, apiculture, saffron, protected cultivation, nurseries, and seeds) under respective Directorate of Horticulture for Jammu and Kashmir to address institutional fragmentation. • Amend the Fruit Nurseries (Licensing) Act, 1987 to strengthen regulation of planting material production, certification, traceability, and imports; • Amend the State Forest Act to enable orchard rejuvenation while ensuring ecological safeguards.	• Kashmir Valley: Facilitate removal and replacement of senile apple and walnut orchards for high-density rejuvenation using climate-resilient cultivars. • Jammu Plains: Strengthen nursery regulation and quality control for subtropical vegetables, TOP crops, and imported planting material.

S. No.	Theme	Action	Geographic and Agro-Climatic Application
B	Nursery and Planting Material Systems (Zone-specific specialisation within a unified certification framework)	- Establish PPP-based model nurseries, seed villages, and high-tech nurseries; introduce standardised certification systems and capacity-building for modern nursery management. - Establish modern nurseries (40-50 ha) in each district with hydroponics, aquaponics, vertical farming, precision farming (automation, micro irrigation), tissue culture and renewable energy practices. - Establish at least one tissue culture lab in each agro-climatic zone	Jammu (Subtropical): Nurseries for TOP crops, garlic, and off-season vegetables, with a focus on heat- and humidity-tolerant varieties. Kashmir Valley (Temperate): High-tech nurseries for apples, walnuts, kiwi, saffron, and floriculture, including clonal rootstocks. Cold and High-Altitude Areas (>2500 m): Pilot nurseries for niche crops such as medicinal herbs, seed potatoes, and berries.
C	Productivity Enhancement and Crop Diversification (Cluster-based, agro-ecologically aligned)	Promote high-density plantations, crop-specific SOPs/POPs, and horticultural clusters to enhance productivity and profitability.	Jammu Plains: - Subtropical clusters for grapes, garlic, onion, tomato, and off-season vegetables. - Introduction of other high value crops like blueberries, avocado in sub-tropical and mid-hills. - Revival of water chestnut and lotus stem in wetland belts Kashmir Valley: - Temperate fruit clusters (apple, kiwi, walnut), saffron belts, and floriculture zones. - Orchard rejuvenation using disease-resistant, high-yielding cultivars
D	Research, Innovation and Infrastructure (Centres of Excellence in key districts)	Strengthen, functionalise and network existing Centres of Excellence (COEs) and integrate advanced pre- and post-harvest technologies across value chains.	Temperate districts: COEs for apple, walnut, and saffron; expansion of CA/ULO storage facilities. Subtropical districts: Vegetables-focused COEs; packhouses and grading facilities near transport corridors. Across zones: Modernisation of irrigation systems, on-farm storage, aggregation, and collection centers.
E	Sustainability and Climate-Resilient Practices (Statewide adoption with zone-specific adaptation)	Promote organic and natural farming, climate-resilient varieties, and circular economy models aligned with national sustainability goals.	Jammu (Subtropical): Natural farming practices combined with crop residue recycling and water-efficient irrigation systems. Kashmir (Temperate): Organic certification for apples and saffron; adoption of climate-resilient temperate cultivars.

S. No.	Theme	Action	Geographic and Agro-Climatic Application
F	Human Capital Development and FPO Strengthening (Division-wise targeting)	Strengthen farmer training, women and youth entrepreneurship, and FPO/SHG capacities across horticulture value chains.	• Jammu Division: Skills development in vegetable aggregation, grading, and primary processing. • Kashmir Valley: Training in orchard management, post-harvest handling, quality standards, and export compliance. • Across J&K: Digital extension services, mobile-based advisories, and improved access to credit and insurance.
G	Markets, Value Addition and Exports (cluster-based export infrastructure development)	Strengthen cold chains, packaging systems, digital market integration, and export-oriented infrastructure to minimise 25-35% post-harvest losses and boost off-season supply to northern markets.	• Jammu Division: Prioritise vegetable export hubs with minimal processing and moisture-resistant, low-cost packaging for vegetables. • Kashmir Valley: Expansion of CA storage, minimal processing facilities for apples and kiwi; GI branding and linkage with horti-tourism. • All zones: District-level integrated export hubs with quality certification, e-commerce, and retail integration.
H	Community Engagement, PPPs and Horti-Tourism (Location-specific development)	Promote community participation, PPP models, and horticulture-linked tourism to enhance rural livelihoods.	• Jammu Foothills: Vegetable clusters linked with agro- and rural tourism pilot initiatives. • Kashmir Valley: Apple, saffron, and floriculture-based tourism circuits integrated with GI branding.

7

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8

ANNEXURES



Annexure-I

Composition of the Experts Group

F.No.-Q-11019/1/2024 – AGRICULTURE
NITI Aayog
(Agriculture Vertical)

NITI Aayog, Sansad Marg, New Delhi.
Dated: 25th April, 2024

OFFICE MEMORANDUM

Subject: Constitution of the Expert group for “Formulation of a roadmap for horticulture development in the UT of Jammu and Kashmir

With the approval of competent authority, the expert group has been constituted on the subject cited above. The objectives and the terms of reference (ToR) for the study are also given.

1. Composition

1.	Dr. Neelam Patel Senior Adviser, Agriculture, NITI Aayog	Chairperson
2.	Dr. Jyoti Kachroo, Prof. & Head, Agriculture Economics, SKUAST-Jammu E-mail: djaskachroo@rediffmail.com ; Mobile no. 9419241713	Member
3.	Dr. Vikas Tandon, Dean Horticulture, SKUAST-Jammu E-mail: tdandonvikas2@gmail.com ; Mobile no. 9419155273	Member
4.	Dr. Syed Zameer* Head, Food Science & Technology, Faculty of Horticulture, SKUAST-Kashmir E-mail: szhussain4u@gmail.com ; Mobile no. 77808 27474	Member
5.	Dr. Ashiq Pandith, Head, Division of Fruit Science, Faculty of Horticulture, SKUAST-Kashmir E-mail: ashaqpandit@gmail.com ; Mobile no. 94690 16333	Member
6.	Dr. Javid Iqbal Mir, Principal Scientist, In-charge Head - Division of Fruit Science, ICAR-CITH, Srinagar E-mail: javidiqbal1234@gmail.com ; Mobile no. 9906602101	Member
7.	Dr. Farhat Shaheen, Assoc. Professor, School of Agri-Economics and Horti-business Management, SKUAST-Kashmir E-mail: fashaheen@yahoo.com ; Mobile no. 78895 91843	Member
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10.	Sh. Vikas Sharma, Director Horticulture (Planning and Marketing), E-mail: dirhpm@rediffmail.com ; Mobile no. 9419182317	Member
11.	C.S.Tomar (Scientist-F) Head Meteorological Centre Srinagar E-mail: cs.tomar@imd.gov.in ; Mobile no. 9810296728	Member
12.	Dr. Babita Singh* Senior Consultant, Agriculture, NITI Aayog E-mail: singh.babita@nic.in ; Mobile no. 7042241985	Member & Member Secretary

* **Dr. Syed Zameer** Head, Food Science & Technology, Faculty of Horticulture, SKUAST-Kashmir and **Dr. Babita Singh**, Senior Consultant, Agriculture, NITI Aayog will be leading the expert team for the content development.

2. Objective

The primary objective of this study is to develop a roadmap that outlines strategies and actionable recommendations for enhancing horticultural development in the UT of Jammu and Kashmir. The roadmap will aim to address existing challenges, capitalize on opportunities, and promote sustainable growth in the sector.

- a. A comprehensive report detailing the findings of the study, including an analysis of the current status of horticulture, SWOT analysis and identified opportunities and challenges.
- b. A roadmap document outlining specific goals, objectives, strategies and actionable recommendations for fostering sustainable growth in horticulture in the UT of Jammu and Kashmir

3. Terms of Reference (Specific)

- 3.1 To analyse the current status of horticulture in the UT of Jammu and Kashmir, i.e, production, productivity of major crops, export and import, schemes, status in Indian Horticulture, existing infrastructure and challenges.
- 3.2 To assess the strengths, weakness, opportunities and threats (SWOT analysis) of the horticulture sector in the UT.
- 3.3 To identify opportunities for diversification, establishment of crop clusters and expansion of horticultural crops based on agro-climatic conditions and future demand.
- 3.4 To suggest innovations in horticulture, including the adoption of new technologies and best practices.
- 3.5 To propose strategies for promoting sustainable practices, addressing environmental concerns, and mitigating the impact of climate change.
- 3.6 To propose road map for infrastructure development, including irrigation facilities, cold storage, transportation, marketing infrastructure, availability of quality planting materials, certification and chemical free production.
- 3.7 To identify opportunities for market linkages, value chain development and export, to ensure better returns for horticultural produce.
- 3.8 To develop strategies for capacity building and training programs for farmers, extension workers, women, youth, Farmers Producers Organisations (FPOs) and cooperatives.
- 3.9 To explore opportunities for community engagement, stakeholder collaboration, and promotion of horti-tourisms to enhance rural development.
- 3.10 To recommend policy and regulatory reforms to support horticultural development and address regulatory hurdles.
- 3.11 To develop a monitoring framework to track the progress of the roadmap's implementation and conduct periodic evaluation to assess its impact.

4. Terms of Reference (General)

- 4.1 The Chairperson of the Expert Group may co-opt any other official/non-official expert/representative of any organization as a member(s), if required.
- 4.2 The members of the expert group may form a sub-group for the study; also communicate the details of the sub-group members.

- 4.3 The Expert Group may also examine and address other important issues, not specifically spelled out in the TORs.
- 4.4 The expenditure of the members on TA/DA in connection with the meeting of the Expert Group or any work incidental to the functions of the Expert group or Sub-Group will be borne by their respective parent organization.
- 4.5 The first draft of the report needs to be submitted by 15th May, 2024. The second draft is to be submitted by 24th May, 2024, after incorporating comments of the Senior Experts and the final one by 20th June, 2024.

The undersigned will be the nodal officer for further correspondence /query in this regard.



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(डॉ. बबिता सिंह)
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for Transforming India (NITI Aayog)
भारत सरकार / Government of India
नई दिल्ली / New Delhi

Distribution

Chairperson and Members of the Expert Group

Copy to:

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2. Hon'ble Vice Chancellor, SKUAST-Kashmir. E-mail: provc@skuastkashmir.ac.in
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NITI Aayog,
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No: AU/DR/2024/1377-1900
Dated: 19/06/2024

Subject: Formation of roadmap for horticulture development in the UT of Jammu and Kashmir.

Sir/Madam,

Refer your communication no: Q-11019/1/2024-AGRICULTURE; Dated: 19-06-2024 regarding replacement of Dr. Farhat Shaheen, Associate Professor, School of Agri-Economics and Horti-business Management, SKUAST-K, as Expert/Consultant.

In this regard Competent Authority is pleased to nominate Dr. Sajad H. Baba, Prof. & Head, School of Agri-Economics and Horti-business Management, SKUAST-K in place of Dr. Farhat Shaheen.


Associate Director Research

Copy to:-

- Dr. Sajad H. Baba Prof, & Head, School of Agri-Economics and Horti-business Management, FoH, SKUAST-K Shalimar.
- Dr. Farhat Shaheen, Associate Professor, School of Agri-Economics and Horti-business Management, FoH, SKUAST-K, Shalimar.
- Secretary to Vice Chancellor for information of Hon'ble Vice Chancellor.

Annexure II

F.No.-Q-11019/1/2024 – AGRICULTURE
NITI Aayog
(Agriculture Vertical)

NITI Aayog, Sansad Marg, New Delhi.
-Dated: 12th September, 2024

Subject: Constitution of the Advisory Group for the formulation of “Roadmap for horticulture development in the UT of Jammu and Kashmir”.

With the approval of the competent authority, an Advisory Group has been formed to provide valuable input on the draft roadmap prepared by the Expert Group. The Expert Group developed the draft report based on the Terms of Reference (ToR) outlined in point no. 2.

Please find attached the draft roadmap (Annexure 1) and the composition of the Expert Group (Annexure 2) for your reference.

1. Composition of the Advisory Group

1.	Prof. Ramesh Chand, Member (Agriculture), NITI Aayog, GoI E-mail: rc.niti@gov.in ; Phone no. 011-23096756; 011-23096774	Chairperson
2.	Shri Shailendra Kumar, IAS, Principal Secretary to Government Agriculture Production Department, Government of Jammu and Kashmir (J&K). E-mail: jk.ps.agri@gmail.com ; Phone no. 0194-2461258	Co-Chairperson
3.	Prof (Dr.) Nazir Ahmad Ganai, Hon'ble Vice Chancellor, SKUAST- Kashmir, UT of J&K E-mail: provc@skuastkashmir.ac.in ; Phone no. 0194-2461258	Member
4.	Dr. B.N. Tripathi, Hon'ble Vice Chancellor, SKUAST-Jammu, UT of J&K E-mail: vc@skuast.org ; vcskuastjammu@gmail.com ; Phone no. 0191-2263714	Member
5.	Dr. Sanjay Kumar Singh, Deputy Director General (Horticultural Science), ICAR E-mail: ddghort.icar@gov.in ; ddghort@gmail.com ; Phone no. 011-25842285/62/70/71 Extn. 1422	Member
6.	Shri Abhishek Dev, IAS, Chairman, APEDA, Ministry of Commerce and Industries, GoI E-mail: chairman@apeda.gov.in Phone no. 011-26526187	Member
7.	Dr. Prabhat Kumar, Horticulture Commissioner, Ministry of Agriculture & Farmers Welfare, GoI. E-mail: hort.comm-agri@gov.in ; Phone no. 011- 23381503	Member
8.	Dr. Rajendra Prasad, Professor and Member of Governing Body, ICAR, E-mail: rajendra.kapgald@gmail.com ; Mob.no. 9450681433	Member
9.	Mr. Gagan Jain, Director, VKCNUTS Pvt. Ltd. E-mail: gagan@nutraj.com ; Mob.no. 9906399209	Member
10.	Mr. Izhan Javeed, CEO, Fruit Master Agro Fresh Pvt. Ltd. E-mail: izhan@fruitmaster.in ; Mob.no. 9999957973	Member
11.	Dr. Neelam Patel, Senior Adviser, Agriculture, NITI Aayog, GoI E-mail: neelam.patel@gov.in ; Phone no. 011-23096613	Member Secretary

Objective

The primary objective of this study is to develop a roadmap that outlines strategies and actionable recommendations for enhancing horticultural development in the UT of Jammu and Kashmir. The roadmap will aim to address existing challenges, capitalize on opportunities, and promote sustainable growth in the sector.

- a. A comprehensive report detailing the findings of the study, including an analysis of the current status of horticulture, SWOT analysis and identified opportunities and challenges.
- b. A roadmap document outlining specific goals, objectives, strategies and actionable recommendations for fostering sustainable growth in horticulture in the UT of Jammu and Kashmir

2. Terms of Reference (ToR) of the Study (Specific)

- 2.1 To analyse the current status of horticulture in the UT of Jammu and Kashmir, i.e., production, productivity of major crops, export and import, schemes, status in Indian Horticulture, existing infrastructure and challenges.
- 2.2 To assess the strengths, weakness, opportunities and threats (SWOT analysis) of the horticulture sector in the UT.
- 2.3 To identify opportunities for diversification, establishment of crop clusters and expansion of horticultural crops based on agro-climatic conditions and future demand.
- 2.4 To suggest innovations in horticulture, including the adoption of new technologies and best practices.
- 2.5 To propose strategies for promoting sustainable practices, addressing environmental concerns, and mitigating the impact of climate change.
- 2.6 To propose road map for infrastructure development, including irrigation facilities, cold storage, transportation, marketing infrastructure, availability of quality planting materials, certification and chemical free production.
- 2.7 To identify opportunities for market linkages, value chain development and export, to ensure better returns for horticultural produce.
- 2.8 To develop strategies for capacity building and training programs for farmers, extension workers, women, youth, Farmers Producers Organizations (FPOs) and cooperatives.
- 2.9 To explore opportunities for community engagement, stakeholder collaboration, and promotion of horti-tourisms to enhance rural development.
- 2.10 To recommend policy and regulatory reforms to support horticultural development and address regulatory hurdles.

The undersigned will be the nodal officer for further correspondence /query in this regard.



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Annexure III

Major schemes of the Horticulture Department – J&K

S.No.	Scheme	Activity/Component	Unit	Incentives (₹. in Lac)	Remarks
1	CAPEX	Plantation Support:			
(a)		Area Expansion (Plantation)	ha	50% Subsidy up to Max. ₹ 50,000/ha	
(b)		High-density plantation (Temperate)	ha	80% subsidy on cost of plants	
(c)		Revised Modified H.D. Plantation	ha	50% of the project cost	
(d)		Promotion of Strawberry	Ka	50% Subsidy up to Max. ₹13,000/K	
(e)		Promotion of Aloe-Vera in the Private Sector	ha	50% Subsidy up to Max. ₹75,000/ha	
2		Capital Support for Farm Machinery/Tools/(Mechanisation)			
(a)		108-Subsidy Support for Farm Machinery/Tool and Mechanisation		Project Based	
3		Product Development /Market Support			
(a)		108- Support for establishment of Fruit/Dry Fruit Processing Units (machinery part only- Project Based)	No.	Subsidy 50% and a maximum up to ₹10.00 Lacs	
4		Creation of Water Sources			
(a)		Individual Tubewell/Borewell/Shallow Well/Water harvesting system for storage of water etc.	No.	Subsidy@ 50% cost limited to ₹0.90 Lac	Subsidy@ of 90% cost limited to ₹3.00 Lac is proposed

S. No	Scheme	Private Sector	Unit	Incentives	Remarks
(a)	HADP (P-21)	Root Stock Bank	Nos	80% subsidy to the limit of ₹ 56/plant	
(b)		Mother Block	ha	80% subsidy on the project cost	
(c)		Protected Cultivation	Nos	80% subsidy i.e. ₹15.59 Lakh/Unit(160 sq. mts unit)	
(d)		Plant Propagation unit	Nos	50% Subsidy to the limit of ₹ 65/plant	
(e)		Rejuvenation of Senile orchards	ha	50% subsidy to the limit of ₹ 6.0 lakh/ha	

S. No.	Scheme	Activity/Component	Unit	Incentives (₹in Lac)	Remarks
1	RAINFED AREA DEVELOPMENT HADP (P-15)	Development of Agriculture/ Horticulture & Animal/ Sheep husbandry Department.		Pattern @ 50 % of the cost max up to	
(a)		Technological demonstrations/ interventions w.r.t. Horticulture Agro forestry using critical inputs based on production constraints at each pilot project site	No.	0.15	
(b)		Expanding Area coverage under Micro-irrigation (Drip, Sprinkler, Rainguns)	No.	1.20	
(c)		Gravity Feed drip irrigation systems using plastic tanks (1000-1500 liters capacity) mounted on a raised single stand for 1Kanal area	No.	0.50	
(d)		Water Storage Tanks/ Portable Geo Tanks/ Poly Tanks/ Flexi Water tanks	No.	1.80	
(e)		Creation of Water Irrigation Sources (Deep Bore Wells)	No.	3.00	
(f)		Roof-top rainwater harvesting structures	No.	1.50	
(g)		Establishment of Custom Hiring Centres/ Farm Machinery Banks	No.	8.00	
(h)		Farm Equipment (distribution to Farmers)	No.	0.05	
2		Market-linked Supply Chain Development and Value Addition			
(a)		Creating Post Harvest Handling facilities, Transportation of Harvested produce (Vending Carts/ Ref. Van/Air-controlled Sale Outlets Units)	No.	0.75	
(b)		Adding value through Agro processing/ Creation of storage infrastructure in rural areas (of size 10m x 5m)	No.	2.00	
(c)		Creation of a small processing unit/ pack house (9m x 6m)	No.	2.00	
(d)		Bringing in Marketing Reforms (Establishment/ Strengthening of Mandis)	No.	2.50	
3		Capacity Building and R&D support			
(a)		Formation of Self-Help Groups and capacity building of farmers (trainings/ workshops/ field days etc)	No.	0.50	

S. No.	Scheme	Activity/ Component	Unit	Incentives (₹in Lac) Pattern @ 50 % of the cost max upto	Remarks
1	Farm Mechanisation For Resource Use Efficiency In Hill Agriculture Hadp (P-9)	Cultivator	No.	0.200	The subsidy component will be as per the SMAM guidelines
2		Rotavator	No.	0.504	
3		Brush Cutter	No.	0.30	
4		Power Tiller	No.	0.85	
5		Battery Operated Sprayer	No.	0.03	

S. No.	Scheme	Activity/ Component	Unit	Incentives (₹in Lac) Pattern @ 50 % of the cost max upto	Remarks
1		Creation of Water Sources			
(a)		Water harvesting system for individuals for storage of water in 20 X 20 X 3 m Pond/Tubewell/Dug well @ 100/cum (Hilly Area)	No.	50% of the cost limited to Max. of ₹0.90 lacs	Due to small/marginal land holdings of majority of the farmers in the UT, water harvesting systems of 20x20x3 m are not feasible. Instead the geo tanks dug well / borewell/Tubewell / Poly line tanks need to be incorporated/introduced in the scheme. The subsidy on the WHS need to be enhanced as in the hilly dry land region of the UT farmers are economically very poor. The water table is low and in the rocky terrain the estimated cost of WHS for 1 ha ranges from 4-6 lacs. Hence, 90% subsidy with a max. limit of 3 lacs is proposed(On prorata basis) so that the Plantation potential of rain fed areas can be fully exploited.
2		Integrated Post Harvest Management			
(a)		Pack House	No.	50% of the cost limited to Max. of ₹2.00 lacs	
(b)		Preservation Unit (Low Cost)	No.	50% of the cost limited to Max. of ₹1.00 lacs	
3		Human Resource Development/Training of Farmers			
(a)	MIDH	Within State (₹1000/day per farmer including transport)	Man days	0.01	
5		Protected Cultivation			
(a)		Naturally Ventilated System			
(i)		Tubular Structure (50% cost for a max area 4000 sq m per beneficiary-Hilly Area)	Sq.Mtr	0.006095	Subsidy @ 90 % on Tubular structure (Semi hi tech) is proposed on the actual estimates for small and marginal farmers
(b)		Shade Net House			
(i)		Tubular Structure (50% cost for a max area 4000 sq m per beneficiary)	Sq.Mtr	0.00408	Subsidy @ 90 % on Tubular structure (Semi hi tech) is proposed on the actual estimates for small and marginal farmers
(ii)		Anti Bird/Anti hail nets (50% of the total cost limited to 5000sq m per beneficiary)	Sq.Mtr	0.000175	Subsidy @ 90 % on Anti Bird/Anti Hail nets is proposed on the actual estimates for small and marginal farmers
6		Organic Farming			
(a)		Vermi Compost Unit	Nos.	50% of the cost limited to Max. of ₹ 0.50 lac	
7		Horticulture Mechanisation			
(a)		Tractor upto 20 PTO HP	Nos	1.00	Subsidy @ 50% is proposed max upto ₹ 2.00 lacs
(b)		Power tiller below 8 BHP	Nos	0.50	
(c)		Power Tiller (8 BHP and above)	Nos	0.75	Subsidy @ 50% is proposed max upto ₹ 0.85 lacs

S. No.	Scheme	Activity/ Component	Unit	Incentives (₹in Lac) Pattern @ 50 % of the cost max upto	Remarks
8		Establishment of new Gardens (Area Expansion normal spacing)			
(a)		Without Integration 60:20:20	ha	0.18	Due to increase in prices of planting material and other components the incentive is proposed to be increased to ₹ 0.50 lac/Ha. to the tune of 50% subsidy which ever is less.
(i)		Incentives 1 st Year	ha	0.06	
(ii)		Incentives 2 nd Year	ha	0.06	

S. No.	Scheme	Activity/Component	Unit	Incentives	Remarks
A		Soil Samples-Collection, Testing, Printing & Distribution of Soil Health Cards by MSTL & others STLs.-			
i		Soil Samples-Collection, Testing, Printing & Distribution of Soil Health Cards by MSTL & other STLs @ 300/per Sample	No.		
B	RKVY	Creation of water Resources (Borewell/Dug well/tank/ponds)	No.	₹ 0.90 Lac as per MIDH guidelines	Due to small/marginal land holdings of majority of the farmers in the UT, water harvesting systems of 20x20x3 m are not feasible. Instead the geo tanks dug well / borewell/Tubewell / Poly line tanks need to be incorporated/introduced in the scheme. The subsidy on the WHS need to be enhanced as in the hilly dry land region of the UT farmers are economically very poor. The water table is low and in the rocky terrain the estimated cost of WHS for 1 ha ranges from 4-6 lacs. Hence, 90% subsidy with a max. limit of 3 lacs is proposed(On prorata basis) so that the Plantation potential of rain fed areas can be fully exploited.

S. No.	Scheme	Activity/Component	Unit	Incentives (₹ in Lac)	Remarks
1		Integrated Development of Nurseries and Plantation			
(a)		Olive (No. of plants per Ha 200)	ha	₹48000/ha	
(b)		Wild Apricot (No. of Plants per Ha 400)	ha	₹16000/ha	
2	TBOs	Horticulture Hand Tools	Nos.	50% Subsidy up to Max. ₹10,000/No.	
3		Power Knap Sack/ Power Operated Sprayer (Capacity above 16 Lts.)	Nos.	50% Subsidy up to Max. ₹5,000/No.	Incentive @ ₹10,000/-per unit is proposed

1		Financial Assistance for Procurement of Agriculture Machinery & Equipment			Remarks
(a)		Tractor (40-70 PTOHP)	Nos.	₹2.00 Lacs or 50% of the cost whichever is less	
(b)		Power Tiller (8 BHP and above)	Nos.	50% for Women, SC, ST, Small & marginal Farmers limited to ₹0.85 lakh 40% for other farmers cost limited to ₹0.70 lakh	
(c)		Power Tiller Below (8 BHP)	Nos.	For Women, SC, ST, Small & marginal Farmers, limited to ₹0.65 lakh. 40% for other farmers, cost limited to ₹0.50 lakh	
(d)		Tractor Driven Equipments	Nos.	50% for Women, SC, ST, Small & marginal Farmers limited to ₹ 0.30 lakh	
(e)	SMAM	Garden Hand Tools	Nos.	50% for SC, ST, Small & marginal Farmers limited to ₹0.012 lakh. 40% for other farmers cost limited to ₹0.010lakh.	50% Subsidy on the cost of soil augur and rain guns need to be in cooperated in the scheme
2		Inter cultivation Equipment			
(a)		Manual Knap Sack/ Foot/ battery operated sprayer 8-12lts.		40% for other farmers cost limited to ₹0.0060 lakh.	
(b)		Powered Knap Sack Sprayer above 16 lts		40% for other farmers cost limited to ₹0.08 lakh	
3		Self-propelled /other Power Driven Horticultural Machinery			
(a)		Chain Saw/Wheel Barrow/ Mango Gardner Planter	Nos.	50% for Women, SC, ST, Small & marginal Farmers limited to ₹0.75 lakh 40% for other farmers cost limited to ₹0.60 lakh	
4		Establishment of Farm Machinery Banks for Custom Hiring			
(a)		Establishment of Custom Hiring Centre up to ₹ 10 Lakh	Nos.	40% limited to ₹ 4.00 lakh	
5		Promotion of Farm Mechanisation in selected Villages			
(a)		Farm Machinery Banks with minimum 8 farmers /bank	Nos.	80% limited to ₹8.00 lakh	



सत्यमेव जयते

NITI Aayog