IMPROVING AGRICULTURAL VALUE CHAINS IN UTTAR PRADESH

NOVEMBER 2021

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Note:

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Cover design by Claudette Rodrigo.

On the cover: Smallholder farmers in Uttar Pradesh is the main workforce behind agriculture in the state. Farmers' income and livelihoods could be enhanced by improving agricultural value chains from production, produce aggregation, primary sorting to processing, and the encouraging their direct and more active participation along the value chains.

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Foreword

This study on improving agricultural value chains in Uttar Pradesh is a pivotal contribution to the state's efforts to develop value chains for potato, mango, guava, gram, and mustard. The research and review process was meticulous, and I applaud the efforts of the Asian Development Bank (ADB) in making it possible. I was fortunate to have the opportunity to be part of the entire process from conception to completion and can say that all the suggestions made during the many discussions were given careful consideration.

The study does an excellent job of linking global, national, and state-level scenarios for both macro and micro perspectives of the full value chain for each of the five commodities, which will help the state design effective implementation pathways. Moving forward, it would be useful to have ADB provide a detailed road map for implementation of the suggested recommendations and apply its private-public partnership expertise to prepare a separate action plan to boost private sector participation in strengthening value chain development in Uttar Pradesh in a systematic manner. It would also be useful to build systems to support the state's agriculture and allied departments (horticulture, fisheries, livestock, and food processing) in translating these suggestions into appropriate formats for our farmer producer organizations and their members. ADB's earlier studies on building better infrastructure and logistics for Uttar Pradesh could be useful in this course of action.

I highly appreciate ADB and its entire team, in particular Sunae Kim, Natural Resources and Agriculture Specialist, and Krishna Singh Rautela, Associate Project Officer, both with the South Asia Department, for enabling the high quality of this study for the benefit of the state. Their continuous efforts in serving the interests of Uttar Pradesh and facilitating productive consultation meetings were useful.

Best wishes,

K. V. Raju

Economic Advisor to the Honorable Chief Minister
Government of Uttar Pradesh
Lucknow
August 2021

Preface

Agriculture is integral to the livelihoods of people in the rural areas of Uttar Pradesh. With agriculture households accounting for 74.8% of all rural households in 2014, the state was the largest producer of food grains, mango, guava, muskmelon, potato, sugarcane, and milk in India for 2017–2018. Despite significant production, small and marginal farmers, who cultivate 65% of the agricultural area of Uttar Pradesh, face challenges in connecting to value chains and markets.

Modernizing production systems, agribusiness infrastructure, and market links for farmers would have a significant impact in terms of increasing farmer incomes and improving livelihoods in Uttar Pradesh. Accordingly, the Asian Development Bank provided technical assistance to support the state government to review and identify gaps in selected agricultural value chains and to provide recommendations for areas of investment across the value chains of the selected commodities.

This study selected potato, mango, guava, mustard, and gram as the five focus crops after in-depth analysis and consultation with the Government of Uttar Pradesh. To identify the gaps and needs across the focus crop value chains, the study conducted stakeholder consultations and field visit interviews over 4 months in 2019 and consulted more than 115 private sector agribusiness firms, covering input suppliers; technology and service providers in transportation, storage, packing houses, cold chains, and logistics; food processors; trading companies; organized retailers; and e-marketplaces.

Based on the gaps and needs identified through intensive field interactions and consultations, recommendations and interventions are offered in this study. Special attention was directed toward strengthening infrastructure and stakeholder capacity building. These recommendations are offered as a contribution to the vision of the Government of Uttar Pradesh to ensure food and nutritional security and improve the quality of village life through inclusive and sustainable growth.

The Asian Development Bank will continue to work closely with the Government of Uttar Pradesh to improve market connectivity and agricultural value chain links and to increase agricultural productivity and food security as outlined in Strategy 2030.

Kenichi Yokoyama
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The publication was jointly developed with the State Government of Uttar Pradesh under the leadership of Devesh Chaturvedi, Additional Chief Secretary, Agriculture, and K. V. Raju, former Economic Advisor to the Honorable Chief Minister, State Government of Uttar Pradesh; it was led by J. P. Singh, former Director and Mr. Anjani K. Singh, Director, Uttar Pradesh State Agriculture Marketing Board. Interdepartmental committee members in Uttar Pradesh reviewed the draft and provided guidance. The Department of Economic Affairs coordinated the review of the draft report by the Government of India.

From the Asian Development Bank, Mio Oka, Director, Environment, Natural Resources and Agriculture Division, South Asia Department, provided overall guidance during the preparation of the publication. Pamela Barrameda, Associate Operations Officer, and Princess O. Lubag, Project Analyst, supported the publication process, and Cynthia Ceniza, Senior Operations Assistant, provided administrative support to the technical assistance project and publication. Terry Erle Clayton provided editorial support. Garry Smith, external reviewer, greatly improved the methodology, presentation, and analysis of the report. Hyun-young Song, Natural Resources and Agriculture Specialist, Southeast Asia Department, provided helpful comments.

Abbreviations

ACGR	annual compound growth rate
AGMARK	Quality Certification Mark by the Directorate of Marketing and Inspection
AGMARKNET	Agricultural Marketing Information Network
AgriExchange	APEDA Trade Portal
APEDA	Agricultural and Processed Food Products Export Development Authority
APMC	Agricultural Produce Market Committee
ASEAN	Association of Southeast Asian Nations
CAGR	compound annual growth rate
CECA	Comprehensive Economic Cooperation Agreement
CEPA	Comprehensive Economic Partnership Agreement
CGF	Credit Guarantee Fund
CGST	Central GST
CHC	Custom Hiring Center
CISH	Central Institute for Subtropical Horticulture
CPRI	Central Potato Research Institute
DAC&FW	Department of Agriculture, Cooperation, and Farmers Welfare
DAP	di-ammonium phosphate
DBT	Direct Benefit Transfer
DGFT	Directorate General of Foreign Trade
DRMR	Directorate of Rapeseed and Mustard Research
EDI	Electronic Data Interchange
eNAM	National Agriculture Market
EPB	Export Promotion Bureau
EU	European Union
FAO	Food and Agriculture Organization
FPC	Farmer Producer Company
FPO	Farmer Producer Organization
FSSAI	Food Safety and Standards Authority of India
FTA	free trade agreement
GAP	good agricultural practices
GST	goods & service tax
GVA	gross value-added

HACCP	Hazard Analysis and Critical Control Point
HS Code	Harmonized Commodity Description and Coding System
ICAR	Indian Council of Agricultural Research
IFFCO	Indian Farmers Fertilizer Cooperative Limited
IGST	integrated goods & service tax
IQF	individual quick freezing
ITC	International Trade Centre
KVK	Krishi Vigyan Kendra
MEIS	Merchandise Exports from India Scheme
MEP	minimum export price
MIDH	Mission for Integrated Development of Horticulture
MoAFW	Ministry of Agriculture and Farmers Welfare
MoFPI	Ministry of Food Processing Industries
MoP	Murate of Potash
MSP	minimum support price
NABARD	National Bank for Agriculture and Rural Development
NAFED	National Agricultural Cooperative Marketing Federation of India Ltd.
NCDEX	National Commodity and Derivatives Exchange
NGO	nongovernment organization
NHB	National Horticulture Board
NPK	nitrogen, phosphorus, potassium
PRC	People's Republic of China
PTA	preferential trade agreement
R&D	research and development
RDA	recommended dietary allowance
RKVY	Rashtriya Krishi Vikas Yojana
SAMPADA	Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters
SFAC	Small Farmers Agribusiness Consortium
SGST	state goods & service tax
SMAM	Sub-Mission Agricultural Mechanization
SME	small and medium-size enterprises
SPV	special purpose vehicle
SSI	small-scale industries
SSP	single super phosphate
UAE	United Arab Emirates
UK	United Kingdom
US	United States
UN	United Nations
VAT	value-added tax
VHT	vapor heat treatment

Weights and Measures

cm	centimeter
ha	hectare
kg	kilogram
L	liter
MT	metric tonne

Executive Summary

The objective of this study is to provide recommendations for areas of investment across the agricultural value chain of selected commodities. It seeks to review agricultural value chains in Uttar Pradesh from market demand and trend analysis to policy, production, rural infrastructure, marketing, and infrastructure and to identify gaps and needs to improve selected value chains.

Major Challenges

Potato: Low productivity (reportedly because of reduced groundwater availability); injudicious use of inputs; the low scale of operations; lack of proper sorting, grading, and packing of produce, leading to higher wastage and expenses; technically outdated single-product cold storage; lack of organized potato processing firms in the state owing to low volumes of processable varieties; lack of real-time market and price information; and limited access to affordable finance by farmers engaged in the potato value chain

Mango: Old/senile orchards; lack of quality planting materials; injudicious use of chemical inputs, leading to declining productivity; poor harvesting techniques resulting in about 10%–15% wastages owing to fruit bruising and cracking; lack of primary processing (manual sorting and grading, use of ineffective packaging materials), leading to low price realization; lack of packhouses, cold storage, and refrigerated logistics, which restricts access to distant markets and increases wastage; and the domination of farmers' sales by contractors and commission agents, limiting farmers' bargaining power

Guava: Lack of availability of quality planting materials; lack of awareness and availability of nonchemical plant protection kits and bioagents; inappropriate primary processing practices; lack of packhouses and common collection centers; lack of availability of cold storage spaces for guava; poor condition of farm access roads and lack of appropriate transportation facilities; and low level of processing

Gram: Higher seed rate and use of seed from previous crops, which reduces productivity; inappropriate fertilizer use; plant protection; intercultural operations and irrigation; limited arrangements in market yards for scientific weighing and quality testing, which widens the scope for malpractice

Mustard: Lack of awareness on best cultivation practices; weak market infrastructure in the mandi, particularly for weighing and quality assessment; delays in procurement and payment settlement; lack of knowledge on seed sale prices; farmers who tend to depend more on informal sources of financing such as local money lenders, who charge higher interest rates, as they face difficulties obtaining institutional credit for cultivation purposes

Potential Interventions

Potato: Establishment of standardized tissue culture and micro-propagation techniques; setting-up of small-scale potato processing units and larger scale processing units for manufacturing other value-added products; upgrading and creation of near-to-farm-gate, energy-efficient, modern cold storage facilities

Mango: Rejuvenation of the large number of old and senile mango orchards; setting-up of public and private hi-tech, multi-crop nurseries to supply quality rootstock to farmers; uniform handling and aggregated marketing of produce; provision of high-end facilities, such as vapor heat treatment and irradiation facilities, to augment the existing infrastructure and capacity for export; establishment of model Individual Quick Freezing (IQF) and canning units to encourage processing of table variety mango

Guava: Establishment of public and private hi-tech nurseries producing disease-free planting material to set up and maintain healthy orchards; promotion of drip irrigation systems in guava orchards; setting-up of modern packing houses to increase marketability and access to distant markets; setting-up of integrated facilities for pulping and juicing

Gram: Appropriate storage structures both on farm and in the market; value addition into gram processing

Mustard: Strengthening the quality testing infrastructure in major markets, such as equipping them with cleaning and grading machines, moisture meters, and oil content analyzers to ensure fair and transparent price setting

Common Areas of Investment in Agricultural Value Chain Development for the Focus Crop Value Chains

- Encouraging and supporting farmers to adopt better cultivation practices and to improve their knowledge of quality requirements and standards, and harvesting and postharvest techniques, with potentially significant impacts on productivity and their marketable surplus
- Promoting and strengthening farmer collectives associated with crop-growers for aggregated sales and marketing produce as well as dissemination of advanced technologies among producer members; interventions are also required to improve market links between growers and private sector players within and outside the state, particularly processors
- Strengthening market intelligence and price discovery mechanisms to provide real-time information on arrivals and grade-specific pricing at different markets within and outside the state
- Extending term loans and working capital loans, with partial loan guarantees for farmer collectives and agro-enterprises, to help reduce growers' dependence on cold storage owners and other informal sources and encourage more farmers to engage in collective production and marketing
- Encouraging the use of various web- and app-based models of agriculture market information systems among farmers and farmer collectives for access to real-time market intelligence, especially grade-specific pricing, and transparent price discovery
- Training and capacity-building for farmers, farmer collectives, traders, and intermediaries to improve their understanding and knowledge of trading parameters and standards related to quality, produce grading, and pricing

- Promoting farm mechanization suitable for smallholder cultivation by establishing multi-crop equipment banks across different blocks
- Assisting farmer producer organizations in setting up retail outlets near urban markets
- Creating of dry storage infrastructure to cater to the needs of smallholder farmers for storage of their produce

Private Sector Assessment and Opportunities for Coinvestment

Interviews with 115 private sector actors and detailed discussions with more than 50 firms were the basis for the following suggestions: (i) promotion and capacity building for farmers and FPOs, (ii) maintaining farmer's access to agro-inputs, (iii) provision of crop advisory services and training on improved production practices, (iv) harvesting and postharvest management, (v) development of postharvest infrastructure and storage facilities, and (vi) provision of financial support and incentives.

The study also suggests links to recent reforms in agricultural sector development by summarizing the following three acts of the Government of India: (i) The Essential Commodities (Amendment) Act, 2020; (ii) The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020; and (iii) The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020.

Recommendations for Institutional Development and Infrastructure Enhancement

The study identifies areas of intervention for institutional development and infrastructure enhancement from the perspective of production and postharvest improvement, farmer collective promotion, agribusiness sector enhancement, and overall development of agricultural value chains. This analysis suggests that Uttar Pradesh could invest in (i) training farmers on best practices in cultivation and postharvest management, (ii) strengthening farmer collectiveness by assisting FPOs in hiring professional staff to manage business operations and build market links, (iii) improving market intelligence and transparent price discovery mechanisms, (iv) providing incentives to the agribusiness sector that promote long-term partnership with farmers by supporting the procurement of large-scale purchases of quality products at farm level, and (v) enhancing guarantee scheme coverage. The study concludes with suggested infrastructure development for each focus crop.

I. Introduction

A. Project Rationale

Agriculture is one of the most important sectors of the Indian economy. It supports the livelihoods of the majority of the population in rural areas and contributes significantly to food and nutrition security in the country. As many as 70% of rural households still depend directly or indirectly on agriculture for their livelihoods.¹ Although the share of agriculture and allied sectors in the gross value-added (GVA) of the country at current prices has generally declined over the past few years on account of the relatively higher growth performance of nonagricultural sectors, the sector still contributes 16.5% to GVA and was valued at \$412 billion (at current prices) in 2019–2020 (footnote 1).

Globalization and liberalization of trade, with rapid urbanization and income growth, in low- and middle-income countries have accelerated growth of the agriculture sector and resulted in an increasing dietary transition from cereals to high-value processed foods, fruits, and vegetables. In addition, there has been a shift of focus from food security to nutrition security and food safety. The growing integration of global economies presents an opportunity for increased vertical and horizontal integration of production clusters in developing countries with the global consumption market. India, as one of the leading global producers of many fruits and vegetables, has immense potential to benefit from such integration, particularly in terms of increased value realization for actors in agricultural value chains.

In spite of these opportunities, the benefits of such developments are yet to be realized among smallholder and marginal farmers in a sustainable manner. The integration of smallholder farmers in global agricultural value chains is constrained by factors such as small farm size, low productivity, a deteriorating natural resource base, impacts of climate volatility, access to technology and quality inputs, a shortage of and increasing cost of labor, high levels of waste, lack of postharvest storage and marketing infrastructure, and low processing levels.

While the sector strategy in the past has focused primarily on increasing productivity through the use of better seeds, irrigation, fertilizers, mechanization, credit, and agro-support services, a more holistic approach is needed to support and integrate economic activities across agro-value chains. Such a strategy, coupled with mapping weak links in value chains, can help in prioritizing and sequencing the interventions required, especially in terms of attracting appropriate strategic investment and technical assistance for infusion and dissemination of the requisite technology and innovation. Integrated agricultural value chains will enable stakeholders to respond quickly to growing demand from both domestic and international markets. This is critical to achieving the Government of India's commitment to doubling farmer incomes by 2022.²

¹ Ministry of Finance. 2020. *Economic Survey 2019–2020. Volume II, Chapter 7: Agriculture and Food Management*. https://www.indiabudget.gov.in/economicsurvey/doc/vol2chapter/echap07_vol2.pdf.

² National Institution for Transforming India. 2017. *Doubling Farmers' Income: Rationale, Strategy, Prospects and Action Plan*. March. https://niti.gov.in/writereaddata/files/document_publication/DOUBLING%20FARMERS%20INCOME.pdf.

B. The Agriculture Sector Landscape in Uttar Pradesh

Uttar Pradesh is the most populous state in the country, with a population of 199.8 million people (Census 2011), accounting for nearly 16.5% of the total population of India. The state is the fifth largest in terms of geographical area, covering 240,928 km²—7.33% of the total geographical area of the country.³

According to the agriculture household survey conducted by the National Sample Survey Office, agricultural households account for 74.8% of all rural households in Uttar Pradesh.⁴ Thus, agricultural activities form an integral part of the livelihoods of most people in rural areas in the state. Also, the Agriculture Census 2015–2016 published in September 2018 reveals that the state has the highest number of agricultural operational holdings (23.82 million out of 146 million total), operating on 17.45 million ha; 92% of operational holdings are small and marginal and account for 65% of the operational area (Table 1). The average size of an operational holding in the state is estimated at 0.85 ha.⁵

Table 1: Status of Operational Holdings for All Social Groups in Uttar Pradesh

Distribution and Size	Marginal <1 ha	Small 1≤2 ha	Semi-medium 2≤4 ha	Medium 4≤10 ha	Large ≥10 ha
% distribution in terms of number of operational holdings	74.8	16.9	6.6	1.6	0.1
% distribution in terms of area operated	42	24	20	12	2
Average size of operational holding	0.43	1.39	2.68	5.44	26.22

Source: Government of India, Ministry of Agriculture and Farmers Welfare. 2016. *Agriculture Census 2015–2016*. https://www.thehinducentre.com/the-arena/current-issues/article28682480.ece/binary/T1_ac_2015_16.pdf.

Estimates for the marketed surplus ratio in Uttar Pradesh for major commodities in 2014–2015 indicate that for cereals this varies between 48% (barley) and 78.4% (rice). For pulses it varies between 67% (gram), 76% (mustard), 92% (lentils), and 95% (potato).⁶

C. Share of Agriculture in Gross State Value-Added

According to the State Account Statistics, in 2018–2019 the agriculture sector contributed 24.58% to total gross state value-added, equivalent to ₹3.6 trillion at current prices (Figure 1).⁷

³ Office of the Registrar General and Census Commissioner. 2011. *Census 2011*. http://www.dataforall.org/dashboard/censusinfoindia_pca/; <https://www.census2011.co.in/facts/largestates.html>.

⁴ Ministry of Statistics and Program Implementation. Agriculture Census 2015–16. http://mospi.nic.in/sites/default/files/publication_reports/KL_70_33_19dec14.pdf.

⁵ Government of India, Ministry of Agriculture and Farmers Welfare (MoAFW). 2016. *Agriculture Census 2015–2016*. https://www.thehinducentre.com/the-arena/current-ssues/article28682480.ece/binary/T1_ac_2015_16.pdf.

⁶ Government of India. 2018. *Agricultural Statistics at a Glance*. <http://agricoop.gov.in/sites/default/files/agristatglance2018.pdf>.

⁷ Directorate of Economics and Statistics. Gross state domestic product by economic activity percentage distribution at current prices. http://updes.up.nic.in/esd/STATE_ACC_STATISTICS/State_Domestic_Product/24.02.2020/6GSDP_2018_19_Percent_Distribution_current_prices.pdf.

Figure 1: Gross State Value-Added by Economic Activity at Current Prices, 2011–2012 to 2018–2019

Note: 1 crore = 10 million.

Source: Directorate of Economics and Statistics. *Gross State Domestic Product by Economic Activity*.

Uttar Pradesh is a major producer of a wide variety of crops and is the largest producer of food grains, fruits and vegetables, sugarcane, milk, and meat (Figure 2).

Despite significant production, several challenges remain in the development of value chains, which are often fragmented, lack investment, fail to include vulnerable groups, and are missing critical links between farms and markets. It is important to address these deficiencies to resolve rural socioeconomic problems and improve poverty conditions. Thus, it is imperative that suitable interventions be taken to modernize production systems, agribusiness infrastructure, and market links for farmers. This would have a significant impact in terms of increasing farmer incomes and improving livelihoods in Uttar Pradesh along with increased GVA.

Figure 2: All India Rank of Uttar Pradesh in Terms of Production, 2017–2018

Foodgrain Production		Milk Production	Fruit Production	Vegetable Production
Cereals Rank 1 Rank 1 - wheat Rank 2 - wheat Rank 2 - wheat Rank 5 - wheat	Pulses Rank 5	Milk Rank 1	Fruits Rank 2 Rank 1 - Mango Rank 1 - Guava Rank 1 - Anola Rank 1 - Muskmelon Rank 2 - Watermelon	Vegetables Rank 1 Rank 1 - Potato Rank 1 - Peas Rank 2 - Bottle Gourd Rank 3 - Carrot
	Oilseed Rank 5	Fish Production		
		Inland fish Rank 3		

Sources: Data from the Government of India records, including Ministry of Agriculture, Cooperation and Farmer Welfare. *Agricultural Statistics at a Glance*. <https://agricoop.gov.in/sites/default/files/agristatglance2018.pdf>; and Ministry of Agriculture, Cooperation and Farmer Welfare. *Horticulture Statistics at a Glance*. <https://agricoop.nic.in/sites/default/files/Horticulture%20Statistics%20at%20a%20Glance-2018.pdf>.

D. The Pre-Feasibility Study

The Government of Uttar Pradesh Agriculture Policy 2013 set a vision for the state to be the “granary of the nation” by ensuring food and nutritional security, and to improve the quality of village life with inclusive and sustainable growth. To achieve this vision, the state government is targeting agriculture sector growth of 5.1% per year by encouraging private sector participation in the field of agricultural research, development, extension, input management, and marketing.⁸ It is in this context that the state government requested ADB to support agricultural value chain development. For this purpose, ADB carried out a pre-feasibility study through the Small-Scale and Support Technical Assistance project. The project aimed to:

- review agricultural value chains in Uttar Pradesh, from market demand and trend analysis to policy, production, rural infrastructure, marketing, and transportation; and
- provide recommendations for areas of investment across the value chains of the selected commodities.

E. Approach and Methodology

Phase 1: Inception Phase

Primary sector analysis: A preliminary analysis of the current status of the Uttar Pradesh primary sector was conducted using secondary research to assess the contribution of the sector in terms of gross state value-added, livelihood generation, land use patterns, and major subsectors. The major subsectors and categories were further studied in depth to understand the production contribution, productivity, contribution to the state economy, processing capabilities, export potential, and scope for value addition and to identify and prioritize subsector selection. The major subsectors are cereals, pulses, oilseeds, fruits, vegetables, cash crops (sugarcane), fisheries, animal husbandry, and dairy.

Based on the subsector assessment, the key commodities with high potential to create a significant development impact in terms of doubling farmers’ incomes and offer opportunities for public–private partnerships and investments along the value chain were identified.

Selection of focus crops: Sectoral analysis was followed by consultations with the Government of Uttar Pradesh and ADB during a meeting on 26 March 2019. A total of 16 crops were flagged for further comparative assessment to enable the final selection of focus crops. The high-value and high-volume crops identified were:

- pulses: tur, urad, moong, gram, lentil (masoor);
- oilseeds: mustard, groundnut, sesamum;
- fruits: mango, banana, guava, aonla (Indian gooseberry);
- vegetables: potato, green pea, tomato; and
- fishery: carp.

A comparative assessment for these identified crops was conducted based on six parameters. Each parameter was assigned a weight based on its relevance in the identification of the most significant crops that could create the optimum impact and attract investments along the value chain (Table 2).

⁸ Department of Agriculture. Uttar Pradesh Agriculture Policy 2013: Roadmap for Progress & Prosperity. 2013. <http://upagriparadarsi.gov.in/MediaGallery/agripolicyhindi.pdf>.

Table 2: Weighting and Relevance of Parameters for Selection of Focus Crops

Selection Parameter	Weight %	Relevance
Percentage share in all India production of the crop	5	A higher percentage is indicative of state production potential and competitiveness in comparison with other states. The scale of crop production causally relates to the capacity to fulfill market demand.
Waste along value chain	15	Higher waste along the value chain indicates greater scope for interventions to reduce waste and improve efficiency through technology interventions, adoption of best practices, capacity-building, and creation of adequate postharvest infrastructure.
Area under cultivation for specified crops in Uttar Pradesh ('000 ha)	10	A higher area under cultivation is indicative of a larger number of farmers associated with the cultivation of the crop in the state, which would lead to greater impact of interventions. A productivity gap analysis identified the potential for increasing production, with the adoption of improved practices leading to a higher contribution to GVA.
% share of agriculture and allied sector GVA (excluding forestry and logging)	10	A higher percentage contribution to agriculture and allied sector GVA indicates higher importance of the crop in the state economy.
Price volatility	20	The higher the variation in prices and level of uncertainty among farmers, the greater the need for interventions to support stabilization of prices and management of price risks.
Scope for value addition	40	The higher the scope for value addition, the more options available for farmers to market value-added produce and increase income generation over traditional marketing in fresh form. Relative scoring was done for this parameter. Crops like potato, which has multiple value addition possibilities, such as French fries, wafers, chips, flakes, starch, frozen food items, and powder, have been given a high score. Produce like carp fish, for which value addition is limited to cold chain storage, is assigned a low score.

Source: Deloitte India research and analysis; parameters and weights were discussed and agreed on between the state government and ADB.

The detailed comparative assessment and final scoring were based on the parameters in Table 2 for the 16 shortlisted agricultural products provided in Appendix 1. Based on the analysis and consultations with the state government, **potato, mango, guava, mustard and gram** were selected for the study.

Phase 2: Value Chain Analysis and Market Assessment

Value chain analysis: The Food and Agriculture Organization (FAO) defines a value chain as a portion of a socioeconomic system where upstream agents are linked to downstream partners by technical, economic, territorial, institutional, and social relationships.⁹ Thus, a value chain refers both to a set of interdependent economic activities and to a group of vertically linked economic agents that starts with the production of a primary commodity, ends with the consumption of a final product, and includes all the economic activities undertaken

⁹ Bellù, L. 2013. *Value Chain Analysis for Policy Making, Methodological Guidelines for a Quantitative Approach*. EasyPOL Series 129. Rome: FAO. <http://www.fao.org/3/a-at511e.pdf>.

between these phases such as processing, delivery, wholesaling, and retailing. To understand the dynamics of the market systems in its totality, the analysis focused on

- exploring value chain structures, activities, and the relationships among agents;
- examining the flow of commodities and their distribution patterns through different agents;
- understanding the value-added for different agents and analyzing their costs, margins, profits, and losses;
- identifying the bottlenecks, opportunities, and areas of potential improvement for value chain development.

Field visits and stakeholder consultations: Detailed production data of selected focus crops were collected and analyzed to identify the major production clusters of the focus crop. Field visits were conducted to selected clusters for each of the focus crops, in consultation with key stakeholders and representatives of the concerned departments of the state. In-depth interviews with stakeholder representatives and group consultations were carried out from May to July 2019. The following key stakeholders were interviewed during the field visits:

- farmers and FPOs;
- local traders, commission agents, and aggregators;
- transport and logistics providers;
- cold storage and other postharvest infrastructure operators;
- secondary and tertiary processors;
- officials from mandis and agricultural produce marketing committees (APMCs).¹⁰

The field visits included mapping of existing supply chains and identification of gaps and inefficiencies at each stage, with an added focus on institutional arrangements and infrastructure, including marketing infrastructure, existing technology in use, and the potential to introduce appropriate technology.

Market assessment: A comprehensive market assessment exercise was undertaken to ascertain the case for interventions for the development of focus crop value chains from a market perspective. The exercise was two fold, comprising extensive interactions with a cross-section of market stakeholders, including private industries, exporters, regulators, government ministries and departments, financial institutions, and farmer groups and companies, to gain a perspective on the overall concept of focus crop development and attractiveness. Then, an in-depth analysis of international and domestic trade in the focus crop was undertaken, along with a study of related ongoing or past initiatives with regard to policies, market regulatory and control mechanisms, and support infrastructure developments.

Private sector interactions: Extending beyond the survey period, parallel consultations were carried out with private agribusiness actors operating in the focus crop value chains or with some potential for participation. The objective was to identify and assess the gaps constraining their growth and development and their willingness to engage with FPOs as buyers and co-investors, and to seek their suggestions for bridging the existing gaps. For this purpose, a database of 115 private sector agribusiness firms was prepared that included input suppliers; research and development agencies; technology providers; service providers in transportation, storage, packing, cold chains, and logistics; agro-cluster projects; agro and food companies and processors; mega food park projects; trading companies; exporters; organized retailers; and e-marketplaces. The details of the private sector consultations have been compiled in the sections on the assessment of potential buyers and co-investors.

¹⁰ Mandi is a Hindi word meaning “marketplace.”

Stakeholders shared their experiences and highlighted features of their agribusiness sector, including gaps in production practices and harvesting techniques and the need for infrastructure for processing and storage facilities. The private sector assessment focused on (i) identification of the gaps constraining their growth and development, (ii) assessing their willingness to engage with farmers and FPOs as buyers or co-investors, and (iii) seeking their suggestions for bridging the existing gaps in a timely manner.

Identification of gaps and recommendations: The final section of this report offers recommendations for interventions based on the gaps identified, inputs from private sector stakeholders, and the current state-level availability of infrastructure.

II. Focus Crop—Potato

A. Market Overview

Global Production

The potato (*Solanum tuberosum* L.) is the most important non-grain food crop in the world, ranking fifth in terms of worldwide total crop production after sugarcane, maize, wheat, and paddy. In 2018, the world production of potato was 368 million MT.¹¹ Asian countries account for over 50% of the global potato output (footnote 10). Within Asia, the People's Republic of China (PRC) is the largest producer of potatoes, accounting for nearly 25% of world potatoes production. India is the second-largest producer, contributing 12.5% to world production. Other top producing countries include Belarus, France, Germany, the Netherlands, Poland, Russia, the United States (US), and Ukraine (footnote 10). The international potato trade has doubled in volume and risen almost fourfold in value since the mid-1980s. This growth owes to unprecedented international demand for processed products, particularly frozen and dehydrated potato products. The global frozen potato market was valued at \$50,755 million in 2016 and is projected to reach \$66,597 million by 2023, at a growth rate of 3.9% since 2017.

Indian Production

The potato is one of the most important vegetable crops in India. According to recent reports published by the Department of Agriculture, Cooperation, and Farmers Welfare (DAC&FW) of the Government of India, total potato production in India in 2019–2020 was 51.9 million MT.¹² The production of potatoes in India is concentrated mainly in the Indo-Gangetic Plain, which spreads across three states: Uttar Pradesh, West Bengal, and Bihar. Collectively, these states contribute nearly 70% of domestic potato production. Other major potato-producing states are Gujarat, Madhya Pradesh, Punjab, and Haryana.

¹¹ FAOSTAT. 2018. <http://www.fao.org/faostat/en/#data/QC/visualize> (accessed in April 2020).

¹² MoAFW, DAC&FW, Horticulture Statistics Division. 2020. *Monthly Report of Potato, January 2020*. http://agricoop.gov.in/sites/default/files/ilovepdf_merged_3.pdf.

B. Potato Production in Uttar Pradesh

Area and Production

Uttar Pradesh is the largest potato-producing state in India, contributing 28.9% to national production. Over the past few years, the production area has gradually increased (Figure 3). In 2017–2018, the state produced 15.5 million MT of potato cultivated on 615,000 ha.

Uttar Pradesh lags in productivity compared with other potato-producing regions. Average productivity in Uttar Pradesh is 25.3 MT/ha, which is greater than the national average of 23.9 MT/ha and the global average of 19.58 MT/ha but lower than the productivity of other states such as West Bengal (29.9 MT/ha), Gujarat (28.5 MT/ha), and Punjab (26.1 MT/ha).¹³

Production Regions

Potato cultivation is most prominent in the western subtropical and mid-plain agro-climatic zones. The top potato-growing districts in the state are Agra, Kannauj, Firozabad, Hathras, Farrukhabad, Aligarh, and Etawah. These districts collectively account for 50% of the state's potato production (footnote 12). Mainpuri, Allahabad, and Shahjahanpur districts are other major potato-producing areas (Table 3).

¹³ MoAFW. 2018. *Horticulture Statistics at a Glance*. <http://agricoop.nic.in/sites/default/files/Horticulture%20Statistics%20at%20a%20Glance-2018.pdf>.

Table 3: District and Agro-Climatic Area and Production of Potatoes in Uttar Pradesh, 2016–2017

District	Agro-Climatic Zone	Area		Production		Productivity (MT/ha)
		'000 ha	% of State Total	'000 MT	% of State Total	
Agra	Western subtropical	64.81	11	1,664.10	11	25.68
Kannauj	Mid-plains	53.10	9	1,374.10	9	25.88
Firozabad	Western subtropical	51.83	8	1,334.01	9	25.74
Hathras	Western subtropical	50.20	8	1,255.60	8	25.01
Farrukhabad	Mid-plains	36.66	6	1,012.98	7	27.63
Aligarh	Western subtropical	25.13	4	635.14	4	25.27
Etawah	Mid-plains	17.58	3	465.75	3	26.49
Mainpuri	Western subtropical	15.32	2	384.84	2	25.12
Allahabad	Mid-plains	14.47	2	361.84	2	25.01
Shahjahanpur	Mid-Plains	13.32	2	354.45	2	26.61

Source: Government of India, Ministry of Agriculture and Farmers Welfare. 2018. *Horticulture Statistics at a Glance*.

Major Potato Varieties Cultivated

Potato varieties cultivated in Uttar Pradesh include Kufri Bahar (3797), Sadabahar (302), Kufri Surya, and Kufri Chipsona-1. Table 4 highlights the characteristic features of these.

Table 4: Major Potato Varieties Grown in Uttar Pradesh and Their Characteristics

Variety	Yield (MT/ha)	Characteristics	Remarks
Kufri Bahar (3797)	28–30	Good keeping quality, suitable for long-distance travel, shiny appearance, medium maturing type, table variety	Most widely cultivated variety across the state. Preferred because of its features. Seeds have high viability, and the produce can be used as seed for 3–4 years. However, the variety is highly susceptible to late blight, leading to moderate to extensive yield losses.
Sadabahar (302)	40	Better productivity	Cultivated in only in some pockets in Fatehabad region in Agra District. This variety has low demand owing to its perceived inferior taste and fetches much lower prices. Even in Fatehabad, farmers are shifting to other varieties for better prices. The availability of seed is also limited for this variety, and it is susceptible to seed-related diseases.
Kufri Surya	28–30	Good keeping quality and processing variety	Provides better price realization than Kufri Bahar; however, the seeds need to be replaced every 2 years, so farmers do not cultivate this variety on a large scale.
Kufri Chipsona-1	25	Processing variety	This variety fetches an extra ₹100–₹250 per quintal over other varieties; however, yield is lower than for other varieties. Cultivation is limited to small pockets in Kannauj, Farrukhabad, and Hathras Districts.

Note: 1 quintal is equal to 100 kg.

Source: Data and information collected during the field survey.

Seasonality

In many states, potatoes are sown at the beginning of the winter season in October and November and harvested from December to March (Figure 4). In terms of crop seasonality, the state does not enjoy much advantage within domestic markets as the harvesting season largely overlaps with that of the other potato-producing states.

Figure 4: Sowing and Harvesting Season in Major Producing States

Producer State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Uttar Pradesh												
West Bengal												
Bihar												
Punjab												
Karnataka												
Gujarat												
Uttarakhand												
Himachal Pradesh												
<div> <div>Sowing</div> <div>Harvesting</div> </div>												

Source: MoAFW. 2018. *Horticulture Statistics at a Glance*.

C. Value Chain Analysis

Major Actors in the Potato Value Chain in Uttar Pradesh

The main actors in the potato value chain are described in Table 5.

Input suppliers: Many growers use seed saved from their own farm or from fellow farmers with quality produce saved from the previous harvest. Some purchase from local seed dealers and private companies. The State Department of Horticulture and Food Processing is also engaged in the production and supply of quality potato seeds. Some FPOs have started potato seed production and supply to member farmers; however, the supply from the government department and FPOs is insufficient to meet existing demand.

Government department and institutions: Schemes are being implemented across districts through the State Department of Horticulture and Food Processing for research, training, and planned development of potato crops. These include the Mission for Integrated Development of Horticulture (MIDH), the Establishment of Drip/Sprinkler Irrigation Systems, and the Rashtriya Krishi Vikas Yojana (RKVJ) and Food Processing Development Schemes. Under the Uttar Pradesh Potato Development Policy 2014, subsidies and concessions are also being promoted; these include capital and interest subsidies, marketing support, support for the purchase of a refrigerated vehicle (reefer), exemptions from stamp duties, and incentives for export facilitation (Appendix 8). The agriculture universities in the state are also engaged in education, research, and extension.

Table 5: Agents and Activities in the Potato Value Chain in Uttar Pradesh

Activity	Agent	Output
Input supply	Private seed companies, input dealers, other farmers, Department of Horticulture, farmer producer organizations	Supply planting material, fertilizers and micronutrients, plant protection chemicals, micro-irrigation equipment
Training and subsidy	Department of Horticulture and Food Processing, agriculture universities and research institutions	Training on a package of practices, subsidy on inputs (planting material, machinery, chemicals)
Crop production	Farmers	Production and harvesting produce
Postharvest management	Farmers, cold storage operators, commission agents	Primary processing, sorting, grading, packing, trading
Processing	Processors	Secondary and tertiary processing (potato chips, French fries, flakes, starch, powder)
Distribution	Commission agents, wholesalers, traders, retailers	Marketing sorted and graded processed products

Source: Deloitte India field survey data.

Potato farmers: Uttar Pradesh is the largest producer of vegetables in the country (28.32 million MT from 1.46 million ha). Potato accounts for 55% of the total vegetable production (15.5 million MT) and 42% of the area under cultivation (0.62 million ha) (footnote 12). Thus, a significant number of farmers are engaged in potato cultivation in Uttar Pradesh. Most potato growers are smallholders or marginal farmers and are involved until the harvesting and storage stages. Most farmers store their produce at cold storage facilities and sell it after a few months when the price increases (during the monsoon July–September.)

Cold storage: Potato growers and traders mostly store their produce in February and March at cold stores and make staggered sales in later months when demand rises, to take advantage of higher prices. Producers are dependent primarily on cold storage centers for obtaining information on prevailing market rates and sales of produce. Thus, cold storage centers are important stakeholders in the value chain. As of March 2018, the state had 2,368 cold storage facilities with an installed capacity of 14.50 million MT, i.e., 40% of the total installed cold storage capacity of India (footnote 12). A total of 95% of installed cold storage capacity in the state is used for potato. More than 90% of potato production is stored for 2–7 months. Cold storage owners charge a lump sum storage fee per unit for the season (generally per 50 kg unit of potatoes stored).

Processors: Most potato varieties cultivated in Uttar Pradesh are table varieties and not suitable for processing, given their low dry matter content and a reducing sugars level over the prescribed limit for making quality value-added products. Kufri Chipsona-1 is the only major processable variety, cultivated in small quantities in selected production clusters in Agra and surrounding districts. Thus, despite being one of the major potato-producing states, Uttar Pradesh has relatively few large-scale processing units. Potato processing is carried out by small and unorganized units, which for the most part process potatoes into chipped products only.

Commission agents, traders, and wholesalers: Commission agents are licensed traders that mostly operate through the APMC markets. They facilitate trade between farmers and traders and charge a fixed commission from the trader who buys from the farmers. The produce is sold through an open-outcry auction managed by the commission agent, who deducts his/her commission after the sale.¹⁴ There are also wholesalers and specialized

¹⁴ In an open-outcry auction, bids and offers must be made out in the open market, giving all participants a chance to compete for the order with the best price.

potato traders dealing in large quantities that they buy from the APMC mandis during peak season or from cold storage centers during the off-season.

Commodity Flow Analysis

Based on the primary survey, the commodity distribution and marketing flow along the value chain is depicted in Figure 5.

Channel 1: Marketing through cold storage centers. Channel 1 is the most prevalent trade channel. Between 90% and 95% of growers in the major production districts of Agra and Hathras prefer to store their produce in cold storage facilities and then sell a few months later, preferably during or after the monsoon months. Large traders buy from cold storage centers and sell in distant markets.

Cold storage centers are an important trade channel for potato marketing in Uttar Pradesh. Cold storage center owners charge a lump sum storage fee per unit for the season (generally per 50 kg unit of potatoes stored).

Cold storage centers also provide credit to potato farmers and traders against the potatoes stored, which is adjusted later when the stock is sold and returns are earned. There is also a small offshoot to this marketing channel, wherein some processing companies buy processable grade potato varieties to manufacture value-added potato products.

Channel 2: Marketing through APMC mandis.¹⁵ Approximately 4%–5% of the produce is directly sold by farmers in APMC mandis. This trade is mostly facilitated through commission agents operating from mandi premises. The produce is sold at auctions, and the commission agent charges a fixed commission from the trader who buys the produce from farmers. The produce from APMC mandis in the peak season and from cold storage centers in the off-season is aggregated at the wholesaler/large trader level for onward distribution and retail sales in distant locations such as Delhi, Kolkata, Bengaluru, and Mumbai.

Channel 3: Marketing through farmer producer organizations. FPOs are being promoted by the Small Farmers Agribusiness Consortium (SFAC),¹⁶ the National Bank for Agriculture and Rural Development (NABARD),¹⁷ Uttar Pradesh Bhumi Sudhar Nigam,¹⁸ and other similar agencies. There are 10 registered FPOs in the state with members engaged in potato cultivation. Meetings with FPOs revealed that 6 out of 10 are currently operational and three of those six are active FPOs focused on potatoes.

- Kashi Vishwanath Farmer Producer Company Limited (Varanasi) mainly facilitates the supply of farm inputs such as seeds, fertilizers, and pesticides to member farmers. It is also engaged in marketing members' produce through its own trading outlets through the Panchkoshi Mandi in Uttar Pradesh. The Kashi Vishwanath FPO has also set up a farm machinery bank to lease out agricultural implements and machinery (e.g., tractors, rotavators, threshers). The Kashi Vishwanath FPO also undertakes cottage-level processing of potatoes into chips and making papads (thin crisp cakes) through women's self-help groups and markets these products under the FPO brand name.
- Rameshwar Farmer Producer Company Limited (Varanasi) facilitates marketing of potatoes and other vegetable crops cultivated by member farmers. The Rameshwar FPO is also planning to set up an outlet at a private mandi in Rajatalab in Uttar Pradesh for marketing the aggregated supply of member farmers' produce.
- Fatehabad Farmer Producer Company Limited (Agra) mainly facilitates the supply of farm inputs such as seeds, fertilizers, and pesticides to member farmers. It has also initiated a potato seed production program on 40 acres and produces approximately 800 quintals of potato seed of the Kufri Bahar variety. At present, the Fatehabad FPO is not engaged in marketing potatoes, but it is exploring market links with processors to facilitate a contract farming arrangement to supply the Chipsona varieties.

Price Build up Analysis

Channel 3 marketing through FPOs comprises less than 1% of the potato trade at present. Across the state, FPOs have been recently incorporated (2015–2017) and are in their initial years of operation. Four out of 10 remain inactive owing to a range of challenges, related to business viability, capacity-building needs, and marketing and finance issues, among others.

¹⁵ Mandis are physical, primary agricultural markets.

¹⁶ SFAC was mandated by the Department of Agriculture and Cooperation, MoAFW, to support state governments in the formation of FPOs. The initiative was started in 2011–2012. SFAC. 2019. *Strategy Paper for Promotion of 10,000 Farmer Producer Organizations*. <http://sfacindia.com/UploadFile/Statistics/StrategyPaperonPromotion10KFPOs.pdf>.

¹⁷ NABARD set up a Producers Organization Development Fund on 1 April 2011. <https://www.nabard.org/content.aspx?id=684>.

¹⁸ Farmers' groups were supported under the Uttar Pradesh Sodic Lands Reclamation III Project, which was implemented from 2010–2011 to 2018–2019. <http://www.upbsn.org/index.htm>.

A study of production and marketing functions and activities was carried out to determine the actual expenses and gains in bringing potato produce from farm gate to consumers; pre- and postharvest activities along the chain were analyzed.

Preharvest Activities

Land preparation: A well-pulverized seedbed is required for good tuberization of the potato crop. As a general practice, it is recommended to plow the field once to a depth of 20–25 cm soon after the harvest of the kharif crop, followed by two to three cross-harrowings or four to five plowings to level the field.¹⁹ Farmers in the surveyed areas were observed plowing the field 10 times before sowing potato seeds, thus increasing the cost of field preparation. The cost of one plowing per hectare is estimated at ₹1,875 or ₹18,750/ha for 10 plowings.

Seed input and labor: In general, the spacing for well-sprouted potato seed tubers is recommended at 2.5–3.5 MT/ha depending on their size and the purpose of production (e.g., for seed, table use, or processing). Most farmers tend to use an excessive seed rate of 4.3–5 MT/ha, in part because of poor seed quality. The unit cost of seed potatoes is estimated at ₹1,450 per 50 kg bag, making the total cost of seed input per hectare ₹145,000. Farmers tend to use their farm-saved seeds and generally replace seeds every 3 years; thus, the average cost of seed input is estimated at ₹48,333/ha per year. The seed input cost accounts for the major share (~40%) of the total cost of crop establishment. In addition, the average labor cost for sowing seeds was ₹6,250/ha, bringing the total cost of sowing to ₹54,583/ha.

Nutrient management: In general, for the central Indo-Gangetic plains, a fertilizer dose of 100–120 kg/ha of nitrogen (N), 80–100 kg/ha of phosphorous (P), and 100–120 kg/ha of potassium (K) at the time of planting and 100–120 kg/ha of N at time of earthing-up is recommended.²⁰ Thus, urea is applied as a base dose at the time of sowing and again 1 month after sowing. Di-ammonium phosphate (DAP) and murate of potash (MoP) are applied as a base dose at the time of the sowing only. Micronutrients, mainly zinc and iron, are also applied, as they are vital for tuber growth. Farmers were observed to be applying urea at 12.5 bags/ha (45 kg bags), DAP at 10 bags/ha (50 kg bags), and MoP at 5 bags/ha (50 kg bags). Thus, the average nitrogen, phosphorus, potassium (NPK) application is calculated as 350:230:150 kg/ha, indicating that a considerable number of farmers are applying more fertilizer than recommended, causing soil health deterioration, leading to a decline in crop yields and adding to the cost of cultivation.²¹ The average cost of fertilizer inputs and their application is estimated at ₹31,875/ha, calculated at a unit cost of ₹350 per 45 kg bag of urea for 12.5 bags/ha, ₹1,450 per 50 kg bag of DAP for 10 bags/ha, and ₹850 per 50 kg bag of MoP for 5 bags/ha.

Water management: Potato crops are highly responsive to good water management. To have optimum moisture for uniform germination of seed tubers, a pre-sowing irrigation and subsequent irrigation at an interval of 7–10 days is recommended (up to 10 days before harvesting) depending on the crop requirement. The common practice in the major production clusters was observed to be three to four times this amount. Farmers generally practice furrow irrigation using tube wells as their primary source of water. Coupled with groundwater depletion in different regions of the state, this adversely affects the crop yield. The unit cost per irrigation is ₹2,500/ha, bringing the total estimated cost of irrigation to ₹10,000/ha.

¹⁹ Kharif crops are typically sown at the beginning of the first monsoon rains in June of each year.

²⁰ When the plants are 10 cm tall, the leafy shoots can be mounded around with soil to their full height, a process known as “earthing-up.” ICAR. *Package of Practice for Ware and Seed Potato Production in Central Indo-Gangetic Plains*. Extension Bulletin 16. <https://cpri.icar.gov.in/WriteReadData/LINKS/ExtBullNo16Engfb1e51db-0d72-4de3-9037-fb79447e301b.pdf>.

²¹ Calculated at 46% N content in urea, 18% N and 46% P content in DAP, and 60% K content in MoP.

Weeding: Most farmers practice chemical weed control by applying weedicides within 20–25 days of planting. The unit cost of weed control is estimated at ₹2,500/ha.

Plant protection: Potatoes are prone to fungal, bacterial, and viral diseases. Early and late blight are the major diseases that affect crop growth in the surveyed region. Insect pests, such as aphids, cutworms, and defoliators, also damage the crop. As a preventive measure, farmers generally apply two to three sprayings of plant protection chemicals (fungicides and insecticides) during the crop season at a unit rate of ₹2,500 per spraying, bringing the cost per hectare to ₹7,500.

Harvesting and Postharvest Activities

Harvesting: The crop is harvested when the tuber skin is fully cured. Most farmers harvest using tractor-mounted harvesters. Before putting the crop in cold stores, the freshly harvested tubers are kept in heaps in a cool, shady area for 10–15 days for curing and covered with paddy or sugar straw to protect them from direct sunlight to prevent the skins from greening. The cost of harvesting is estimated at ₹15,000/ha.

Primary processing (sorting, grading, and packaging): After curing, potatoes are graded by visual inspection according to size, appearance, and defects. In Uttar Pradesh, the produce is segregated into three grades. Potatoes with a diameter of 35–50 mm are called bada (Grade A), potatoes with a diameter of 25–30 mm are called gulla (Grade B), and those with a diameter of 20–25 mm are called kirri (Grade C). Most farmers employ labor for manual grading, segregation, and packing. Specialized infrastructure for cleaning, grading, packaging, and weight standardization is mostly lacking. For sale in domestic markets, the preference is for packing approximately 50 kg in jute gunny bags. Some farmers use plastic bags. For bulk export, different packaging materials are recommended, such as corrugated fiberboard boxes of 10 kg capacity, hessian (jute) bags, or leno bags (polypropylene bags) of 25 kg capacity. The cost of labor for sorting, grading, and packing is estimated at ₹12,500/ha, and for purchase of packaging material ₹15,625, calculated at a unit rate of ₹25 per 50 kg bag each (i.e., 625 bags).

Storage at cold store centers: Almost 90%–95% of growers store their produce in February and March in cold store centers and make staggered sales in later months. The cold store centers charge a lump sum fee for the entire storage season, from mid-March to November, irrespective of the actual duration of storage. The storage rate is fixed by the Cold Storage Association and is revised annually based on a review of operational expenses by the cold stores. For 2019–2020, the applicable storage charges were fixed at ₹230 per 100 kg of potatoes.

Transportation and trade facilitation: The cost of transportation to nearby local mandis or a cold storage facility, along with the labor charges for loading and unloading the bags, is borne by the cultivator. Transport costs may vary from ₹3,750 to ₹5,000/ha, depending on the distance from the farm gate. The labor charges for loading and unloading are estimated at ₹2,500/ha, calculated at a unit rate of ₹4 per 50 kg bag. Outbound transportation to distant markets is mostly done by commission agents and traders. The average costs for outbound transportation from the Agra cluster to various markets outside Uttar Pradesh using a 24 MT capacity transport vehicle are detailed in Table 6.

Table 6: Average Cost of Transportation from Agra Cluster to Key Destination Markets

Cost	Delhi	Ambala (Haryana)	Kolkata	Bengaluru	Chennai
₹per 24 MT	10,000	25,000	70,000	95,000	130,000
Cost/kg (₹)	0.41	1.04	2.91	3.95	5.41

Source: Based on data and information collected during field survey.

Sales and Marketing Within and Outside the State

Major markets²²: The major markets for the potato trade within the state are Farrukhabad, Kanpur, Sirsaganj (Firozabad District), Fatehabad (Agra District), and Visoli (Badaun District).²³ Kanpur District is not a major potato-producing region; however, Kanpur Mandi reports the second-highest arrival of produce within the state. Kanpur Mandi acts as a logistics hub for distribution to the rest of the state and other neighboring states like Madhya Pradesh and Rajasthan. The mandi records secondary arrivals from production clusters as a result of its better price offers. This information was verified in field interactions. A significant quantity of potatoes produced in Uttar Pradesh is also sent to markets outside the state in Burdwan (West Bengal), Delhi, Mumbai, Bengaluru, and Ahmedabad. Some large-scale farmers from Agra are exporting their produce under the potato export promotion scheme of the Uttar Pradesh State Agriculture Marketing Board, wherein farmers are given an export promotion subsidy of ₹0.50/kg and a transport subsidy of ₹2/bag. International exports from Uttar Pradesh are limited to Nepal.

Market prices: A number of factors govern the price in the sale of potatoes at APMC markets and cold storage centers. These include total production within and outside the state, arrivals in APMC mandis, the variety being traded, the period of sale (peak or lean), and the prevailing price across the country. Grade and variety price differences at the farmer level are recorded in Table 7.

Price trends: Wholesale prices in the major markets have fluctuated considerably from 2010 to 2019 (Figure 6).

Table 7: Produce Price by Grade and Variety

Grade	% Share of Harvested Produce	Price Realization (₹ per 100 kg)		
		Kufri Bahar	Kufri Surya	Chipsona 1
Grade A	60	800–1,000	1,000–1,200	900–1,200
Grade B	30	400–600	600–800	500–800
Grade C	10	150–300	300–400	250–400

Source: Based on Deloitte India data and information collected during field survey.

A comparative analysis of the mean of daily modal price of potatoes in major markets for the period January to December 2018 reveals that the offered prices are better in markets outside the state (Figure 7).²⁴

²² Based on data available from the Agricultural Marketing Information Network portal of the Directorate of Marketing and Inspection.

²³ Traders who purchase from cold storage centers are required to obtain a gate pass issued from the mandi in whose jurisdiction the cold storage center is located. Thus, the sale of produce through cold storage centers is recorded in the overall trade volume of the mandi.

²⁴ AGMARKNET provides the modal price at which a commodity has been traded in a particular market on a particular day. The “mean of daily modal price” refers to the mean of all modal prices at which a commodity was traded in a particular market in 2018.

Figure 6: Comparative Analysis of Mean of Daily Modal Prices of Potatoes in Major Markets Calculated for January–December 2018

Source: MoAFW. <https://agmarknet.gov.in/>.

Figure 7: Mean of Daily Modal Prices of Potatoes in Major Markets in Uttar Pradesh, 2010–2019

Source: Government of Uttar Pradesh, Directorate of Economics and Statistics.

The price of potatoes across some major markets in India outside Uttar Pradesh followed a similar trend during the same period (Figure 8).

Figure 8: Mean of Daily Modal Price of Potatoes in Major Markets Outside Uttar Pradesh, 2010–2019

Source: MoAFW. <https://agmarknet.gov.in/>.

Secondary and tertiary processing: Potatoes can be processed into potato chips, fries, frozen, dehydrated products (dehydrated chips, diced or cubed, waris, papads, flakes, granules, and flour), and potato starch. Despite being the largest potato producer in India, the state lags in potato processing (<1%) owing to the low availability of processable grade potato varieties. According to field estimates, 10% of the potatoes grown are processable varieties. Potato processing is usually undertaken in the informal sector in rural areas, which lack infrastructure and market links. Thus, farmers get a lower price for processable grade produce, as compared with other states, although the prices received for processable varieties are higher than those for the table varieties. Two medium to large potato processing units were identified, but neither is located in the production belts. The establishment of potato processing units in the formal sector is expected to increase the demand and the prices for processable grade varieties, for processing grade varieties, and should encourage farmers to grow more processable varieties and get better returns for their produce (Table 8).

Table 8: Agro-Processing Units in Uttar Pradesh Dealing in Potato-Based Products

Processor	Location	Products	Capacity
Vegit (Merino Group)	Hapur (UP)	Dehydrated potato products and ready-to-cook snack mixes made from potatoes such as aloo mash, potato flakes, aloo tikki, vegetable cutlets, aloo bonda, burger patties, and halwa	8,000 MT per annum finished product with the capacity to process up to 50,000 MT of raw potatoes per annum
Haldiram Snacks Pvt. Ltd.	Gautam Budh Nagar (UP)	Potato chips and other potato-based products, including namkeen (savory) snacks	Information not available
Sahu Fresh	Sambhal (UP)	Frozen fruits and vegetables, including frozen diced potatoes	Annual processing capacity of 10,000 MT

Source: Stakeholder consultations and secondary research.

D. Farm-Level Economics of Potato Cultivation, Storage, and Marketing

Compared with other food crops, potato production is capital-intensive, requiring the purchase of large quantities of bulky seed and the application of fertilizers and pesticides. The initial investment for potato cultivation by the farmer is estimated at ₹125,000/ha, which includes the cost of land preparation, planting material, fertilizer application, weeding, irrigation, and plant protection. In addition, to store potatoes in cold storage centers and sell at a mandi, the cultivator has to bear about ₹121,000 toward the cost of packing materials, sorting, grading, transportation, loading and unloading, and storage fees. The net profit earned by the farmer is estimated at ₹32,000/ha. The price realization for processing varieties such as Chipsona-1 and Kufri Surya is higher than that of major table varieties such as Kufri Bahar. The processable varieties grown in Uttar Pradesh are mostly purchased by locals in the informal sector for making potato chips. Stakeholder consultations revealed that some processable varieties are sold for table purposes and still fetch higher prices than table varieties, owing to their better quality (Table 9, Case 1).

Table 9: Initial Investment for Potato Cultivation and Marketing

	Cost Particulars	Unit Cost (₹)	Frequency	Value (₹/ha)
A	Preharvest activities			
1	Cost of land preparation	1,875 per plowing	10 plowings	18,750
2	Cost of sowing	NA	NA	NA
	Planting materials (3-year average)	1,450 per pack of 50 kg seed	5,000 kg	48,333
	Labor input	6,250/ha	1 time	6,250
3	Application of fertilizer inputs			
	Urea	350 per 45 kg bag	12.5 bags	4,375
	DAP	1,450 per 50 kg bag	10 bags	14,500
	Potash	850 per 50 kg	5 bags	4,250
	Micronutrients	8,750	1 time	8,750
4	Irrigation charges	2,500 per irrigation	4 times	10,000
5	Cost of weeding	2,500	1 time	2,500
6	Cost of plant protection	2,500 per spraying	3 sprays	7,500
	Cost of cultivation			125,208
	Average yield per ha		31,250 kg/ha	
	Cost of cultivation per kg			4.01
B	Harvest and postharvest activities			
1	Cost of harvesting	15,000/ha	1 time	15,000
2	Cost of primary processing			
	Sorting, grading, packing	12,500/ha	1 time	12,500
	Cost of packing materials	25 per 50 kg bag	625 bags	15,625
	Cost for harvesting, grading, sorting, and packing per kg			1.38
3	Cost of inbound transportation to nearby mandi or cold storage center			
	Transportation charges	3,750/ha	1 time	3,750

Continued on next page

Table 9: *continued*

	Cost Particulars	Unit Cost (₹)	Frequency	Value (₹/ha)
	Cost for loading, unloading	4 per 50 kg bag	625 bags	2,500
	Cost for transportation per kg			0.20
4	Cost of storage at cold store	230/quintal	312.50 Q/ha	71,875
	Cost of storage per kg			2.3
	Cost of storage and marketing			121,250
C	Total income @ average sale price of 8.91/kg	31,250 kg/ha		278,437
D	Net profit earned by farmers per ha			31,980
	Farmer's profit margin per kg			1.02

Source: Based on data and information collected during the field survey and MoAFW. <https://agmarknet.gov.in/>.

Case 1: Cost-Benefit Analysis of Chipsona-1 versus Other Table Varieties in Uttar Pradesh

Information was collected from 175 farmers across three important potato production clusters of Agra, Farrukhabad, and Meerut. Of the potato area, 63% is being cultivated with the Kufri Chipsona-1 variety and 62.30% with Kufri Bahar. Other important varieties cultivated in the region included Kufri Badsah, Kufri Bahar, and Kufri Pukhraj. The findings showed that:

- 11.54% of respondents reported that the yield of Chipsona-1 was higher than for other varieties.
- 69.23% reported it was on a par with Chipsona-1 yields.
- 19.23% reported that it was less than other varieties.
- 92.3% highlighted that the price realization was better for Chipsona-1.
- 80.77% said that it had better keeping quality in cold storage.
- 84.61% said that Chipsona-1 had better resistance to diseases than table varieties.

The profitability analysis showed that the yield per hectare for Chipsona-1 (281.2 Q/ha) was slightly higher than for other varieties (272.9 Q/ha). The cost of cultivation is also 9% higher than for other varieties. The price realization for Chipsona-1 in local markets (₹609.2/Q) is also higher than for table varieties (₹514.5/Q).

Overall, a higher benefit-cost ratio (1.91) was reported for Chipsona-1, in comparison with other varieties (1.61), and farmers growing Chipsona-1 are receiving better margins than their counterparts growing other varieties.

Note: q = 100 kg.

Source: Rajesh K. Rana, N.K. Pandey, Arun Pandit, and S.K. Pandey. 2009 Profitability Analysis of Kufri Chipsona-1 Cultivation in Uttar Pradesh. *Potato J.* 36 (3–4). pp. 166–172.

Summary of Price Build up

During the peak potato harvesting months (December–March), prices are as low as ₹400–₹600 per quintal but rise to ₹800–₹1,000 per quintal in local markets and ₹1,000–₹1,500 in distant markets during the off-season. Individual farmers rarely sell at distant markets. Mostly, commission agents and traders sell produce from cold storage centers at distant markets (Channel 1) at margins ranging from 8% to 10%. Traders also bear the charges for mandi access (2.5% in Uttar Pradesh), loading produce, and transportation. Cold storage centers charge an informal facilitation fee of up to 5%–6% for facilitating links between farmers and traders. As a result, traders tend to adjust the cost in price offered to the farmer. Sometimes, the farmer's price is discounted by 10% owing to an

assumption of shortage in weight as a result of handling and storage losses. With increasing potato production in other states, traders in Uttar Pradesh are reportedly losing sales in distant markets, which affects the prices they offer to the local mandi. A typical cost build up per kg of potato is illustrated in Figure 9.

The farmer's share in the final price paid by the consumer is 4%, while intermediaries (commission agents, traders, sub-wholesalers, distributors, and retailers) earn 48%. Waste at various stages is estimated to total 14%.²⁵ The remaining share of 35% in the consumer price is attributable to marketing, transport, and other expenses (Figure 9).

Table 10: Potential Benefits of Application of Drip Irrigation in Potato Crop

Attribute	Benefit (%)
Yield advantage	33–39.5
Fertilizer saving	25
Water saving	50
Labor saving	30–35
Higher number of tubers	10–15
Higher price of produce	25
Overall income enhancement	₹50,000/ha

Source: ICAR. 2019. *Bulletin on Indian Horticulture*. November–December. 64(6).

²⁵ Ministry of Food Processing Industries. 2015. Assessment of Quantitative Harvest and Postharvest Losses of Major Crops and Commodities in India. https://mofpi.nic.in/sites/default/files/ciphet_mofpi_report1.pdf.

Gaps in the Value Chain

Production Gaps

Low productivity: Uttar Pradesh lags in productivity, compared with other potato-producing regions of the country. The average productivity in Uttar Pradesh is 25.3 MT/ha, which is marginally greater than the national average but lower than for other states (Figure 10). The average productivity of the potato crop in the state has increased marginally over the years. During the field survey, the farmers interviewed mainly attributed this to factors such as declining groundwater availability, which depletes the quality of the soil owing to increased salinity and thus affects crop yields. The problem is most pronounced in Agra, the largest producer in the state, where the Central Ground Water Board of India has declared 12 out of 15 blocks of the district “dark zones.” Water management should be improved to conserve the soil to support long-term productivity by adopting water-saving technologies, such as drip and sprinkler irrigation.

Injudicious input use: Farmers usually apply fertilizer in excess of the recommended amounts. Injudicious use of fertilizers adds to the cost of cultivation and reduces the soil quality, affecting the yield and quality of the tubers. Growers should be encouraged to perform a soil test before applying fertilizers and should be made aware of the fertilizer type, quality, and quantities to be used and of better application methods such as fertigation systems and placement techniques.

Small-scale and marginal production of individual growers: Most potato farmers are small-scale or marginal growers. Uneconomical lot sizes raise the cost of transportation and other transaction costs, leading to high marketing costs. Small quantities also lower the farmer’s bargaining power and hinder marketing to distant markets. Low-scale operations also limit the implementation of contract farming through which direct links can be established between farmers and buyers.

Weak FPOs: While the emerging farmer collective systems can help overcome the limitations of the predominant small-scale and marginal landholdings in the state, interviews with FPOs revealed several challenges to profitably sustaining their operations. These are:

- issues related to professional skills such as leadership and business acumen, and management of internal conflicts and disputes (Appendix 3);
- a low equity base owing to challenges in promoting share capital;
- inability to access affordable credit owing to lack of collateral;
- challenges in developing business plans, planning business activities, and forging backward and forward integration;
- lack of skills and infrastructure for aggregation of produce such as transport facilities, storage, value addition (cleaning, grading, sorting), and processing;
- poor marketing and value addition expertise.

FPO-linked marketing models have the potential to be promoted as grassroots agencies for technology dissemination and as aggregators to cater to the bulk requirements of the private sector. Therefore, it is important to extend assistance to FPOs for an initial period of at least 4 years from the present 2 years to help them develop capacities to respond to the changing agricultural environment. Extensive capacity-building is needed to help FPOs develop enterprise management and governance skills, supply chain management, trade activities, and credit management (Appendix 3).

Developing FPOs and ensuring their sustainability would be a long-term, sustained support effort in the form of extensive capacity-building. In the recently launched scheme from the Ministry of Agriculture and Farmers Welfare (MoAFW) on Formation and Promotion of 10,000 FPOs, there are provisions for matching equity grants from the government, which will be needed to strengthen the financial base of the FPOs. The scheme also has a dedicated Credit Guarantee Fund (CGF), which can provide suitable credit guarantees to ensure FPOs obtain access to credit from commercial banks and financial institutions. The scheme also provides support to new FPOs for up to 5 years from the year of founding in all aspects of management, inputs, production, processing, value addition, market links, credit links, and use of technology.

Postharvest management gaps

Primary processing: While potato farmers in Uttar Pradesh generally employ labor for manual sorting, grading, and packing produce based on visual inspection of size, appearance, and defects, these practices can have the following disadvantages:

- Manual grading is not uniform and requires time and energy, which brings down the overall returns.
- It is difficult to find labor during the peak harvest season, and there is competition from other producer states.
- Laborers tend to charge 30%–40% more during the peak harvesting period.
- Cold storage centers do not segregate multiple varieties after farmers mix two or three varieties at harvest and keep them in a single lot. This limits the potential for export to markets such as the United Arab Emirates (UAE) and the Middle East, which have strict standards for imports.

Farmers should be encouraged to adopt improved sorting and grading practices. Various mechanical graders are available for size-grading potato tubers. The use of modern handling, grading, and packaging lines should be especially encouraged for high-grade export quality produce. In particular, FPOs may be encouraged to set up improved infrastructure with assistance under various state and central government schemes. Organized and online retailers can be directly linked with farmers and expect to get “ready-for-shelf” products from a source location after training farmers and providing them with packing materials. Emphasizing improved primary processing would help build trust with distant buyers in the potato supply chain and lead to better price discovery for farmers.

Availability of Postharvest Infrastructure

Storage infrastructure: Although Uttar Pradesh has 40% of India's total cold chain capacity, at over 14 million MT, most of these facilities are technically outdated and designed and used exclusively for storage of potatoes and remain idle for a significant period of the year. Farmers cannot afford to pay the storage fees when the market price slumps or cannot generate sufficient revenue from using cold storage facilities. These factors impact the overall trade operation; hence, it is important to upgrade these facilities to make them energy-efficient and user-friendly for multi-commodity storage and to reduce price and revenue fluctuation risks. Another opportunity lies in rectifying the “skewness” of the location of these facilities in production clusters such as Agra, Firozabad, Badaun, Etawah, Aligarh, Hathras, and Kannauj. Because limited facilities are available to cater to production in other regions and districts, smaller storage facilities at the farm level and development of “last mile” connectivity would help minimize postharvest losses and increase potato trade within and outside Uttar Pradesh.²⁶

Secondary and tertiary processing: With the growing demand for processed potato products (Appendix 2), there is immense potential for the production of processable grade potato varieties and value addition for domestic consumption as well as export. Potato growers in Uttar Pradesh, however, tend to lack interest in such varieties, owing to lower yields, absence of a price premium, and limited demand as a result of the absence of processing units in the production regions. The shortage in availability of the desired quality and volume of varieties discourages organized processing firms from investing in developing supply chain networks in the state. Production regions such as Agra, Firozabad, Mathura, Hathras, and Etah are in the Taj Trapezium Zone, restricting the establishment of major industrial units to protect the Taj Mahal from pollution.

Box 1: Feedback from Processors, Organized Retailers, Commission Agents, and Government Officers

High potato production leads to surpluses in key production clusters during harvesting season, which results in low market prices.

The price realization for potatoes has not increased much in the past 3 years, which has reduced profitability.

Production of processing varieties is limited (estimated around 10% of total production) as farmers mainly grow table varieties. The processable varieties being grown are mostly purchased by local units in the informal sector to make potato chips. Although the processable varieties fetch higher margins for farmers, the lack of organized processing units in the state limits the demand for processable varieties. They are likely to fetch higher rates if processing units are established in the area.

Exporters say there is considerable scope for exports of processed potato products, such as samosa, parantha, and frozen fries in overseas markets, but the state is unable to tap those markets owing to the lack of product standardization.

Farmers usually do not practice farm level grading; the produce stored in cold storage centers is also not graded or segregated, making standardization difficult.

The FPOs involved in potato production are primarily in the supply of inputs to farmers. One FPO operating in Varanasi is also engaged in cottage-level processing of potatoes into chips and papadum and markets these products under the FPO brand name. It has also set up a farm machinery bank that rents farm equipment to members at a nominal rate.

Source: Deloitte India field data as of 2020.

²⁶ Refer to Box 1 more information.

For these reasons, no large potato processing companies operate in the main potato-producing districts in the state. Organized retailers are dependent primarily on local aggregators and procurement agents to secure supplies of the required quality and quantity. These agents often control prices by keeping high margins for themselves, while farmers fail to get reasonable prices for their produce and are discouraged from maintaining quality.

There are a number of successful contract farming models reported across India, and similar models could be adapted and promoted in Uttar Pradesh.

Marketing Gaps

Access to real-time market flows and price information: With potato increasingly becoming a cash crop, smallholder growers are vulnerable to abrupt changes in input and output prices. Seasonal and year-to-year price movements affect individual smallholder growers more as they lack the financial resources and resilience of larger producers and cooperatives. Interventions to improve the efficiency of markets to manage commodity flows and provide farmers with access to real-time market and price information should help improve their bargaining power and decision-making to get better prices for their produce.

Mandi cess²⁷: Commission agents and traders dealing in potatoes perceive the mandi cess of 2.5% to be on the high side, given the lower taxes prevailing in neighboring states.

Access to Credit Services

High cost of finance: Availability of affordable finance is one of the main challenges facing the farmers and their FPOs engaged in the potato value chain. Farmers and FPOs typically seek loans from informal creditors, such as cold storage center owners, who charge interest rates ranging from 18% to 24% per annum. These high rates increase the likelihood of potato farmers defaulting on repayment when the price falls, affecting the overall supply chain operation.

E. Market Assessment

Potato Product Map

Potatoes can be processed into a wide range of products and are traded globally in various forms (fresh, seed, dried, frozen, and processed) as depicted in Figure 11.

²⁷ A cess is a form of tax levied over and above the base tax liability of a taxpayer. A cess is usually imposed additionally when the state or the central government looks to raise funds for specific purposes.

Import–Export Trade Analysis Global Scenario

According to the United Nations Comtrade and the International Trade Centre statistics, the value of global exports of potatoes and potato products was estimated at \$14.6 billion in 2018.²⁸ Analysis of trends from 2008 to 2019 of global import–export of potato products shows an increasing trend in worldwide demand for potato products (Appendix 2, Case 2).

Fresh potatoes: A large part of the trade consists of imports by Belgium, the Netherlands, and the US to feed a growing potato processing industry. The PRC, Egypt, and Pakistan are among other countries gaining prominence in the fresh potatoes trade (Case 2).

Frozen processed potatoes: The market for frozen processed potatoes has seen tremendous growth over the past 10 years. Global trade increased from 5 million MT in 2008 to more than 8 million MT in 2019. The major countries include the Netherlands, Belgium, France, and Germany in the European Union (EU), and the US and Canada. Combined, these countries export more than 80% of all frozen processed potato products traded worldwide. While Europe and the US compete, each dominates in different markets. The US is the leading exporter of frozen processed potato products to markets such as Japan, Mexico, the Republic of Korea, the PRC, the Philippines, Malaysia, and Saudi Arabia, while the EU countries dominate exports within Europe, the Russian Federation, the Middle East, South America, the Caribbean, and some African countries.

²⁸ ITC Trade Map. <http://www.intracen.org/itc/market-info-tools/trade-statistics/>.

Other prepared and preserved potato products (nonfrozen): The potato crisp is the second-largest processed potato product in the global trade. The import–export trade is mostly limited to neighboring countries in Europe and the US and Canada. As the product is lightweight but bulky and fragile, crisps are costly to transport. As a result, most snack products (except specialty snacks) are produced near to where they are consumed. For instance, the US is the leading exporter of nonfrozen preserved and processed potatoes in Canada and the Netherlands, while Belgium leads exports to the United Kingdom (UK) and France.

**Case 2: Increasing Exports of Fresh and Frozen Processed Potatoes Outside Europe—
A Potential Opportunity for Indian Exports**

People's Republic of China: As the world's largest potato producer, the People's Republic of China (PRC) accounts for nearly a quarter of global production. In the past few years, the PRC has also emerged as the fourth-largest exporter of fresh potatoes in the world. However, exports of fresh potatoes are mainly to the surrounding markets of Malaysia, Viet Nam, and the Russian Federation, which account for approximately 60% of total fresh potato exports. The PRC also processes 15% of its potato production, which includes starch, dehydrated potatoes, chips, and frozen French fries. It also regularly imports frozen processed potato products and repackages and then re-exports them. Japan continues to be the largest destination market, accounting for 70% of the PRC's total frozen processed potato product exports.

Egypt: Over the past decade, Egypt has emerged as the eighth-largest exporter of fresh potatoes in the world. From 2009 to 2018, the country more than doubled its fresh potato exports to 502,720 MT and quadrupled frozen processed potato exports to 52,597 MT. The country is primarily exporting fresh potatoes to the Russian Federation (249,760 MT or 49%), to a lesser extent to the EU-28 (116,518 MT or 23%) and the UAE (53,100 MT or 7%). Egypt also exports frozen processed potatoes, largely to the UAE (16,587 MT or 36.8%), Saudi Arabia (8,277 MT or 18.4%), and other Middle East countries such as Kuwait, Jordan, Morocco, and Bahrain.

Pakistan: Exports of fresh potatoes have increased steadily over the past few years. In 2018, the country exported 688,763 MT valued at \$120 million. In 2018, the country was the leading exporter of fresh potatoes to Afghanistan, accounting for nearly 80% of Afghanistan's imports. Pakistan also accounts for 60% of potato imports in Sri Lanka, compared with the 20% share of India in Sri Lankan potato imports. The country has also emerged as the largest exporter of potatoes to the UAE in terms of volume and stands in second place to Egypt in terms of value of trade with the UAE (accounting for 25% of the import share compared with India's 2% share).

Source: ITC Trade Map. International Trade Statistics. <http://www.intracen.org/itc/market-info-tools/statistics-export-product-country/>.

Potato flakes and granules: Potato flakes are widely used in the food manufacturing industry. They offer several benefits such as water and oil retention and have thickening properties. The global market is expected to undergo further growth over the next few years as more people turn to processed convenience foods, many of which use potato flakes as ingredients. Historically, the trade is dominated by Europe and the US, with Germany and the Netherlands accounting for 50% of the trade. Major net importer countries are the UK, Italy, Malaysia, France, Japan, and Mexico. Recently, India has entered this market and established itself among the top 10 exporter countries.

Potato starch: In 2017, the global volume of potato starch production was estimated at 3.5 million MT.²⁹ Exports of potato starch during the same year were estimated at 0.5 million MT.³⁰ The top exporters are Germany, Poland, and Belgium. The top importers are the US, the Netherlands, the Republic of Korea, the UK, and the PRC (Table 11).

Table 11: Major Exporter and Importer Countries of Potatoes and Potato Products

	Major Exporter Countries	Major Importer Countries
Fresh or chilled potatoes (excluding seeds)	France (16.3%), Germany (9.8%), PRC (7.9%), Netherlands (7.5%), US (6.9%), Canada (6.8%), Iran (6.1%), Egypt (6%), Belgium (4.7%), Pakistan (3.7%), Spain (3%), UK (2.4%)	Belgium (12.7%), Netherlands (8.9%), US (5.8%), Spain (5.8%), Russian Federation (5.6%), Germany (5.3%), Italy (4.1%), Iraq (3.8%), UK (2.8%), Viet Nam (2.7%)
Frozen prepared or preserved potato products	Belgium (26%), Netherlands (24.8%), US (15.3%), Canada (14.4%), France (5.4%), Germany (3.9%), Poland (2.3%)	USA (13.4%), UK (8.5%), France (7.6%), Japan (6%), Netherlands (4.5%), Germany (4.4%), Brazil (4.1%), Italy (3.9%), PRC (2.7%)
Other prepared or preserved potato products, not frozen	Netherlands (15.7%), Belgium (12.3%), US (10.7%), UK (8.3%), Germany (7.5%), Poland (6%), Iran (4.8%), Canada (4%), Spain (3.7%), France (2.8%), Russian Federation (2.5%)	France (10.3%), US (7.9%), Germany (7.4%), Canada (5.3%), Iraq (4.9%), UK (4.6%), Netherlands (4.6%), Belgium (2.9%)
Potato flakes, granules and pellets	Germany (36.6%), US (15.5%), Netherlands (15.2%), Belgium (15%), Denmark (3.9%), Poland (2.6%), Italy (2.4%)	Italy (9.4%), Malaysia (8.9%), US (7.8%), UK (6.8%), France (6.1%), Mexico (5.7%), Japan (5.5%), Belgium (5.2%), Germany (3.9%), Spain (2.7%)
Potato starch	Germany (50%), Poland (23.4%), Belgium (6.8%), Netherlands (3.6%)	USA (10.9%), Netherlands (9%), Korea (7.1%), UK (5.8%), Germany (5.1%), PRC (4.7%), Belgium (4.2%), Italy (3.8%), Mexico (3%)
Potato flour, meal, and powder	Netherlands (61.2%), US (7.6%), UK (4.5%), Poland (4.3%), Saudi Arabia (4.3%), India (2.9%), Ireland (2.4%)	UK (17.2%), Philippines (12.6%), Ireland (6.6%), Italy (6.5%), Germany (6.4%), Japan (5.2%), US (4.3%), PRC (4.1%)
Frozen uncooked or steamed or boiled potatoes	USA (18%), PRC (8.7%), UK (8.6%), Belgium (8.1%), Spain (7.5%), Iran (6.5%), Netherlands (6%), Egypt (5.5%), South Africa (5.3%), Pakistan (4.4%)	Spain (16.5%), UK (15.3%), Japan (7.6%), Italy (6.3%), PRC (5.2%), France (4.3%), Germany (4.2%), Iraq (3.4%), Belgium (2.7%)

Source: ITC Trade Map. International Trade Statistics. <http://www.intracen.org/itc/market-info-tools/statistics-export-product-country/>.

Import–Export Analysis India Scenario

Although India contributes 12.5% of total world potato production, its share in the global export of potatoes and potato products is not significant (Table 12).

²⁹ IMARC Group. *Research Report on Potato Starch Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2018–2023*. <https://www.imarcgroup.com/global-potato-starch-market>.

³⁰ ITC Trade Map. International Trade Statistics. <http://www.intracen.org/itc/market-info-tools/statistics-export-product-country/>.

Table 12: India's Share in Global Exports of Potatoes and Potato Products

HS Code	Product Description	World Exports		India Exports		% Share in World Exports	
		\$ million	'000 MT	\$ million	'000 MT	Value	Qty
70110	Seed potatoes	1,002	1,740	0.9	1.673	0.1	0.1
70190	Fresh or chilled potatoes (excluding seed)	3,300	11,496	57	335	1.7	2.9
200410	Frozen potato products (prepared and preserved)	7,450	8,059	18.8	17.8	0.3	0.2
71010	Potatoes, uncooked/cooked by steaming/boiling in water, frozen	185.7	302	0.82	3.5	0.4	1.2
110520	Potato flakes, granules, and pellets	601.2	452	2.57	2.0	0.4	0.4
110510	Potato flour, meal, and powder	105.9	101	3.1	5.5	2.9	5.4
200520	Other prepared and preserved potato products, not frozen	2,600	1,130	1.28	0.43	0.05	0.04
110813	Potato starch	411.4	502	0.3	0.38	0.1	0.1

Source: Based on analysis of ITC Trade Map. International Trade Statistics. <http://www.intracen.org/itc/market-info-tools/statistics-export-product-country/>.

In 2018, India's total exports of potatoes and potato products were valued at \$84 million. Fresh and chilled potatoes accounted for 90% of the volume and 70% of the value of exported potatoes and potato products. In 2018, India exported 335,000 MT of fresh and chilled potatoes valued at \$ 57 million. Nepal remains the major destination market for fresh and chilled potatoes, accounting for 80% of India's exports. Other major destination markets include Oman (6%), Sri Lanka (3%), Malaysia (3%), Indonesia (2%), Mauritius (2%), Maldives (2%), Kuwait, the UAE, and other markets with a negligible share. Total fresh and chilled potato exports are less than 1% of India's total production (i.e., 51.9 million MT). India's share in the global trade of fresh and chilled potatoes is less than 3% of the global trade volume and less than 2% of the total trade value.

India's share in world exports of prepared and preserved (frozen) potato products is also small. However, these exports are steadily increasing. The export of such products constitutes 5% of total exports and accounts for over 20% of the total export value. In 2018, India exported 17,800 MT of preserved and processed (frozen) potato products worth \$18.8 million. The major export destinations included Thailand (34%), Pakistan (18%), the PRC (11%), Australia (9%), South Africa (7%), and the Philippines (7%). India is gradually becoming an important supplier in Nepal, the UAE, Sri Lanka, and other countries in Asia and the Pacific. India's exports to leading importing countries like the US, the UK, France, Japan, the Netherlands, Germany, Brazil, and Italy is not significant and could be explored by potato processing industries. The remaining share in exports of potato products is made up of potato flakes, granules, pellets, flour, meal, powder, and starch.

India holds a relatively better position in terms of exports of dehydrated potato products such as potato flour, meal, and powder. In 2018, its share in world exports of these products was 5.4% (in volume). Dried potato products from India are mainly exported to Australia, Bangladesh, Indonesia, Malaysia, Pakistan, Thailand, the UAE, the US, and other countries in Asia and the Pacific and Africa. These products are widely used for processing and manufacturing convenience foods and frozen and prepared foods. Storage and transportation of potato flakes are safe and cost less, and the shelf life is longer. The market for processable varieties, particularly under-sized

potatoes, is changing, with increasing demand from manufacturers of flakes and potato granules. These products offer potential opportunities for trade expansion in both domestic and export markets.

Imports of Potatoes and Potato Products

India's imports of potatoes and potato products are limited, and mostly in the form of potato starch (footnote 28). There are a limited number of potato starch manufacturers in India, given the preference for starch extraction from maize.³¹ More than 90% of India's imports of coarse potato starch is from the Netherlands (25%), Denmark (24%), France (22%), Belgium (13%), Poland (10%), and Germany (4%). Most are refined and used domestically or re-exported to other countries.

India also imports potato flakes, granules, and powder. According to ITC trade statistics, in 2018 imports of these products were valued at \$1.6 million and were mostly imported from Malaysia (42%), Pakistan (13%), Thailand (9%), Australia (7%), and Israel (7%).

Share of Uttar Pradesh in India's Trade of Potato and Potato Products

Despite Uttar Pradesh being the largest producer, its exports of potatoes and potato products are not diversified. Exports from the state are limited to Nepal, and the state competes with exports from the bordering states of West Bengal and Bihar and some imports from other countries such as Bangladesh and the PRC (Table 13). A comparative analysis shows that Gujarat and Maharashtra stand out as the leading exporters of potatoes and potato products from India. This can be attributed to their strengths in terms of suitability of varieties grown and the availability of postharvest, manufacturing, and logistics infrastructure. Exported potatoes and potato products typically fetch a price premium of 30%–40% over domestic prices.

Table 13: State Exports of Potatoes and Potato Products, 2018–2019

Product	State	Quantity (MT)	Value (\$ million)	Major Destination Markets
Fresh and chilled potatoes	Gujarat	59,419	21.01	Oman (38%), Malaysia (16%), Indonesia (14%), Mauritius (11%), Kuwait (8%), UAE (5%)
	Uttar Pradesh	144,292	15.19	Nepal (100%)
	West Bengal	91,676	13.69	Nepal (99%), minor exports to Qatar, Brunei, Singapore
	Bihar	50,543	6.53	Nepal (100%)
	Tamil Nadu	12,407	4.75	Sri Lanka (58%), Maldives (41%), minor exports to Singapore, Seychelles, Malaysia, Saudi Arabia
Frozen potato products	Gujarat	17,341	17.82	Thailand (35%), Pakistan (18%), Australia (9%), PRC (11%), South Africa (7.5%), Philippines (7.4%), UAE (2%)
	Maharashtra	285	0.73	Qatar (19%), Canada (33%), Australia (21%), US (10%), Netherland (7%), Malaysia (2%), Singapore (3%), Mauritius (1%), Comoros (1%)
	Uttar Pradesh	281	0.39	Nepal (100%)
	Bihar	232	0.38	Nepal (100%)
	West Bengal	27	0.04	Bhutan (98%), Nepal (2%)

Continued on next page

³¹ While maize contains 12% water, potatoes are 78% water, rendering extraction of starch less viable.

Table 13 continued

Product	State	Quantity (MT)	Value (\$ million)	Major Destination Markets
Potato flakes, granules, and pellets	Gujarat	1,393	1.73	Pakistan (34%), Indonesia (20%), Malaysia (17%), Lebanon (5%), Thailand (5%), Senegal (10%), Kuwait (2%), UAE (1%)
	Uttar Pradesh	957	1.4	Malaysia (47%), Thailand (16%), Indonesia (14%), Israel (11%), UAE (7.7%), Singapore (1.8%), Nepal (1%)
	West Bengal	130	0.15	Bangladesh (100%)
	Maharashtra	46	0.15	Australia (78%), Japan (17%), some quantities exported to US, Canada, UK
	Tamil Nadu	21	0.02	Malaysia (50%), UK (22%), Singapore (20%)
Potato flour, meal, and powder	Madhya Pradesh	3,773	2.12	USA (100%)
	Maharashtra	1,199	0.67	USA (100%), minor quantities to New Zealand, Singapore, Germany, Oman
	Delhi	631	0.35	Australia (57%), Nigeria (14%), USA (12%), New Zealand (9%), Hong Kong (6%)
	Gujarat	38	0.03	USA (45%), Bahrain (24%), South Africa (32%)
	Tamil Nadu	11	0.01	Minor quantities to Singapore, Malaysia, Canada
Potato seed	Punjab	889	0.33	Myanmar (100%)
	Gujarat	722	0.22	Senegal (93%), Kuwait (7%)
	Maharashtra	48	0.02	Myanmar (100%)
	Uttar Pradesh	1	0.01	Nepal (100%)

Source: APEDA. AgriExchange. <http://agriexchange.apeda.gov.in/>.

To promote potato exports from Uttar Pradesh, the State Agriculture Marketing Board has launched a registered trademark, the “Taj” brand. The volume of fresh potato exports from Uttar Pradesh has increased over the years (Figure 12).

Exports of potato flakes, granules, and pellets could be boosted to distant markets, which may otherwise be difficult to tap for raw produce supplies, owing to high freight charges, the bulkiness of the product, and the temperature-controlled container chain.

Demand Outlook

Given stagnating growth rates of cereal productivity; an expected rise in per capita consumption of pulses; edible oil, fruits, vegetables, and milk; and a steadily rising population, it can be concluded that the potato crop can make a crucial contribution to the national food security agenda. According to estimates from the Central Potato Research Institute (CPRI), rapid urban population growth from 375 million to 840 million over the next 40 years at an average compound growth rate (ACGR) of 2.04% is expected against the overall national ACGR of the population at 0.78%.³² An increase in the number of nuclear families and higher disposable incomes will result in a higher tendency toward out-of-home eating, while the rapid increase in the number of working women in the medium and long term is expected to maintain the ACGR at 2.34% in per capita consumption of fresh potatoes. The CPRI report mentions the following points:

- Per capita food demand for fresh potatoes at this ACGR is estimated to increase from 19.7 kg in 2010 to 48.5 kg in 2050. The corresponding national demand for fresh potatoes is estimated at 78.5 million MT in 2050.
- The demand for processing quality potatoes is estimated to rise at the fastest pace for French fries (11.6% ACGR), followed by potato flakes and powder (7.6%) and potato chips (4.5%). Thus, actual demand for processable potatoes (i.e., raw material demand for the potato processing industry) is estimated to rise from 2.8 million MT in 2010 to 25 million MT in 2050 at an ACGR of 5.61%. Correspondingly, the demand for processed potato products is estimated to rise from 0.7 million MT in 2010 to 7.3 million MT in 2050. The use of potatoes for seed tubers is also projected to increase to 6.1 million MT by 2050. Waste is expected to account for 12.2 million MT.

According to CPRI and Indian Council of Agricultural Research (ICAR) estimates, the overall demand for potatoes in India is estimated to rise to 122 million MT by 2050. Therefore, there is immense potential to expand potato production in Uttar Pradesh and take advantage of the growing fresh market and opportunity to diversify

³² ICAR, Central Potato Research Institute. 2013. Vision 2050. http://cish.res.in/recent/pdf/CISH_Vision_2050.pdf.

processed potato products manufactured in the state. This will also promote best practices and infrastructure development and industry assistance as well as strengthen farmer–buyer trade interface.

F. Potential Interventions

Based on the gaps identified in the potato value chain, potential interventions are outlined as follows:

Institutional Development

- Encourage and support farmers to adopt better cultivation, harvesting, and postharvest techniques, which could have a significant impact on productivity and marketable surplus through
 - market-oriented production of potato varieties;
 - training on soil fertility management through judicious use of fertilizer inputs;
 - promoting the use of drip irrigation technologies for water resource management and fertigation;
 - increased mechanization of farm operations; and
 - building awareness about markets and quality aspects of the produce, including knowledge of optimal harvesting time, storage practices, tradable parameters, sorting, grading, and handling protocols, packaging requirements for distant transport, and business-to-consumer retail marketing.
- Promote and strengthen farmer collectives associated with potato growers for aggregated sales and marketing and dissemination of advanced technologies among members.
- Strengthen market intelligence and price discovery mechanisms for providing real-time information on arrivals and grade-specific pricing at markets within and outside the state and help increase farmers' value realization by enabling them to make timely sales.
- Provide for the extension of term loans and working capital loans with partial loan guarantees for farmer collectives and agro-enterprises. This will help reduce potato growers' dependence on cold storage owners and informal sources and encourage more farmers to engage in collective production and marketing through FPO routes.

Infrastructure Support

- Promote farm mechanization suitable for smallholder potato cultivation by establishing multi-crop use equipment banks across different blocks.
- Establish hi-tech seed production nurseries for producing disease-free planting material for potatoes based on standardized tissue cultures and micro-propagation techniques.
- Set up small-scale potato processing units for manufacturing different value-added potato products such as dehydrated potato cubes and shreds, potato dalia, and potato powder premix.³³ Larger processing units could be set up for manufacturing other value-added products. Such interventions would accelerate the cultivation of processing varieties and thus create better marketing avenues for farmers.
- Create and upgrade near-to-farm energy-efficient modern cold storage facilities in potato-producing regions, coupled with skills development and capacity-building of cold store operators and technicians.
- Assist FPOs in setting up retail outlets near urban markets (Figure 13).

³³ Dalia is the Hindi term for “broken cereals.” Dalia is the basis for a wide variety of dishes.

Figure 13: Potential Infrastructure in the Potato Value Chain and Benefits

Source: Deloitte India field data. 2020.

III. Focus Crop—Mango

A. Market Overview

Global Production of Mango

Mango (*Mangifera indica* L.) is a major global tropical fruit crop. In 2018, global mango production (including mangosteen and guava) was estimated at 55.3 million MT cultivated on 5.7 million ha with an average yield of 9 MT/ha.³⁴ Asian countries account for over 73% of global mango production. India is the largest producer of mangoes, accounting for nearly 40% of world production. The PRC is the second-largest producer after India, contributing 9% to world production. Other top producing countries include Bangladesh, Indonesia, Nepal, Pakistan, the Philippines, Thailand, Sri Lanka, Viet Nam, and Yemen.

Indian Production of Mango

According to recent reports published by DAC&FW, total mango production in India in 2019–2020 was estimated to be 21.3 million MT from an area of 2.3 million ha with average productivity of 9.3 MT/h.³⁵ Mangoes grow in almost all states in India. In 2018, Andhra Pradesh was the leading producer, contributing 22% to total domestic production (5 million MT), followed by Uttar Pradesh accounting for 20%.³⁶ Bihar, Karnataka, Tamil Nadu, Gujarat, Telangana, West Bengal, Odisha, Madhya Pradesh, and Maharashtra are also major producer states.

B. Mango Production in Uttar Pradesh

Area and Production

In 2017–2018, the state had 0.47 million ha under fruit crop cultivation and ranked second in terms of fruit production in the country, with a total production of 10.5 million MT (footnote 12). Mangoes occupy more than 50% of the area under fruit cultivation in the state and account for more than 40% of total fruit production. During the past 5 years (2013–2018), the area and production of mangoes in Uttar Pradesh have increased to

³⁴ International commodity classification schemes for production and trade do not require countries to report the fruits within this cluster separately, thus official data remain sparse. According to an FAO report on the global prospects for major tropical fruits (2017), it is estimated that, on average, mango accounts for approximately 75% of the total production volume, guava 15%, and mangosteen for the remaining 10%. Indian national statistics record mango, guava, and mangosteen separately. Also see FAOSTAT. 2018. <http://www.fao.org/faostat/en/#data/QC>.

³⁵ DAC&FW. 2019. Final Estimates of 2018–2019 and First Advance Estimates of 2019–2020 of Area and Production of Various Horticulture Crops.

³⁶ MoAFW. State Details of Mango Production in India. <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1562530>.

0.265 million ha and 4.5 million MT, respectively.²⁵ The state's share in national production is 20% and the area share stands at 12%. The average productivity of the crop in Uttar Pradesh is estimated at 17.58 MT/ha, which is much higher than the national average productivity of 9.3 MT/ha—as shown in Figure 14 (footnote 12).

Mango Production Regions

In terms of agro-climatic zones, districts in the mid-plain zone contribute more than 25% of the total mango production. The other important agro-climatic zones are Bhabhar terai, the eastern plain zone, and the western and mid-western plain zone (Table 14).

Lucknow and Saharanpur are the major mango-producing districts in the state, accounting for 27% of total state production; Unnao (8%), Bulandshahr (6%), Amroha (5%), Sitapur (4%), Faizabad (3%), Sultanpur (3%), Meerut (3%), Ambedkar Nagar (3%), Muzaffarnagar (2%), Kasganj (2%), Bijnor (2%), and Aligarh (2%) are the other major mango-producing districts. Collectively, these districts account for 75% of state mango production.

Mango Varieties

Several varieties of mango are cultivated in the state including Dussheri, Langra, Chausa, Safeda, Ramkela, Malika (hybrid Neelum-Dussheri), Amrapali (hybrid Dussheri-Neelum), and Ambika (hybrid Amrapali-Janardan Prasad). The leading commercial cultivars are Dussheri, Langra, and Chausa, which are traded on domestic and export markets. Both Dussheri and Chausa are in demand internationally, while Chausa is considered more suitable for long-distance transport owing to its longer shelf life. The characteristics features of these varieties are shown in Table 15.

Table 14: District and Agro-Climatic Area and Production of Mangoes in Uttar Pradesh, 2016–2017

District	Agro-Climatic Zone	Area		Production		Productivity (MT/ha)
		'000 ha	% Share in State Total	'000 MT	% Share in State Total	
Lucknow	Mid-plain	29.66	11	588.77	14	19.9
Saharanpur	Bhabhar terai and western plain	29.74	11	578.6	13	19.5
Unnao	Mid-plain	17.1	6	358.13	8	20.9
Bulandshahr	Western plain	15.32	6	263.08	6	17.2
Amroha	Mid-western plain	9.3	4	197.49	5	21.2
Sitapur	Mid-plain	15.99	6	186.62	4	11.7
Faiziabad	Eastern plain	7.65	3	151.89	3	19.9
Sultanpur	Eastern plain	9.3	4	142.64	3	15.3
Meerut	Western plain	8.06	3	128.79	3	16.0
Bijnor	Bhabhar terai	5.91	2	118.09	3	20.0

Source: MoAFW, 2018. *Horticulture Statistics at a Glance*.

Table 15: Characteristics of Major Mango Varieties Grown in Uttar Pradesh

Variety	Yield (MT/ha)	Characteristics	Remarks
Dussheri	15–17	Fruit size is small to medium, shape is oblong to oblong-oblique, and fruit color is yellow. The pulp is firm and fiberless. A mid-season variety with good keeping quality and is mainly used for table purposes.	Cultivated across all major mango-producing districts in Uttar Pradesh. Malihabad in Lucknow District is renowned for Malihabadi Dussheri, and it also holds a Geographical Indicator (GI) tag for this variety.
Chausa	12–13	Fruit is large, ovate to oval-oblique, light yellow. A late variety. Keeping quality is better than Dussheri and Langra, owing to its thick peel. Mainly used for table purposes.	More prevalent in Saharanpur District. Generally harvested late in July and August and thus more susceptible to diseases after the onset of the monsoon. Gives a better price realization to farmers, compared with other varieties.
Langra	18–20	A mid-season variety mostly used for table purposes. Fruit is medium size, ovate, and lettuce-green. Fruit quality is good but keeping quality is medium.	Cultivated mostly in Varanasi District. Most cultivated variety in the state after Dussheri and Chausa. Higher yield than Dussheri and Chausa as the fruit size is bigger.

Source: Based on data and information collected during the field survey.

Seasonality

The harvesting pattern of mangoes in the leading producer states is shown in Figure 15.

The major varieties grown in southern Indian states, such as Alphonso, Karnataka Hapus, Totapari, and Kesar, arrive in the market in the early part of the calendar year and are off the market after the arrival of the monsoon. The Dussheri, Langra, and Chausa varieties are harvested from the end of May to August, with peak production in June.³⁷ Dussheri is the first major variety to be harvested, followed by Langra and Chausa. There is a difference of a fortnight between the arrival periods of these varieties. These varieties are available in the market for 30 to 45 days from the beginning of their harvest seasons. In terms of crop seasonality, the state enjoys an advantage, along with Bihar, for the late arrival of mangoes, particularly in August.

C. Value Chain Analysis

Major Actors in the Mango Value Chain

The actors in the mango value chain are identified in Table 16.

Table 16: Agents and Activities in the Mango Value Chain

Activity	Agent	Output
Input supply	Private nurseries and other vendors, Department of Horticulture, KVKs, Central Institute of Subtropical Horticulture (Lucknow)	Supply of planting material, fertilizers, and micronutrients, plant protection chemicals, micro-irrigation equipment, farm equipment

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³⁷ APEDA, AgriExchange. Product profile. http://agriexchange.apeda.gov.in/product_profile/seasons.aspx?categorycode=0204.

Table 16: *continued*

Activity	Agent	Output
Training and subsidy	Department of Horticulture, Central Institute of Subtropical Horticulture (Lucknow), KVKs	Training on a package of practices and postharvest management, subsidy on inputs (planting material, machinery, chemicals)
Crop production	Farmers, lease contractors	Production and harvesting
Postharvest management	Preharvest contractors, village aggregators, exporters	Primary processing, sorting, grading, packing, trading
Distribution and retail	Commission agents, wholesalers, traders, retailers	Marketing sorted and graded produce
Processing	Processors, packing houses	Secondary- and tertiary-level processing

KVK = Krishi Vigyan Kendra.

Source: Based on data and information collected during the field survey.

Input suppliers: Most mango farmers buy planting material from private nurseries. Out of approximately 40 nurseries accredited by the National Horticulture Board (NHB) of the Government of India for the production of mango-planting material, 35 are in Lucknow District, resulting in low availability of certified planting material in other mango-producing districts.³⁸ Interactions with farmers revealed that the lack of quality planting materials was a major issue in many areas. Some farmers buy saplings from agriculture universities or research institutions, or through agriculture extension centers such as Krishi Vigyan Kendras (KVKs) in their vicinity. Other required input materials, such as fertilizers, micronutrients, and plant protection chemicals, are mostly purchased from private retailers. Some FPOs operating in the state are involved in input marketing. The State Department of Horticulture supplies quality planting material and other inputs to farmers at subsidized rates, but the supplies are limited (Appendix 6).

Government departments and institutions: The State Department of Horticulture administers issues related to the horticulture sector. The department is responsible for coordinating the implementation of various horticulture promoting schemes in the state and supports farmers by providing technical guidance on mango cultivation through training and exposure visits, advocating new technology, and evaluating other needs for assistance (Appendix 6). The state has strong research support for varietal development and scientific cultivation of mangoes extended by ICAR and by the Central Institute for Subtropical Horticulture (CISH), which is based in Lucknow.

Mango producers and growers: Operations carried out by growers include land preparation, sourcing and planting saplings for new orchards and the replacement of senile trees, orchard maintenance, and harvesting. As for marketing activities, most growers sell to preharvest contractors or village-level aggregators, who procure the produce at the farm gate at a price determined before harvesting based on visual inspection of the orchard. Aggregators then regrade the produce. This is followed by packaging and transportation for sale in nearby and distant markets.

Lease contractors: Sometimes, growers lease out a whole orchard for 2–3 years to a contractor at a fixed price. In this case, the contractor is responsible for undertaking all farm activities including marketing through the period of the contract. The lease amount takes into account the orchard area, the variety grown, the number and age of the trees, and the yield and value realization during earlier seasons.

³⁸ NHB. Find a Star Nursery. *Nursery Star Rating Report*. <http://nhb.gov.in/nursery/report/nurseryreport.aspx>.

Preharvest contractors and village-level aggregators: Most mango farmers in the region sell their produce to preharvest contractors, who are frequently traders or commission agents or their representatives (mostly village-level contractors). These contractors buy directly at the farm gate at a predetermined price and sell at wholesale markets after sorting, grading, and packaging. Farmers sell the rejected produce at nearby APMC markets at a lower price.

Commission agents, traders, and wholesalers: Commission agents are licensed traders who mostly operate through the APMC mandis. The produce is sold by means of an open-outcry auction managed by the commission agent who charges a commission to the buying traders and wholesalers at a rate of 6% of the sale price. There are wholesalers who buy produce from commission agents in larger quantities and sell it onward in distant markets.

Processors: Mangoes are usable at all stages of development. The raw fruits are used in making pickles, dried mango powder, green mango beverages (aam panna), sauces, and chutneys. The ripe fruits are processed into pulp, jams, jellies, frozen and dehydrated slices, canned products, and ready-to-serve beverages. Based on field surveys and data analysis of registered units under the Food Safety and Standards Authority of India (FSSAI), only a few agro-processing units operating in the state are engaged in secondary- and tertiary-level processing of mangoes into value-added products. This includes one unit registered under a state license and five units registered under a central license from FSSAI. According to estimates based on information from FSSAI and interaction with stakeholders, the processing capacity for mangoes in the state is 450–500 MT/day in the organized sector (i.e., less than 2% of the present production).³⁹ The major varieties grown in Uttar Pradesh (Dussheri, Chausa, and Langra) are not suitable for pulping, and agro-processors prefer pulping varieties like Alphonso, Kesar, and Totapari from outside the state.

Packing houses: There are four packing houses for primary processing approved by the Agricultural and Processed Food Products Exports Development Authority (APEDA). Two of these are owned by Uttar Pradesh Mandi Parishad (council or assembly)—one located in Rehmankheda (Lucknow) and the other in Saharanpur. The two other packing houses are privately owned and located in Gautam Buddha Nagar District. These facilities are used only for export purposes. For the domestic market, laborers are employed at farms to undertake manual sorting, grading, and packing based on visual inspection.

Commodity Flow Analysis

Based on stakeholder interactions during the field survey, four different marketing channels have been identified in the mango value chain (Figure 16).

³⁹ According to the FSSAI classification, state licensees are those with a capacity of 100 kg to 2 MT/day, whereas central licensees have capacities above 2 MT/day.

Figure 16: Trade Channels for Marketing of Mango in Uttar Pradesh

Channel 1: Marketing through lease contractors and preharvest contractors. In this channel, growers engage with preharvest lease contractors for the sale of their produce. This channel accounts for 70%–85% of the mangoes produced. Under this mode of engagement, the mango growers contract out the orchard either for 2–3 years or for one season to a preharvest contractor just a few months before harvest at the flowering and fruiting stage. The decision to sell through a preharvest lease contractor depends on the distance from the nearest market and the price offered by the contractor. The contractor inspects each tree in the orchard and quotes a lump sum price for the crop based on a visual inspection, taking into account the number of trees with matured fruits, fruit size, and proportion of diseased or damaged fruits. The lessor generally has links with traders and exporters in distant markets and sells the produce through preestablished marketing channels after sorting, grading, and packing.

Channel 2: Marketing through commission agents. This marketing channel accounts for 15%–25% of the mangoes produced. In this channel, mango growers maintain the orchard and market produce on their own, and are responsible for postharvest activities such as on-farm sorting, grading, packing, transportation from farm to market, and loading and unloading. Most farmers adopting this channel sell their produce in distant market yards such as Azadpur Mandi in New Delhi. Delhi is a major hub for the distribution of mangoes from Uttar Pradesh to

the rest of the country and offers better prices. The fruits are packed in plastic crates of 20–25 kg capacity and transported to Delhi by road.

Some farmers who have no links with distant markets bring their produce directly to the APMC fruit markets in their district, where the produce is sold in open auction through commission agents cum wholesalers. The commission agents sell the produce to wholesalers at local and distant markets and charge a fixed commission to the wholesalers. Wholesalers from distant markets have their representatives in these markets, who inspect the produce and participate in the auction process. Payments are mostly made by check or cash by the commission agents within a few days of sale, and sometimes immediately.

Channel 3: Marketing to processing units. As there are few mango processing units operating in the state, only 2%–3% of the produce is marketed to processing units. Generally, the processing unit purchases through an appointed procurement agent or manager who buys the required quantities from the APMC markets in the vicinity of the processing facility. Direct links between farmers and units are generally absent. Stakeholder consultations revealed that the processors were more sensitive to price than to quality. They mostly buy lower-grade produce (business-to-consumer), which otherwise does not sell well in fresh retail markets.

Channel 4: Marketing through FPOs. Under this channel, member farmers sell their produce to the FPO, which then undertakes sorting, grading, packing, and transportation to distant wholesale markets for aggregated sales. Presently, only four registered FPOs operating in the state are dealing with mangoes. Of these four, three are located in Lucknow District (the major mango-producing district in Uttar Pradesh) and one is in Sonbhadra District (Appendix 3).

Malihabad Mango Farmer Producer Company (FPC) Limited (Lucknow) mainly facilitates the supply of fertilizer inputs to member farmers but is starting to take on marketing. In 2018, the FPC successfully facilitated direct marketing of a mango consignment of 16 MT from Uttar Pradesh to Mumbai (Maharashtra state) and earned an incremental price of ₹20/kg. The FPC plans to facilitate more such transactions to other destination markets within and outside Uttar Pradesh, including Delhi, Hyderabad, and Bengaluru. Recently, the FPC has connected with a wholesale buyer, Metro Cash and Carry, for daily supply of at least 1 MT of Dussheri mangoes in the harvest season to tap urban markets (Case 3).

- Irada FPC Limited (Lucknow) is into both supply of inputs and marketing of mango produce of member farmers. In the past two seasons, it has been able to facilitate trade of 190 MT of mangoes aggregated from member farmers. It is registered on the National Agriculture Market (eNAM) platform for auction of produce through the fruit and vegetable market in Lucknow.
- Avadh Aam Utpadak evam Baghwani Samiti (Lucknow) is more focused on enhancing the livelihoods and profitability of mango growers by promoting good agricultural practices (GAP). It has been working closely with ICAR/CISH under their flagship Farmer FIRST program.⁴⁰ Recently, it supplied 5 MT of Dussheri mangoes to National Commodity and Derivatives Exchange (NCDEX) e-Markets Limited in Hyderabad through rail transport.
- Vindhyaasini FPC Limited (Sonbhadra) is mainly into supply of fertilizer and compost to member farmers. It has also been facilitating the sale of member farmers' produce in some mandis through indirect links. It is keen to explore establishing direct marketing links with buyers.

Overall, marketing mangoes through Channel 4 is not prominent at present (~1%–2%) and faces issues on matters relating to business management, credit access, and marketing. There are no FPOs actively operating in mango

⁴⁰ ICAR. *Farmer FIRST Program. Enhancing Livelihood and Profitability of Malihabad Farmers through Horti-Enterprise Module*. https://ffp.icar.gov.in/project_detail?proj_id=21.

production zones such as Saharanpur District, which is the second-largest producer of mangoes in Uttar Pradesh, or in Varanasi, which dominates in the production of Langra and Chausa mangoes.

Case 3: Direct Market Links of Farmer Producer Organizations

The Malihabad Mango FPC was established in 2016 with around 200 mango farmers, who were traditionally involved in the cultivation of Dussheri mangoes. The FPC is involved in marketing and trading its mango produce directly with traders in cities such as Mumbai, Bengaluru, and Hyderabad. In Financial Year 2018–2019, the FPC supplied around 16 MT of mangoes directly to wholesale markets in Vashi and Mumbai and earned an incremental price of ₹20/kg. It has also established marketing links with Metro Cash and Carry to supply 1 MT/day of Dussheri mango during the season in 2019–2020.

The Avadh Aam Utpadak evam Baghwani Samiti FPC in Malihabad in Lucknow was established in 2016 with around 200 mango farmers and now has links with the ICAR Central Institute of Subtropical Horticulture, Lucknow, where it received training on GAP. It also received ventilated Corrugated Fibre Board (CFB) mango packing boxes. The FPC initiated the sale of Grade A mangoes packed in CFB boxes then hired a van and sold mangoes across Lucknow city during the peak season. The FPC signed an agreement with NeML, Hyderabad, to supply mangoes directly. Recently, the FPO supplied 5 MT of Dussheri mangoes to NeML in Hyderabad through rail transport.

Source: M. Mishra, A. K. Verma, P. S. Gurjar, G. Baradevanal, and S. Rajan. 2019. GAP and Market Links Enhanced Mango Growers' Incomes in Malihabad; Deloitte India field data gathered from interviews with FPO members.

Price Buildup Analysis: Production, Marketing Functions, and Activities

To investigate the actual expenses and gains of bringing mango produce from farm gate to consumer, the value chain was analyzed in further detail in terms of pre- and postharvest activities along the chain and the costs and margins involved.

Preharvest Activities

Land preparation: For establishing new orchards, land preparation and careful layout are essential. Before planting, the orchard is cleared of unwanted vegetation and prepared through deep plowing, followed by harrowing and leveling with a gentle slope for good drainage. Following this, farmyard manure and other nutrients are added to enrich the soil before planting. Since most orchards in Uttar Pradesh are old, the initial cost of land preparation is not considered in the price buildup calculation in this report.

Planting: Conventionally, a spacing of 10 x 10 m is used, which accommodates 100 trees/ha. In the surveyed area, most farmers plan for 150 trees/ha. On average, good quality planting material costs ₹40–50/plant, which adds significantly to the cost of cultivation considering that 150 plants/ha are planted under the conventional spacing system. Medium-density planting of 5 x 5 m spacing can accommodate 400 plants/ha but is not widely adopted.⁴¹

Nutrient management: In general, the CISH-recommended application for optimal yields is 1 kg each of N, P, and K per tree per year to 10-year-old Dussheri mango trees (footnote 28). In the study area, it appears farmers are applying recommended doses of N and P, and the average NPK application is calculated as 0.91 kg of N and 1.15 kg

⁴¹ ICAR/CISH. 2018. Annual Report 2017–2018.

of P.⁴² Fertilizer application through drip irrigation is lacking. The average cost of fertilizer is estimated at ₹27,150/ha, calculated at ₹10/kg for farmyard manure, ₹350 per 45 kg bag of urea for 3.5 bags/ha, ₹1,450 per 50 kg bag of DAP for 7.5 bags/ha, and micronutrients at ₹50/kg.

Water management: In fruit-bearing orchards, three irrigations are recommended after fruit set. Irrigation at the time of fruit setting (mustard size), marble-size stage, and fruit development (before maturity) are identified as critical stages for optimizing fruit size and quality.⁴³ In the surveyed area, farmers generally practice conventional surface irrigation using tube wells as their main water source. Irrigation is applied three times during the year, once during the winter months (November–December) and twice at the time of fruit setting in the summer months. The average cost per irrigation is ₹5,625/ha. Thus, total cost of irrigation is estimated to be ₹16,875/ha.

Intercultural operations: Plowing orchards is undertaken four times a year to remove weeds and to maintain soil aeration. Cost per plowing is estimated at ₹2,250. Thus, annual cost of intercultural operations is estimated at ₹9,000/ha.

Plant protection: Mangoes are prone to damage by a large number of pests, diseases, and disorders. Damage owing to insect pests such as leafhoppers, thrips, shoot borers, fruit flies, and mealybugs are prevalent, along with diseases such as shoulder browning, powdery mildew, and anthracnose stem end rot. Depending on the weather conditions and outbreak of diseases, the number of sprays required in a season may vary from four to eight. Some farmers spray according to recommendations, but others use indiscriminate spraying of pesticides (10–12 sprayings). Although environment-friendly bio-control methods have been developed with support from ICAR/CISH, the adoption of such practices is low because of a lack of farmer awareness. Considering an average of six sprays per season, the cost of plant protection works out to be ₹45,000/ha at a unit cost of ₹7,500/spray.

Harvesting and Postharvest Activities

Harvesting, sorting, grading, and packaging: Mango trees start bearing fruit from their fourth to fifth year. To determine the maturity of a mango tree, most farmers use visual methods. For the main commercial cultivars, hired laborers carry out the harvesting, between June and August. Most farmers and preharvest contractors use the manual method of harvesting by beating the branches with a bamboo pole or vigorously shaking the tree branches. Mechanical harvesters developed by ICAR/CISH can pluck a mango with a 1 cm of pedicel according to the recommendation for export and avoid sap oozing. Farmers think this takes more time for harvesting and requires more labor. Generally, the laborers employed for fruit harvesting are also responsible for primary sorting and grading. As a standard practice, damaged, spotted, and diseased fruits are removed, and the produce is segregated into a “top grade” and “the rest.” In the contractor/trader model, one or more levels of specialized sorting is done. Mango fruits weighing more than 350 grams are designated Grade A, fruits with weights of 250–350 grams Grade B1, those weighing 150–250 grams Grade B2, and fruits less than 150 grams Grade C. Losses at harvesting are estimated to be 10%–15%. The sorted and graded fruits are packed in plastic crates of 20–25 kg capacity and transported by road in non-refrigerated trucks to destination markets. To meet export market standards, the APEDA-approved packing house facilities in the state are equipped with facilities for washing, grading, and packing produce; cold rooms; ripening chambers; and vapor heat treatment (VHT) chambers. These can be used by farmers, traders, and exporters by paying a fixed user charge. Exports from the state are low at present. Based on the field survey, the cost of harvesting, sorting, grading, and packing, including consideration of waste, is estimated to be ₹90,000/ha.

⁴² Farmers were observed to be applying base doses of some nutrients after harvesting fruits, including farmyard manure at 750 kg/ha, urea applications at 150 kg/ha, and DAP at 375 kg/ha. Some farmers also apply micronutrients at 150 kg/ha (calculated at 46% N content in urea, 18% N and 46% P content in DAP).

⁴³ ICAR/CISH. 2014. *Report on Production Technologies Recommended for Subtropical Fruits*. http://agricoop.nic.in/sites/default/files/ICAR_9.pdf.

Storage: There are insufficient cold storage facilities for mangoes as most are dedicated to potatoes. The cold storage facilities available at APEDA-approved packing houses are only for export purposes. Therefore, farmer and traders for domestic markets tend to sell immediately after the harvest.

Transportation: The total cost of transportation from the farm to nearby markets is estimated at ₹7,500/ha and comprises transportation charges of ₹5,000/ha and labor charges for loading and unloading at ₹2,500/ha. The outbound transportation of produce to distant markets is carried out mostly by commission agents and traders. For long-distance transportation to destinations such as Mumbai, eastern and northeastern states, and Nepal, trucks of 10–15 MT capacity are used. For relatively short-distance transport (e.g., to Delhi market), trucks of 4–7 MT capacity are generally used. The average cost for outbound transportation from Lucknow to Delhi is estimated to be ₹2/kg and ₹4–5/kg for transportation to distant markets such as Patna and Kolkata. The cost of transportation is decided by the transport unions, which operate locally.

Sales and marketing: Varanasi, Lucknow, and Saharanpur are the major markets within the state. The price of mangoes in these mandis varies based on grade, as illustrated in Table 17. In terms of retail prices, while the farmer's price is ₹18/kg, the average retail price is ₹65/kg in some major cities. The difference between the farmer's price and the retail price is even higher for graded produce. For instance, graded mangoes from Uttar Pradesh fetch a price in the range of ₹80–150/kg across online retail portals and major retail outlets in cities like Delhi and Bengaluru. Export quality produce can fetch a price as high as ₹160–200/kg. This is a considerable price difference between retail and farm gate. Fruit and vegetable sales through organized and online retailers have been experiencing good growth in India and this provides an opportunity to fetch higher prices in these emerging markets.

Secondary and tertiary processing of mangoes in Uttar Pradesh: A limited quantity of mangoes is used for processing in the state (less than 2% of production). Only a few processors in the state are involved in producing fruit beverages, aseptic and canned mango pulp, slices, and pickles (Table 18). The major varieties (Dussheri, Chausa, and Langra) are not deemed suitable for pulping owing to their high phenol content, which causes the pulp to ferment quickly and thus affects the taste and quality. Even for other processing purposes, these varieties have less flesh compared with processable varieties. Thus, processing companies prefer to source other varieties like Alphonso, Kesar, and Totapari.

Table 17: Grade and Variety Prices of Mangoes

Grade	% Share in Harvested Produce	Price Paid (₹/Quintal)		
		Dussheri	Chausa	Langra
Grade A	15–20	2,500–3,000	4,500–5,000	3,000–3,500
Grade B1	20	2,000–2,500	3,500–4,000	2,500–3,000
Grade B2	40	1,500–2,000	3,000–3,500	2,000–2,500
Grade C	20–25	500–1,000	2,500–3,000	1,000–1,500

Source: Based on data and information collected during the field survey.

The pricing trends for the major markets were analyzed based on data in the Annual Price Arrival Report of the NHB and are given in Figure 17.

Figure 17: Mean of Daily Modal Prices of Mango Varieties Within and Outside Uttar Pradesh

Source: Based on analysis of data according to Annual Price Arrival Report of NHB.

Dussheri (top left): Delhi's market (Azadpur Mandi) is the biggest market in terms of arrivals of the Dussheri variety. After Delhi, Jaipur's market has the second-highest rate of arrivals outside Uttar Pradesh, followed by Dehradun, Nagpur, and Srinagar. Within the state, Varanasi is the major market for the Dussheri variety, and Lucknow is the second. The volumes received in Varanasi are mostly secondary arrivals directed from the production clusters of Lucknow, Saharanpur, Unnao, Bulandshahr, and Amroha. Price realization is much higher in markets outside Uttar Pradesh.

Chausa (top right): Across India, Delhi's Azadpur Mandi is the biggest market in terms of arrivals of Chausa. Other markets include Kolkata, Dehradun, Mumbai, and Chandigarh. However, the arrival volume is much less in these markets. Within Uttar Pradesh, Varanasi is the major primary market for the Chausa variety. The price realization is much better in cities outside the state—namely, Delhi, Mumbai, and Kolkata.

Langra (bottom left): No data are available on the market trade of this variety in markets within the state, suggesting this variety is marketed mainly outside the state. Although Delhi's market has the highest arrivals of Langra in the country, the price realization is the least. In contrast, Guwahati's market has the least arrivals among the major markets for Langra but the best price realization (₹7,116/quintal), which is far greater than in other markets. Jaipur's market offers the next best price for this variety.

Table 18: Agro-Processing Units in Uttar Pradesh Dealing in Mango Products

Processor	Remarks
Manpasand Beverages Pvt. Ltd.	The company produces carbonated fruit beverages and thermally processed, ready-to-serve beverages. It has processing units in Varanasi and can produce around 100,000 MT of secondary processed products from mangoes. Most products are made using Alphonso or Totapuri pulp. Mango drinks are marketed under the brand name Mango Sip.
Tapovan Foods Pvt. Ltd.	Tapovan Foods is a manufacturer of canned fruits and vegetables, juices, fruit pulp, and tomato puree. These products are marketed under the name of Testo. The company has a canning unit with a capacity of 12 MT/day in Hathras. One of the products manufactured by the company is mango pulp from Dussheri mangoes. It is one of the few companies involved in the production of mango pulp using this variety.
Allahabad Canning Limited (Morton)	The company manufactures canned fruits and vegetables, jams, jellies, and other products. It manufactures mango pulp from Alphonso and Totapari mangoes, canned Totapari mango slices, jam, mango crush, squash, beverages (aam panna), and sweetened juice. The manufacturing facility is located in the outskirts of Allahabad. The processing capacity for the production of thermally processed puree is 3,500 MT per annum.
Sahu Khan Chand Foods	The company is a manufacturer of frozen pulp and fruit juice, including mango pulp, mango juice, and mango panna. The manufacturing unit is in Moradabad.

Source: Stakeholder consultation and secondary research.

In general, no mango processing-related organized sector unit was found to be operating in the main mango producing districts of Uttar Pradesh.

D. Farm-Level Economics of Mango Cultivation, Storage, and Marketing

Based on the overall analysis, the investment for farm-level maintenance of a matured fruit-bearing mango orchard is estimated at ₹98,025/ha. This includes the cost of fertilizer applications, intercultural operations, irrigation, and plant protection. The farmers or contractors supplying the produce to nearby markets bear an additional cost of ₹97,500 for harvesting, sorting, grading, packing, and transportation. The net profit earned by the farmer is estimated to be ₹74,500/ha (Table 19).

Financial Viability Analysis of Establishing New Orchards

As most of the existing orchards are old, there is a need for rejuvenation or establishing new orchards for higher returns to farmers. The financial viability of establishing new orchards has been analyzed for traditional orchards with 150 trees/ha and considering an economic life of 40 years. Based on the analysis (Appendix 4), the financial viability of establishing a new mango orchard is estimated to have an internal rate of return of 21.79% and a payback period of 8 years.

Table 19: Cost-Benefit Analysis for Dussheri Mango Cultivation

	Cost Particulars	Unit Cost (₹)	Frequency	Value (₹/ha)
A	Preharvest activities			
1	Application of fertilizer inputs			
	Farmyard manure	10/kg	750 kg	7,500
	Urea	350/bag	3.5 bags of 45 kg	1,275
	DAP	1,450/bag	7.5 bags of 50 kg	875
	Micronutrients	50/kg	150 kg	7,500
2	Irrigation charges	5,625/irrigation	3 times	16,875
3	Cost of intercultural operations	2,500	4 time	9,000
4	Cost of plant protection	7,500 /spray	6 sprays	45,500
	Cost of cultivation			98,025
	Average yield per ha		15,000 kg/ha	
	Cost of cultivation per kg			6.5
B	Harvest and postharvest activities			
1	Cost of harvesting, sorting, grading, and packing (including wastages)	90,000 per ha	1 time	90,000
	Cost for harvesting, grading, sorting, and packing per kg			6
2	Cost of transportation to nearby markets (including loading, unloading)	7,500 per ha	1 time	7,500
	Cost for transportation per kg			0.50
C	Total income @ average sale price of ₹18/kg		15,000 kg/ha	27,000
D	Net profit earned by farmers (per ha)			74,475
	Farmer's profit margin per kg			5.0

Source: Based on data and information collected during the field survey.

There is an upfront expenditure of ₹200,000 in the first 4 years when there is no production. From the fifth year onwards, mango production starts in lower volumes, and the orchard achieves full production in the eighth and ninth years onwards. The indicators show that mango orchard establishment is a financially viable enterprise. In the analysis, the earnings from intercropping in the initial 5 years have not been considered, which would further increase the viability. The analysis has been done for traditional orchards, which have lower tree density (150 trees/ha versus a medium density of 400 trees/ha). With medium-density orchards, quality planting materials, and GAP, productivity can be further increased, leading to even higher returns and viability.

Summary of Price Buildup

The value chain of 1 kg of mangoes indicating the activities and cost buildup is mapped in Figure 18.

The average cost of mango cultivation is ₹6.5/kg. The farmer or contractor bears the cost of harvesting, grading, and packaging (including waste), which comes to ₹6/kg. The realized price at farm level is ₹18/kg. Thus, the net margin earned at farm level is ₹5/kg. Mostly, the commission agents and traders facilitate onward sales. Commission agents charge a fee of 6%, which the buying trader bears. The trader also bears the payment of any market cess (tax) and the cost of onward transportation of produce to distant markets, including loading and unloading charges, to sub-wholesalers, who, in turn, sell to produce distributors and onward to retailers. The farmer's share of the price paid by the consumer is approximately 8%. Intermediaries (commission agents, traders, sub-wholesalers, distributors, and retailers) take approximately 51%. Postharvest losses are estimated to be 20%. The remaining 21% of the consumer price is attributable to the cost of marketing, transport, and other expenses (Case 4).

Gaps in the Value Chain

Production Gaps

Need for rejuvenation of old orchards: Most mango orchards in the state are more than 35–40 years old and are becoming less remunerative, with reducing yields. Rigorous effort and training are required for farmers on rejuvenation techniques. Newer varieties and medium-density planting techniques should be promoted to enhance productivity.

Availability of quality planting material: The availability of quality planting material is the key to productivity. Presently, there are few nurseries in the state recognized by the NHB for certified planting material production. Most are located around production clusters in Lucknow District, limiting the accessibility of growers in other

regions. For increased mango output, it is critical to promote the use of high-yield planting material, and more hi-tech nurseries should be promoted across the state.

Injudicious use of chemical inputs: The increasing prevalence of mango pests and diseases has led to higher use of plant protection chemicals. ICAR/CISH in Lucknow has been training and educating farmers on better maintenance of orchards and insect pest and disease management practices. However, farmers said the recommended chemicals for some diseases were not available from local dealers. A significant dependence was observed on local input dealers for advice on pest control. In particular, smallholder orchard owners who buy input material on credit from a local supply shop mostly end up buying the chemicals that dealers suggested. To save costs, farmers will sometimes purchase cheaper chemical inputs, which most often prove to be ineffective and require a greater number of sprays. Another adverse impact of the injudicious use of agro-chemical sprays is that the population of pollinating insects in the region is reportedly declining, and this is adversely affecting flowering and thus overall production of the crop.

Case 4: Sri Siddeshwara Farmer Producer Organization, Chittoor, Andhra Pradesh

Sri Siddeshwara is an FPO of 500 mango farmers with a cultivated area of 6,000–7,000 acres. The FPO has worked extensively on promoting GAP among its member farmers and has developed 24 packing houses for collection, sorting, grading, and storage. The produce is graded according to size, color, presence of spots, and damage to the fruits. The FPO has established forward links with markets of Mumbai, Hyderabad, Pune, Bengaluru, and Tirupati and supplies export quality produce to its partner FPO in Tirupati, which runs a ripening chamber and exports mangoes to the Middle East. The FPO exports mangoes directly to the Middle East through exporters. The entire export trade happens online, and buyers procure mangoes directly according to the grade and weight.

The farmer members of the FPO initiated direct selling in 2014 as they were getting low margins from selling in nearby Chittoor Market, owing to exploitation by middlemen. Within 2 years of operations, the FPO increased member farmers' incomes by 20%. The FPO is also planning to establish a ripening chamber and obtain an export license, which would further improve incomes. The FPO has also established links with the Grameen Bank, the Horticulture Department of Andhra Pradesh, and a nongovernment organization (NGO) called Rural Organization for Social Service based in Tirupati, to fund an expansion of operations. As the FPO was initially set up as a cooperative society, members contributed initially from their savings. This led to insufficient cash during initial operations.

Source: ICRISAT. 2017. Farmer Producer Organization Profiles: Part 2, Rythu Kosam Project, Research Report IDC-16.

Harvest and Postharvest Management Gaps

Poor harvesting techniques: The conventional methods of fruit harvesting by beating branches with bamboo poles or climbing and vigorously shaking the branches result in 10%–15% waste through fruit bruising and cracking. The damaged fruits are not fit for marketing. More farmers need to be encouraged to adopt scientifically designed harvesters for safe fruit harvest and reduced drudgery.

Primary processing practices: Farm-level primary processing is limited to manually sorting and grading produce to remove damaged fruits. Packing at the farm level uses plastic crates or locally made boxes. No farmers use standard corrugated fiber boxes, which are an effective packaging option that improves shelf life by minimizing bruising during transport and storage. Precooling fruits before packing is not practiced. The quantity of produce processed at the available packing house facilities is low compared with the total production of mangoes in the state. Thus,

Case 5: Kisan Suvidha Farmer Producer Organization, Andhra Pradesh

Kisan Suvidha started operations in 2015 and has 70 member farmers working 100 acres of mango orchards. Since its inception, the FPO has promoted good agricultural practices and has obtained Rainforest Alliance Certification. Nearly all the mango orchards of the member farmers use drip irrigation. The FPO has developed market links with retail outlets and juice companies such as Heritage, Mother Dairy, Global Fresh Farms, and Tropicana. It has developed forward links with exporters such as Nava Quality Foods and KayBee exports, which procure export quality mangoes from the FPO. These activities have helped the member farmers earn a 20% premium on their price, which has increased their profits by almost 100%. The FPO plans to set up its own processing unit for pulping, frozen products, juices, and jellies. It also plans to set up an agro-clinic for selling fertilizers and chemical-free pesticides. The long-term plans of the FPO include setting up a cold storage facility that meets export standards.

Source: ICRISAT. 2017. FPO Profiles: Part 2. Rythu Kosam Project Research Report IDC-16.

the bulk of farm-graded produce is not deemed to be up to the desired market standards. For this reason, buyers tend to discount the offer price in anticipation of losses and rejections as a result of poor harvesting and handling techniques, resulting in lower returns to farmers. For distant markets and exports, proper harvesting, sorting, washing, waxing, packing, precooling, and storage of produce should be encouraged. The creation of near-to-farm collection centers with such facilities should be promoted, particularly for collective aggregation, processing, and marketing through farmer groups (Case 5).

Storage-related: Unripe and undamaged mango fruits have a shelf life of 8–10 days when stored in shade at ambient temperature. Since the bulk of the harvested produce is mostly sold in markets on the day of harvest or within a couple of days, there is limited demand for cold storage space. However, for distant transport, traders and exporters are required to maintain the desired quality of the produce throughout the supply chain. Presently, such requirements are fulfilled by using facilities at the limited number of packing houses in the state, which have an installed capacity of only 30–40 MT. Thus, the development of adequate cold storage capacity using the latest cold chain technology should be emphasized to help increase the shelf life through proper storage and to help farmers make timely marketing decisions. Cold storage with multichamber and multi-commodity facilities needs to be promoted (Case 12 and 13).

Transportation-related: The existing transportation system for mangoes is inefficient and unsuitable for long-distance transport. Provision of refrigerated insulated vans should be considered to establish an integrated cold chain network to minimize transportation losses and sustain the marketable quality of graded products to markets. For long-distance and export supplies, cargo and logistics services via rail, air, and sea routes need to be strengthened. During the study, farmers noted the absence of freight services with the major rail services running between Lucknow and Mumbai. For mango transport by rail, the usual luggage tariff rates are applied on mango consignments, which are higher than freight rates. Farmers expressed the need for improving direct connectivity between the main production clusters, such as Malihabad, and urban markets, such as Delhi, Mumbai, and Hyderabad.

Secondary and tertiary processing facilities: Small, inferior quality mango fruits are generally sold in Malihabad at ₹8–10/kg, which results in loss to the farmers. To address the issue, ICAR/CISH Lucknow under the Farmer FIRST program successfully supported the FPO Awadh Aam Utpadak evam Baghwani Samiti in Malihabad to extract

and preserve Dussheri pulp and use it for mango ice cream.⁴⁴ At present, there are no such low-cost pulping units in the major production clusters. More low-cost interventions like this should be promoted to farmers and farmer groups as small-scale entrepreneurial initiatives. There is some scope for improving links with e-commerce firms and organized retail chains to tap the market.

Marketing Gaps

Access to real-time market flows and price information: Farmers are mostly dependent on informal sources such as other farmers, traders, commission agents, and input dealers for advice on market and price information. Except for a few progressive and large farmers, most have yet to develop direct links or develop negotiation skills with traders and wholesalers in distant markets. This is a major reason why owners of mango orchards opt to lease their farms to contractors who are also traders and have good links with wholesalers and distributors. Even though some farmers and FPOs have been able to sell their produce in distant markets, they end up paying higher commission rates, transportation, and other charges. While the Uttar Pradesh State Agricultural Produce Marketing Board has been facilitating buyer-seller meetings to promote direct links between producers and buyers, many farmers believe exporters are not transparent in disclosing the rate at which mangoes would be procured and are therefore reluctant to invest time, resources, and effort to increase their share of exportable produce.

Mandi cess (market tax): As of June 2020, the mandi cess was 2.5%. Commission agents and traders were of the opinion that neighboring states that have lower mandi cess provided a more favorable business environment.

Branding and marketing: Mangoes produced in Malihabad, Maal, and Kakori of Lucknow District have a Geographic Indicator tag.⁴⁵ However, given the absence of Geographic Indicator branding and of interventions to link growers to markets, farmers are unable to fetch premium prices for Geographic Indicator-tagged fruits and sell them at the prevailing market rates.

Limited availability of packing house infrastructure for exports: Presently, there are only four APEDA-recognized packing houses in the entire state, one each in Lucknow and Saharanpur and two in Gautam Budh Nagar. Farmer collectives, exporters, and private agents should be encouraged to use and set up more such facilities across the state by applying for assistance available under government schemes such as the Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters (SAMPADA), MIDH, and APEDA (Case 5 and 7).

Limited number of FPOs and constraints: Only a few FPOs in the state are dealing with mangoes, and none is in the important mango production clusters, such as Saharanpur and Varanasi. Challenges faced by these FPOs are related to:

- lack of training and capacity on governance;
- weak business development, trading, and marketing;
- limited exposure to markets in other states;
- constraints in accessing credit from formal sources like banks and financial institutions;
- absence of direct rail routes from production clusters such as Malihabad for supply to distant markets in the south, such as Hyderabad;
- inadequate or lacking freight facilities on trains;
- lack of transparency in price setting and market information.

⁴⁴ ICAR. Farmer FIRST Program. Intervention Details under FFP. https://ffp.icar.gov.in/dashBoard_intervention?id=I0036.

⁴⁵ A Geographic Indicator tag is a sign used on products that have a specific geographical origin and possess origin-based qualities and reputation in the region.

Access to Credit Services

High cost of finance: Mango farmers are highly dependent on contractors for marketing their produce as well as for credit and advance payment, which reduces their bargaining power. Sometimes, the growers approach commission agents in the local APMC markets for credit to pay for orchard maintenance and cultivation practices. This limits the growers' marketing route to those contractors and commission agents.

E. Market Assessment

Mango Product Map

Mangoes are traded globally as fresh fruits, pulp, dried, squash, and juice as depicted in Figure 19.

Import–Export Trade Analysis Global Scenario

Mango and Mango Product Exports

Global exports of mangoes, including guava and mangosteens, reached an estimated 1.7 million MT in 2017. This represents a 9% increase from 2016, which is significantly higher than the 5% average annual growth registered

between 2007 and 2016.⁴⁶ The expanding trade follows strong growth in demand in the EU and the US, which are not major producers of mangoes (Figure 20).

Figure 20: World Gross Exports of Mangoes by Region, 2007–2017

Note: * Depicts provisional data.

Source: FAO. 2019. *Statistical Compendium 2017*.

Although the world production of mangoes in 2017 was 49 million MT, the world gross export volume was less than 4% of world production. Asian countries account for approximately 75% of global mango production (36 million MT) and have a 40% share in world gross exports (0.7 million MT). South American countries including Brazil and Peru collectively account for 4% of world mango production (1.9 million MT) and have a 23% share of global gross exports (0.4 million MT). South American growers cater mostly to the growing demand in nonproducing regions in the US and the EU (Figure 21).

Figure 21: Share of Major Countries in World Gross Export of Mangoes, 2017

Source: FAO. 2019. *Statistical Compendium 2017*.

⁴⁶ FAO. 2019. *Major Tropical Fruits-Statistical Compendium 2017*. Rome: FAO. www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Tropical_Fruits/Documents/CA2909EN.pdf; S. Altendorf. 2019. *Major Tropical Fruits Market Review 2017*. Rome: FAO. www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Tropical_Fruits/Documents/CA2895EN.pdf.

The leading exporter countries include Mexico, with a volume share of 24%; this is followed by Thailand (14%), Brazil (10.3%), Peru (9.3%), and India (9.1%),⁴⁷ as depicted in Figure 21. Egypt is emerging as a key export player of mango pulp supplying mostly to Middle Eastern countries (which is the prime region for exports from India).

Mango and Mango Product Imports

The US accounts for 34% of global mango imports, followed by the EU, which claimed a 20% global share in 2017. Imports in these countries are dominated by Mexico, Brazil, and Peru. Gulf countries, such as the UAE and Saudi Arabia, are among the other main importers of mango, as depicted in Figure 22. The PRC is the only major producing country that features among the top net importers, mainly importing from Thailand and Cambodia. The US, the PRC, the UAE, Hong Kong, the Netherlands, and Saudi Arabia are the main importers of mangoes in processed form, mainly as mango puree or pulp (Figure 22).⁴⁸

Import–Export Analysis India Scenario

Exports of Mangoes and Mango Products from India

Despite being the largest mango-producing country in the world, India ranks fifth in terms of exports, with a share of only 9% of world trade. The overall export trade of mangoes from India, including in fresh, dried, and pulp form, is estimated to be only 0.8% of total production or 0.16 million MT (Table 20).⁴⁹ The export of fresh mangoes from India has been fluctuating in the past few years, whereas exports of value-added tertiary mango products have increased significantly. This is indicative of a shifting trend from fresh fruit to the processed mango product trade. A further elaboration on India's export trade of major mango products is given in Figure 23.

Fresh mangoes: Many Indian mango varieties have gained international acclaim because of their unique color, flavor, aroma, and taste. These varieties include Totapari, Alphonso, Kesar, Badami, Banganpalli, Rajapuri, and Dussheri, which are showing increased demand for export. According to export statistics from APEDA, 46,510 MT of mangoes worth \$60.26 million were exported from India during 2018–2019. The UAE is the main export

⁴⁷ FAO. 2019. *Major Tropical Fruits - Statistical Compendium 2017*. http://www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Tropical_Fruits/Documents/CA2909EN.pdf.

⁴⁸ UNCTAD. 2016. *Mango: An Infocomm Commodity Profile*.

⁴⁹ Analysis of APEDA Export Statistics for Export of Mango Based Products from India Including HS Code 08045020 (Mangoes, Fresh/Dried), 08045030 (Mangoes, Sliced Dried), 08045040 (Mango Pulp), 08129010 (Mango Slices In Brine), 11063030 (Flour of Mango), 20079910 (Jams Jellies, and marmalades of Mangoes), 20089911 (Mango Squash), 20098910 (Mango Juice). <http://agriexchange.apeda.gov.in/IndExp/PortNew.aspx>.

destination, followed by Nepal, Bangladesh, the UK, and countries in the Middle East. There is a declining trend of imports in Middle East markets, which is affecting India's overall export volume. To reduce dependency on a few markets, emphasis should be given to developing new markets for trade. India has the potential for exporting other value-added forms of mango such as dehydrated and dried and sliced mangoes, which have a greater shelf life and growing demand.⁵⁰ India's exports to the leading importing countries, such as the US and the EU, remain negligible owing to competitive exports from Mexico, Brazil, and Peru. Demand in these countries is expected to continue to grow. This is corroborated by the fact that the per capita availability of mangoes in the US and the EU increased from 1 kg and 0.4 kg, respectively, in 2007 to 1.8 kg and 0.7 kg in 2017.⁵¹ Importing countries such as the PRC, Viet Nam, and the Republic of Korea in Asia and the Pacific also offer untapped potential.⁵² Thus, efforts should be made to increase exports to these countries by improving quality and productivity.

Table 20: Trend in Share of Mango Product Exports from India, 2014–2015 and 2018–2019

HS Code	Product	2014–2015		2016–2017		2018–2019	
		'000 MT	\$	'000 MT	\$	'000 MT	\$
20079910	Mango jams, jellies, marmalade	88.3	101.4	101.4	113.0	146.5	129.0
8045040	Mango pulp	155.0	137.4	130.8	126.4	105.9	94.0
8045020	Mangoes, fresh and dried	43.0	50.3	52.7	67.0	46.5	60.3
20089911	Mango squash	10.3	10.3	11.8	11.2	6.0	4.6
8045030	Mangoes, sliced and dried	4.1	6.4	0.3	2.4	1.5	3.7
20098910	Mango juice	0.9	1.1	0.7	1.6	1.0	3.1
11063030	Mango flour	0.2	0.4	0.3	0.6	0.2	0.7
8129010	Mango slices in brine	0.3	0.4	3.1	5.4	0.3	0.3
Total		302.1	307.7	301.1	327.6	307.9	295.7

Source: APEDA. AgriExchange. India exports statistics. <https://agriexchange.apeda.gov.in/indexp/reportlist.aspx>.

Figure 23: Export of Fresh Mangoes from India, 2018–2019

Source: APEDA. AgriExchange. <https://agriexchange.apeda.gov.in/>.

⁵⁰ APEDA. 2009. *Information on Market Access for Indian Dehydrated/Dried Mango Slices*. http://apeda.gov.in/apedawebsite/Announcements/mexico_opens_market_access.htm.

⁵¹ S. Altendorf. 2019. *Major Tropical Fruits Market Review 2017*. Rome, FAO. 10 pp. Licence: CC BY-NC-SA 3.0 IGO.

⁵² APEDA. 2019. Market Intelligence Report. https://agriexchange.apeda.gov.in/Weekly_eReport/Mango_Pulp_Report.pdf. (accessed Q1 2021).

Figure 24: Export of Mango Pulp from India, 2018–2019

Source: APEDA, AgriExchange. https://agriexchange.apeda.gov.in/index/Product_description_32headChart.aspx?gcode=0303.

Mango pulp: India is a major exporter of mango pulp, accounting for a significant share of mango-based exports. In 2018–2019, India exported 105,873 MT of mango pulp worth \$94 million. The major export destinations are Saudi Arabia, Yemen, the Netherlands, the UK, the US, and the UAE. In terms of consumption and imports, the Middle East and the EU account for 20% of total world imports. These are important markets for the mango pulp trade and more effort on export promotion is required to tap this potential. To make this possible, mango processing infrastructure and investment need to be strengthened by providing access to information on modern technology, packaging, markets, food laws, and hygiene requirements of different markets (Figure 24).

Figure 25: Export of Mango Jams, Jellies, and Marmalades from India, 2018–2019

Source: APEDA, AgriExchange.

Mango jams, jellies, and marmalades: The export of mango jams, jellies, and marmalades accounts for 50% of the total volume and value of mango exports from India and has been growing yearly, with a compound annual growth rate (CAGR) of 13.4% for volume between 2014–2015 and 2018–2019. This is indicative of the continuously growing demand and potential for increasing exports from India. According to APEDA export statistics, 146,507 MT of jams, jellies, and marmalades worth \$129 million were exported from India during 2018–2019 (Figure 25). The Netherlands, Saudi Arabia, the PRC, Iran, the Russian Federation, the UK, the US, and EU countries are the major destination markets.

Imports of mangoes and mango products to India: India is a net exporter of mangoes and mango products, and imports are negligible.

Share of Uttar Pradesh in India's Trade of Mango and Mango Products

Although Uttar Pradesh is the second-largest producer of mangoes in India with production of 4.5 million MT, the volume of mango exports from the state is negligible in total national production (less than 0.05%).⁵³ Total exports of mangoes and mango products from the state at 2,575 MT account for less than 1% of total domestic exports of 307,981 MT (Figure 26 and Table 21).⁵⁴

Fresh and dried mango exports from the state remain stagnant at less than 2,000 MT per annum. While some mango pulp was exported from the state, that too has declined over the past few years. Exports of mango products from Uttar Pradesh are made mostly to Nepal (95%). Thus, there is a need to boost value addition and diversify the overall export of mangoes (notably the Dussheri and Chausa varieties) and mango products to tap potential opportunities in the global market (Box 2).

⁵³ MoAFW. 2019. State Details of Mango Production in India, Horticulture Division. <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1562530>.

⁵⁴ Analysis of APEDA Statistics for Export of Mango Based Products from India and Uttar Pradesh. <http://agriexchange.apeda.gov.in/IndExp/PortNew.aspx>.

Table 21: Share of Mango Product Exports from Uttar Pradesh, 2018–2019

HS Code	Product	Quantity of Export		Value of Export	
		in MT	% share in total	₹ million	% share in total
8045020	Mangoes, Fresh/Dried	1,917.2	74	0.75	57
20079910	Jams, Jellies, and Marmalades	327.0	13	0.3	23
8045040	Mango Pulp	319.7	12	0.25	19
20089911	Mango Squash	6.2	0.2	0.01	1
11063030	Flour of Mango	5.1	0.2	0.01	1
Total		2,575	100	1.3	100

Source: APEDA, AgriExchange.

Box 2: Feedback from Exporters, Traders, and Organized Retailers

The following points are a summary of discussions with exporters and traders registered with the State Agricultural Marketing Board, and representatives of organized retail chains.

There is a demand for varieties from Uttar Pradesh in domestic and export markets, but the low quality of the produce owing to poor farm management and harvesting practices prevents exporters and organized retailers from making large purchases from Uttar Pradesh.

Given the limited presence of organized farmer collectives dealing with mangoes, exporters or retailers prefer to purchase bulk produce from intermediaries. Members of an exporter union highlighted that they could offer a premium of 30%–40% over market rates to farmers and FPOs, provided they supplied good quality produce by adhering to the recommended agricultural and harvesting practices.

Most companies indicated a lack of postharvest infrastructure in major production clusters such as collection centers, packing houses, and cold storage facilities, which are the major constraints in procuring more produce from Uttar Pradesh.

The cold chain infrastructure is not well developed and adversely affects the transport of produce from production clusters to destination markets and major cities.

A phytosanitary certification facility should be made available at Lucknow Airport, which would be beneficial to agro-produce exporters.

There are only four mango-packing houses in the state, all of which are used by exporters, as mangoes need to be treated in either hot water or hot vapor to adhere to the norms of importing countries. Similarly, there is only one irradiation facility in the state. Exporters highlighted the requirement for such facilities in the state to encourage export.

Postharvest infrastructure is missing in major production clusters such as Varanasi, Hardoi, and Saharanpur.

Some of the active FPOs in Uttar Pradesh have already benefited from exports and sales in distant markets after adopting good agricultural and harvesting practices and taking up proper sorting and grading at farm level. For example:

- Malihabad Mango FPC Limited in Lucknow is getting incremental benefits of nearly ₹20/kg by selling graded produce to export facilities in Maharashtra. It is also targeting distant markets in Bengaluru and Hyderabad and has established a link with a German wholesaler, Metro Cash and Carry.
- Avadh Aam Utpadak Baghwani Samiti in Lucknow has benefited from adopting good agricultural practices. It has supplied its produce to NeML in Hyderabad by rail.

Source: Field interviews with exporters, traders, and organized retailers.

Demand Outlook

The shift in favor of high-value cropping is driven mainly by changes in food consumption patterns and income elasticity.⁵⁵ Factors such as increasing consumer income, growing urbanization, and trade liberalization are expected to further increase the demand for fruit products. According to estimates from ICAR/CISH, per capita household demand for fruits in India is projected to increase from 15.4 kg/year (2009–2010) to 115.5 kg/year by 2050 (footnote 32). Horticultural products with high nutritive value are considered to be a vital component of a diversified and nutritious diet.

While global consumption of fresh mangoes has been rising continuously, the current global market for processed mango products is estimated at \$16.55 billion and is projected to grow at a rate of 6.4% per annum.⁵⁶ The trade is expected to rise, particularly because of the growing manufacture of mango-based products by the large agro-processors and fast-food and beverage chains. Some popular mango-based products include fruit-based meals, bakery fillings, candies, confectionery, flavored yogurt and ice cream, baby food, ready-to-serve drinks, juice mixes, and blends with various other beverages such as tea, coffee, and cocktails. As a result, the global market for mango pulp and puree is expected to grow from its current value of \$950 to \$2,120 million by 2024 at a rate of 7.7% per annum (footnote 41). With growing food safety and environmental concerns, the organic segment of the fruit product market is another prospective growth sector that can be tapped in both developed country markets and emerging economies.

F. Potential Interventions

Based on the gaps identified in the mango value chain, potential interventions and envisaged benefits (Figure 27) are as follows:

Institutional Development

- Encourage and support farmers to adopt better cultivation, harvesting, and postharvest techniques, in particular raising grower awareness of market-related quality aspects of the produce, including promotion of good harvesting practices; sorting, grading, and handling protocols; and packaging requirements for long-distance transport and organized retail marketing.
- Promote and strengthen farmer collectives to enable them to undertake aggregated sales and marketing of produce as well as dissemination of advanced technologies among members.
- Strengthen market intelligence and price discovery mechanisms for providing real-time information on arrivals and grade-specific pricing at different markets within and outside the state.
- Provide for extension of term loans and working capital loans with partial loan guarantees to encourage farmer collectives and agro-enterprises to set up backward and forward links and expand their current production capacity.
- Encourage rejuvenation of the large number of old mango orchards. Public and private hi-tech multi-crop nurseries can be set up to supply quality rootstock to farmers. This will also help establish new mango orchards in the state.

⁵⁵ S. Altendorf. 2019. *Global Prospects for Major Tropical Fruits*. Food Outlook, November 2017. Rome: FAO. http://www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Tropical_Fruits/Documents/Tropical_Fruits_Special_Feature.pdf.

⁵⁶ Government of India, APEDA. Market Intelligence Report.

- Encourage market access, uniform handling, and aggregated marketing of produce by creating more packing house infrastructure in the state equipped with facilities for de-sapping, sorting, grading, packing, ripening chambers, and cold storage.
- Hi-end infrastructure such as VHT and irradiation facilities are needed to augment existing infrastructure and capacity for export.
- Establish model individually quick-frozen and canning units to encourage processing table-purpose mango varieties into value-added products. Table varieties are grown in bulk in the state but are not preferred for pulping or tertiary-level value addition given their high phenol content and low flesh content.

Figure 27: Envisaged Benefits of Potential Infrastructure in the Mango Value Chain

IV. Focus Crop—Guava

A. Market Overview

Global Production of Guava

Average annual world production of guava (*Psidium guajava*) for 2015–2017 was estimated at 6.8 million MT.⁵⁷ Guava is predominantly cultivated and consumed in Asia. India is a major guava-producing country and accounted for 57% of total global output in 2017. Other producer countries include Pakistan, the PRC, Brazil, Indonesia, and Thailand, although production in these countries is at significantly lower levels (Figure 28).

Figure 28: Major Guava-Producing Countries in the World, Average 2015–2017

Source: FAO. 2018. Food Outlook. Special Feature on Minor Tropical Crops. July.

Indian Production of Guava

Guava is grown in almost all states in India. In 2017–2018, guava production was estimated at 4 million MT from an area of 0.26 million ha with an average productivity of 15.3 MT/ha. Uttar Pradesh is the leading producer of guava, accounting for 23% of total domestic production and 18.7% of the area under guava cultivation in India. Madhya Pradesh, Bihar, Andhra Pradesh, West Bengal, Chhattisgarh, Punjab, Gujarat, Tamil Nadu, and Karnataka are other major guava-producing states (Figure 29).

⁵⁷ S. Altendorf. 2018. Special Feature on Minor Tropical Fruits: Mainstreaming a Niche Market. Food Outlook. July. Rome: FAO. http://www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Tropical_Fruits/Documents/Minor_Tropical_Fruits_FoodOutlook_1_2018.pdf.

Figure 29: State Area and Production of Guava, 2017–2018

Source: MoAFW. 2018. *Horticultural Statistics at a Glance*.

B. Share of Uttar Pradesh in India's Trade of Guava and Guava Products

Area and Production

Guava holds a 10% share in terms of total area and production of fruit crops in Uttar Pradesh and is the third most cultivated fruit crop in the state after mangoes and bananas (Figure 30).

Figure 30: Area and Production of Guava in Uttar Pradesh, 2013–2014 to 2017–2018

Source: MoAFW. 2016, 2017, 2018. *Horticultural Statistics at a Glance*.

During the past few years, guava production has increased. In 2017–2018, the state produced 0.93 million MT from 49,500 ha (footnote 12). The average yield is 18.75 MT/ha, which is higher than the national average of 15.3 MT/ha, but lower than some other states such as Andhra Pradesh, Punjab, Assam, Karnataka, and Madhya Pradesh.

Guava Production Regions

In terms of agro-climatic zones, districts in the western subtropical zone and mid-plain zone account for more than 50% of the total guava production of the state. The crop is also cultivated in the Bhabhar terai and western plain agro-climatic zones (Table 22).

Table 22: District and Agro-Climatic Area and Production of Guava in Uttar Pradesh, 2016–2017

District	Agro-Climatic Zone	Area		Production		Productivity (MT/ha)
		'000 ha	% Share in State Total	'000 MT	% Share in State Total	
Badaun	Mid-western plain	4.82	10	75.27	8	15.6
Kasganj	Western subtropical	4.11	8	71.76	8	17.5
Aligarh	Western subtropical	4.02	8	70.23	8	17.5
Farrukhabad	Mid-plain	2.68	5	61.97	7	23.1
Etah	Western subtropical	3.11	6	54.75	6	17.6
Hathras	Western subtropical	2.94	6	51.34	6	17.5
Kanpur Nagar	Mid-plain	2.13	4	38.02	4	17.8
Moradabad	Bhabhar terai	1.19	2	35.05	4	29.5
Kaushambi	Mid-plain	2.01	4	33.65	4	16.7
Bulandshahr	Western plain	1.72	3	32.95	4	19.2

Source: MoAFW. 2018. *Horticulture Statistics at a Glance*.

Within the state, Badaun, Kasganj, Aligarh, and Farrukhabad are the major guava-producing districts, accounting for 30% of total state production. Etah, Hathras, Kanpur Nagar, Moradabad, Kaushambi, and Bulandshahr are the other production regions. Collectively, these 10 districts account for 60% of state production. Allahabad District is well known for a red-fleshed guava variety (Allahabad Surkha), which has a Geographical Indicator tag.

Major Guava Varieties

Several varieties are cultivated in the state. Their features are described in Table 23.⁵⁸

Table 23: Characteristics of Major Guava Varieties Grown in Uttar Pradesh

Name of Variety	Ripe Rind Color	Skin Surface	Flesh Color	Seediness	Seed Texture
Allahabad Safeda	Greenish yellow	Smooth	White	Medium	Medium
Lucknow-49	Greenish yellow	Rough	White	High	Medium
Lalit	Saffron yellow with red blush	Rough	Pink	Medium	Soft
Shweta	Creamy white	Smooth	White	Medium	Soft
Pant Prabhat	Yellow	Smooth	White	Medium	Soft

Note: Better appearance = consistent greenish yellow, round in shape, smooth surface with few blemishes.

Source: ICAR Central Arid Zone Research Institute. 2016. Performance Evaluation of Guava.

⁵⁸ A. Singh, S. Kumar, and R.N. Kulloli 2016. *Performance Evaluation of Guava (Psidium guajava L.) Introductions in Arid Conditions of Western Rajasthan*. ICAR-Central Arid Zone Research Institute. <https://krishi.icar.gov.in/jspui/handle/123456789/19476>.

Allahabad Safeda is the preferred guava variety for cultivation as it fetches a higher price owing to its better appearance. Lucknow-49 fetches a lower price but is preferred for cultivation by many because of its higher yield and better resistance to guava wilt disease.

Seasonality

The guava harvesting season varies by region. Figure 31 illustrates the harvesting seasons in various producer states.⁵⁹ Production in Uttar Pradesh overlaps with the production season of most of the other states.

C. Value Chain Analysis

Major Actors in the Guava Value Chain in Uttar Pradesh

The following actors operate in the guava value chain (Table 24).

Input suppliers: Most guava farmers buy planting material from government-accredited private nurseries in Uttar Pradesh. Of 43 such nurseries, 28 are in Malihabad (Lucknow District).⁶⁰ Limited quantities come from the Department of Horticulture and a nursery unit at CISH in Lucknow. Some farmers buy saplings of new varieties from agriculture universities, research institutions, and KVKs, depending on the proximity of the center and the costs involved. A few orchard owners grow saplings on their farms. Other inputs such as fertilizers, micronutrients, and plant protection chemicals are sourced mostly from private dealers.

⁵⁹ APEDA. Harvesting Season of Guava. http://apeda.gov.in/apedawebsite/six_head_product/Harvesting_Season_Guava.htm

⁶⁰ NHB. Nursery Star Rating Report. <http://nhb.gov.in/nursery/report/nurseryreport.aspx?enc=JFg4M7VAmRWST8gU62nUMw==>.

Government department and institutions: The Department of Horticulture supports farmers by providing technical guidance through training and exposure visits, advocating for new technology, and evaluating other needs. Extension officers, assistants, and inspectors are posted at district and block level. Block-level offices can have multiple staff responsible for different production clusters covering all crops. ICAR and CISH, in Lucknow, extend strong research support for varietal development and scientific cultivation of guava.

Guava producers and growers: Growers are responsible for land preparation, sourcing, and planting saplings for new orchards and replacement of old orchards. They also undertake orchard maintenance and harvesting operations.

Lease contractors: Sometimes orchard owners lease their orchards to other farmers in the same village or a neighboring village for an annual cycle of two seasons at a predetermined rate based on factors such as area, variety, number and age of the trees, yield, and value realization during earlier seasons. The lessor is responsible for undertaking farm maintenance activities for the specified lease period as well as postharvest handling.

Preharvest contractors and village aggregators: About 70%–80% of guava farmers in Uttar Pradesh sell their produce to preharvest contractors or village aggregators. The contract is normally made after the onset of the fruiting season but before harvest. The price is determined by the contractor based on a visual inspection of the farm taking into consideration the number of trees with mature fruits, fruit size, and the proportion of diseased or damaged fruit. Once harvested, the preharvest contractors collect the produce at farm gate and are responsible for sorting, grading, and packing, which is done at a collection or packing center or at a suitable place near the farm. The contractor is also responsible for marketing. When contractors buy on behalf of an exporter, only top-quality fruit that matches the specified quality parameters is exported and the rest is marketed through other trade channels.

Commission agents and wholesalers: Some 15%–25% of guava farmers sell their produce at the nearest APMC market through auctions. Commission agents registered in that market then sell to wholesalers who trade in distant markets. Commission agents receive payment from the wholesaler and transfer a receipt to the farmer. Agents buy 5%–7% directly from the farm. In such cases, trade deals are done after the harvest and the procurement rate is based on the type and quality of the harvested produce and the market rates prevailing at that time. The cost of transportation, packaging, and the mandi cess (tax) are borne by the agent. At the market, these agents act and trade on behalf of the farmer for a commission rate of 4%–6% from the farmer and 3%–5% from the buying trader or wholesaler.

Processors: Processing guava involves primary activities such as sorting, grading, and packing, and secondary- and tertiary-level processing into value-added guava-based products such as pulp, ready-to-drink fruit juices, jams, and jellies. There are only a few processors in the state engaged in processing. Most are in the informal sector and have small processing capacities. A few processing units based in other states such as Gujarat and Maharashtra buy guava from APMC markets in Uttar Pradesh.

Table 24: Agents and Activities in the Guava Value Chain

Activity	Agent	Output
Input supply	Private nurseries, Department of Horticulture, CISH	Supply of planting material, fertilizers and micronutrients, plant protection chemicals, micro-irrigation equipment, packing material
Training and subsidy	Department of Horticulture, CISH (Lucknow), KVKs	Training on guava cultivation including orchard maintenance, insect pest and disease management, postharvest handling, subsidy on inputs (planting material, machinery, chemicals)
Crop production	Farmers	Production and harvesting of produce

Continued on next page

Table 24: continued

Activity	Agent	Output
Postharvest management	Farmer, preharvest contractors, village aggregators, CA	Harvesting, primary processing of produce (sorting, grading, and packing) and trading
	Exporters	Graded guava treated using hot water treatment, packing of treated guava in cardboard boxes for export purpose
Transportation	Transport service provider	Logistic assistance
Processing	Processors	Secondary and tertiary level processing of guava into various value-added products
Distribution and retail	Wholesalers, retailers	Marketing of sorted and graded/ processed produce

Source: Deloitte India field data as of 2020.

Commodity Flow Analysis

Based on the primary survey, the commodity distribution and marketing flow along the value chain of guava is detailed in Figure 32.

Channel 1: Marketing through preharvest lease contractors. About 70%–80% of the farmers in the surveyed areas were observed to be routing their produce through either lease contractors or preharvest contractors. These contractors generally have preestablished marketing links with traders in distant markets such as Delhi, Lucknow, Ghaziabad, Nepal, Bihar, Maharashtra, and Gujarat and sell through their network. Once the produce is received in a distant market, it is purchased by wholesalers and marketed through sub-wholesalers to retailers before it finally reaches the consumer.

Channel 2: Marketing through commission agents. Some 15%–25% of growers market their orchard produce on their own. Farmers adopting this marketing channel sell their produce to traders and wholesalers in a distant market such as Delhi, Rajasthan, Nepal (via Gorakhpur), Mumbai, or Kolkata. Azadpur Mandi in Delhi is the hub for guava distribution from Uttar Pradesh and offers better prices compared with local markets. Farmers who do not have direct links in distant markets sell in nearby APMC markets in the district. The commission agents cum wholesalers in these markets buy from farmers and then sell onward to wholesalers within the state or a distant market at a fixed commission rate. Responsibility for making payment to the farmer lies with these commission agents. Payments are made by check or cash almost immediately. Within this channel, farmers bear the costs associated with activities such as on-farm sorting, grading, packing, transportation from farm to market, and loading and unloading.

Channel 3: Marketing to processing unit. This channel represents the procurement of produce by processing companies based within and outside the state. Generally, processing companies buy from APMC markets through an appointed purchase vendor, manager, or commission agent. Only 5%–7% of the produce is marketed under this channel.

Three FPOs were promoted under a novel wadi (orchard) development program by NABARD in Lalitpur District to support members of the vulnerable Saharia tribe to develop guava orchards and related activities. However, this seems to be still at the initial stage, and registered members are selling their produce individually as guava is not a major focus crop cultivated by the farmer members.

Price Buildup Analysis: Production, Marketing Functions, and Activities

To estimate the actual expenses and gains of bringing guava from farm gate to consumer, the value chain was analyzed in terms of pre- and postharvest activities and costs and margins.

Preharvest Activities

Land preparation and layout: This activity involves digging 30–45 cm pits and filling them with a mix of soil and a base dose of farmyard manure before planting the saplings. Along with farmyard manure, some farmers also apply anti-fungal bioagents such as *Trichoderma* to manage guava wilt. In the surveyed areas, the farmers are generally adopting the recommended practice of 6 x 6 m spacing, which accommodates 277–280 trees/ha. The cost of land preparation for 6 x 6 m spacing is estimated at ₹40/pit, thus the total cost of land preparation is ₹11,200/ha. Standards and techniques for high-density planting systems are being popularized by CISH (1 x 2 m spacing), which accommodates 5,000 plants/ha; however, farmers are not yet adopting such techniques (footnote 41).

Planting: To buffer losses caused through transportation and mortality after transplanting, farmers buy 300 saplings/ha. To further reduce losses and for better growth, the saplings are generally hardened before transplanting for 10–15 days. The cost of planting material depends on the age of the plant. A 2-year-old sapling costs ₹40/plant whereas saplings that are 3–3.5 years old may cost ₹50–60/plant. Older saplings will bear fruit sooner after planting. Farmers mostly source planting materials from private nurseries. As these nurseries are mostly based in selected production clusters, the average distance from the orchard is estimated at 40–50 km.

Thus, the cost of planting material, including transportation and handling charges, is estimated at ₹27,000/ha. These are one-time expenses and, assuming the lifecycle of an orchard is 8 years,⁶¹ the cost has been distributed over 8 years. Hence, the cost of planting and land preparation is estimated at ₹4,775/ha per year.

Nutrient management: In the surveyed area, farmers were observed to be applying a base dose of farmyard manure of 1–1.5 MT/ha, supplemented with 300 kg of urea and 500 kg of DAP per hectare. The applied dosage of urea and DAP is higher than recommended, adding to the cost of cultivation. The average cost of fertilizer inputs was calculated at the prevailing rate of application and estimated at ₹22,133/ha. The labor cost for application of these inputs is estimated at ₹3,000/ha, giving a total cost of ₹25,133/ha.

Water management: Conventional flood irrigation methods are used, with tube wells as the primary water source. Irrigation is carried out frequently throughout the year at an interval of 20–30 days. During winter, irrigation is done at intervals of 10–15 days to minimize the effect of frost. The cost of irrigation is estimated at ₹31,200/ha for 12 irrigations.

Intercultural operations: Weeding is done at least once within the initial 3 months of orchard establishment and in the second year of operation. Weeding in the third and fourth years is undertaken for the intercrop. The cost for intercultural operations is estimated at ₹3,750 and calculated at ₹15/plant for an estimated average of 250 plants/ha that survive and grow into mature trees.

Plant protection: Farmers reported that insect and pest damage reduced their marketable produce by at least 1%–5%. Farmers apply insecticides such as phorate to control pests. Only a few farmers were observed to be applying bio-pesticides such as *Trichoderma* and *Beauveria bassiana*, mainly because of lack of awareness of the proper use of such products or their limited supply. The total cost of application of plant protection inputs is estimated at ₹27,500/ha and calculated at ₹110/plant for an estimated 250 surviving plants per hectare.

Harvesting and Postharvest Activities

Harvesting: Plants start bearing fruit at 2–3 years and attain full fruit-bearing capacity at seven to eight years. A 7- to 8-year-old plant yields 100–150 kg of fruit every year. With the increasing incidence of guava wilt and nematode attacks, the survival period of guava orchards in Uttar Pradesh has been reduced to less than 10 years (ranging between 7 and 9 years). Usually, fruit harvesting is done manually. Low-hanging fruits are handpicked, while those higher up are harvested by beating the branches with a bamboo pole or vigorously shaking the tree branches. This injures the fruit through bruising, cutting, and cracking, thereby reducing the quality and lowering prices. On average, the cost of harvesting and transport is estimated at ₹1.2/kg. Considering average productivity of 16 MT/ha for a medium-aged guava orchard, the total cost of operations is estimated at ₹19,200/ha.

Sorting, grading, and packing: The labor engaged for fruit harvesting is employed for sorting and grading. Sorting and grading are usually based on visual inspection of fruit size, appearance, color, and texture. Overall sorting at the farm level categorizes the produce into two or three grades. Mostly, the sorted and graded guava is packed without washing or pretreatment; however, for export purposes and for a limited quantity a hot water treatment is used to prevent postharvest diseases. The sorted and graded fruit are often packed loose in plastic crates of 25 kg capacity. Such packaging is not suitable for long-distance transportation and may cause further losses. Corrugated fiberboard boxes are more suitable as they possess good flexibility, durability, and stacking capacity. Foam sleeves (polystyrene or polyurethane) are recommended for individually wrapping fruit to prevent bruising during long-distance transportation. Given its higher cost, this type of packaging is used mostly for export purposes. The cost of grading and packing plus inbound transportation is estimated at ₹3.5/kg (Case 6).

⁶¹ While guava plantations usually bear fruit for more than 10 years, the survival rate of the plantations in recent years has been low (between 8 and 10 years) in the study area owing to prevalence of wilt and nematodes.

Case 6: Ayakudi Guava and Fruit Producer Company Limited, Tamil Nadu

Ayakudi Guava was established in 2014 under the National Agriculture Innovation Project in Dindigul District of Tamil Nadu. The FPO members cultivate 560 acres of guava orchards. The FPO trains grower members on good agricultural, harvest, and postharvest practices including grading and packing produce. The fruits are foam-jacketed after harvesting, properly graded, packed, and exported to 14 countries in the Middle East region. Guava exports have helped farmers get higher prices (₹30–35/kg) as compared with the earlier price of ₹8–10/kg before the intervention.

Source: ICAR National Academy of Agricultural Research Management Farmer Producer Company. 2017. *A Path-Breaking Grassroots Institutional Innovation*. January.

Storage: Guava is highly perishable. Under ambient conditions, mature and unripe fruits can be stored for 10–12 days. Various technologies and practices are being developed by research institutions such as ICAR/CISH in Lucknow to extend shelf life. These include the use of preservatives and growth regulators and low-temperature storage techniques. For example, Allahabad Safeda can be stored for 28 days at 10°C in 0.25% ventilated low-density polyethylene bags.⁶² Growers and traders in Uttar Pradesh are yet to adopt such practices, and produce is mostly sent to the market almost immediately after harvesting without storage.

Transportation: Road transportation is the most common method for transporting guava to other parts of the country. Vehicles of various sizes are used for transportation depending on the distance to the destination market. Trucks of 10–15 MT capacity are used for long distances (Mumbai, Kolkata, northeastern states, and exports to Nepal). For short-distance transport to Delhi, trucks of 4–7 MT capacity are hired. The average cost for outbound transportation from Lucknow to Delhi is estimated at ₹2/kg, and for transport to distant markets such as Mumbai and Nepal at ₹5–7/kg.

Major market sales within and outside the state: During 2017–2018, out of the total production of 924,000 MT, only 245,000 MT was delivered to markets in Uttar Pradesh. This is indicative of more trading taking place outside the state or data not being reported. The latest market and price data available from the Agricultural Marketing Information Network portal (AGMARKNET) of the Directorate of Marketing and Inspection and the NHB indicates that the major markets for guava trade within the state are Lucknow, Ghaziabad, Aligarh, Agra, and Pilibhit. The major markets outside the state are Delhi, Mumbai, Hyderabad, Kolkata, and Bhopal. Delhi is the largest market for guava.

Market prices: The price earned by farmers varies significantly by region. During the field visit, farmers reported that their produce was being sold anywhere between ₹6 and ₹18/kg. The mean price in various major markets is given in Table 25. Based on a comparison of prices, markets outside the state offer better rates. The mean of daily modal prices is highest in Delhi at ₹4,489/quintal.

⁶² Government of India, ICAR. *Major Achievements of ICAR-CISH*. <http://www.cish.res.in/phm.php>.

Table 25: Comparative Analysis of Market Arrivals and Mean of Daily Modal Prices of Guava, January–December 2018

Location	Major Market	Arrivals (MT)	Mean of Daily Modal Price (₹/quintal)
Within Uttar Pradesh	Lucknow	6,677	1,233
	Ghaziabad	5,023	2,360
	Aligarh	2,155	1,738
	Agra	1,939	2,013
	Pilibhit	1,180	1,825
Outside Uttar Pradesh	Delhi	16,225	4,489
	Mumbai	12,932	3,553
	Hyderabad	7,424	2,056
	Kolkata	7,167	4,348
	Bhopal	4,314	1,489

Sources: AGMARKNET. <https://agmarknet.gov.in/>; and NHB. <http://nhb.gov.in/OnlineClient/MISDailyReport.aspx?enc=3ZOO8K5CzcdC/Yq6HcdIxJ4o5jmAcGG5QGUX3BIAP4=>.

Secondary and tertiary processing: Overall processing of guava in the country is negligible in comparison with total fruit production. In Uttar Pradesh, limited quantities of fruit are used for processing. Most processing units are in the informal sector. Given the lack of up-to-date infrastructure facilities, equipment, hygienic conditions, and latest know-how, these units are unable to produce good quality products, resulting in low demand for processed guava items in the market. In the formal sector, Manpasand Beverages, a manufacturer of thermally processed ready-to-serve fruit drinks and juices, is the only agro-processing company that has a manufacturing unit in Uttar Pradesh that produces guava juice. Its guava juice product is marketed along with other fruit drinks and juice products under the brand name Fruit Up. Mango-based fruit drinks and juices are one focus product, and only a limited quantity of guava is procured for processing purposes. Based on the stakeholder consultations, it is estimated that overall processing capacity within the state for guava-based products is less than 1% of the state's total guava production. A few processing units from Gujarat and Maharashtra also buy guava from Uttar Pradesh for pulping. Generally, these units buy produce through appointed procurement managers or representative agents who facilitate deals in APMC markets for sourcing the required quantities. Processing companies mostly buy low-grade produce, which is available at a cheaper rate of ₹6–8/kg.

D. Farm-Level Economics of Guava Cultivation, Storage, and Marketing

The total cost toward the establishment and maintenance of guava orchards is estimated at ₹92,058. The farmer supplying the produce to a preharvest contractor bears the cost of harvesting. The net profit earned by the farmer is estimated at ₹80,442/ha (Table 26).

Table 26: Estimated Investment for Establishment and Maintenance of Guava Orchard

	Cost Details	Unit Cost (₹)	Frequency	Value (₹/ha)
1	Cost for land preparation	40/pit	280 pits	11,200
2	Cost of planting			
	Planting materials	55/plant	300 plants	16,500
	Transportation cost	20/plant	300 plants	6,000
	Cost of labor	15/plant	300 plants	4,500
	Effective per year cost of land preparation and planting			4,775
3	Application of fertilizer inputs			
	Urea	305/bag of 45 kg	6.67 bags	2,033
	DAP	1410 per 50 kg	10 bags	14,100
	Farmyard manure and micronutrients	6/kg	1 MT/ha	6,000
	Cost of labor	3,000/ha	1 time	3,000
4	Irrigation charges	2,600 per irrigation	12 times	31,200
5	Cost of weeding	15/plant	250 plants	3,750
6	Cost of plant protection	110/plant	250 plants	27,500
	Total cost of guava cultivation			92,358
	Average yield per ha			16,000 kg/ha
	Cost of cultivation per kg			5.8
7	Cost of harvesting	1.2/kg	16,000 kg/ha	19,200
	Cost of harvesting per kg			1.2
8	Total income @ average sale price of ₹12/kg		16,000 kg/ha	192,000
9	Net profit earned by farmers (per ha)			80,442
	Farmer's profit margin per kg			5.0

Source: Based on data and information collected during the field survey.

Financial Viability Analysis of Establishing New Orchards

Guava orchards in key production clusters are increasingly affected by wilt and nematode infestations, which severely affect the lifespan of the orchards. The average lifespan of guava orchards in the area is low, at around 10 years. The use of quality disease-resistant planting material and proper soil treatment can increase the overall lifespan. The financial viability of establishing new orchards has been analyzed for traditional orchards (i.e., 280 trees/ha) considering an economic life of 10 years and 15 years. Based on the analysis, the financial viability of establishing a new guava orchard is given in Table 27.

Table 27: Financial Indicators for Guava Orchard Establishment

Internal rate of return at 10 years	15.18%
Internal rate of return at 15 years	21.42%
Payback period	8 years

Source: Stakeholder consultations and field visits conducted by Deloitte. This is based on information gathered during stakeholder consultations and field visits conducted by Deloitte as a part of the study. The details of the calculations are given in Annex-4 of the report.

There is an upfront net outflow of ₹0.23 million in the first 3 years. Production starts from the third year in low volumes and achieves full production around the eighth year. Indicators show that guava orchard establishment is financially viable with an internal rate of return of 15.18% within a span of 10 years. The internal rate of return increases to 21.42% if an economic life of 15 years is considered. With disease-resistant planting material and better agricultural practices, achieving a lifespan of 15 years is possible.

Summary of Price Buildup

The value chain of 1 kg of guava indicating the various activities and cost buildup is shown in Figure 33.

The average cost of guava cultivation is ₹5.8/kg. The farmer bears the cost of harvesting, grading, and packaging, which comes to ₹1.2/kg. On average, farmers can fetch a price of ₹12/kg for produce that retails for ₹45/kg.⁶³ Thus, the farmer's margin in the final consumer price is 11% and that of intermediaries is 33%. The cost of marketing,

⁶³ Guava sells at ₹40–60/kg in and around Uttar Pradesh, an average ₹40 kg in nearby markets, ₹45 per kg in Agra, Lucknow, and Ghaziabad, and ₹55–60/kg in Delhi.

transportation, and other expenses is estimated at 23.3%. A significant quantity (25%) of produce is wasted or becomes unsuitable for onward retail distribution, and this is added to the consumer price.

Gaps in the Guava Value Chain

Production Gaps

Availability of quality planting material: At present, there are only 43 nurseries in the state recognized by the NHB for certified planting material production. Most are located around the production cluster in Lucknow District and have limited capacities. This creates a supply-side problem, especially for orchard owners in production clusters such as Badaun and Kasganj, who purchase planting materials from local unaccredited nurseries or from traditional suppliers outside the district. The lack of quality planting material remains a cause for concern as the varieties grown in local nurseries and those procured from traditional supplier belts such as Kayamganj are increasingly susceptible to wilt and root-knot nematodes. The average lifespan of orchards is decreasing significantly, with less than 10% surviving beyond 10 years.⁶⁴ Good nursery management practices, including the use of modern propagation techniques and resistant rootstock, should be encouraged in nurseries to control the spread of diseases and pest infestations. The availability of wilt-resistant varieties such as CISH-Lalit should be promoted in affected production belts (Case 7).

Case 7: Study on Impact of Wilt on Guava Orchards in India

The study highlights that wilt has affected guava orchards in many states in India and that 5%–15% of guava trees die as a result of wilt in Uttar Pradesh. States such as West Bengal and Punjab have been more severely affected.

Wilt is a complex disease and several organisms that cause it are in the soil. The disease is difficult to control and excessive use of chemicals to eliminate it can lead to soil degeneration. Wilt damage can be limited by using Trichoderma, neem cake, and gypsum in soil. This helps control it for a short time, but an effective long-term solution lies in the development of resistant rootstock and cultivars.

Source: *Indian Journal of Horticulture*, 58 (1&2). pp. 145–155.

Excessive application of fertilizers: Soil testing and assessment of micronutrients is rarely done as there are no soil testing labs near guava production clusters. Farmers need to be advised about the importance of soil testing and using the recommended dosages of fertilizers, especially micronutrients. Many farmers apply only farmyard manure and urea before planting. A few apply farmyard manure with Trichoderma, which helps control wilt. Farmers who are aware of the effectiveness of bioagents have expressed concerns about the lack of good quality bioagents on a sustainable basis.

Use of plant protection inputs: The increasing prevalence of guava pests and diseases has led to greater use of plant protection chemicals. Integrated pest management practices should be promoted such as suitable cultural and mechanical practices, use of pheromone traps (effective against fruit flies), sticky traps, and bio-pesticides (such as *Beauveria bassiana*, effective against termites and whiteflies). The supply of nonchemical plant protection and bioagents should be strengthened. Farmer awareness should be increased through training on the application of needs-based chemical pesticides.

⁶⁴ Deloitte India field observations. 2020.

Absence of FPOs engaged in the supply of inputs and marketing support: Under the tribal development initiative, NABARD promoted a few FPOs in selected districts in Uttar Pradesh to support marginalized tribal communities in livelihood generation through development of guava orchards for economic and social empowerment. The program included support to local communities on soil conservation practices, water resource development, improved and sustainable agro-horticulture livelihood development, women's development programs, and training and capacity-building. Once the support period ended, these FPOs became inactive and moved away from guava production to other livelihood activities.⁶⁵ This may suggest the importance of supporting new FPOs for a more extended period. Rigorous efforts are required to review such FPOs and promote new formal and informal farmer groups dealing in guava to support sustainable development, particularly for smallholder and marginal orchard owners (Appendix 4).

Harvest and Postharvest Management Gaps

Primary processing practices: There are no packing houses or common collection centers in the production clusters where groups of farmers can aggregate their produce. There is a shortage of primary processing facilities for cleaning, grading, and sorting at the farm level. Farmers or postharvest and lease contractors do the sorting and grading manually by employing skilled labor. There is also an acute lack of awareness among farmers regarding Fair Average Quality standards. The traders interviewed in the surveyed market yards also expressed dissatisfaction with the quality of grading and said it was not up to market trade requirements.

Transportation-related: The transportation of produce from farm gate to the nearest market depends on the quality of access roads. Stakeholder consultations revealed that the condition of many roads connecting the major production clusters with markets was poor. Farmers and traders also raised concerns about having to travel long distances to sell their produce. Varieties like Lucknow-49 are in high demand in southern states, but lack of transportation facilities means farmers prefer to sell their produce in nearby markets at a lower price.

Secondary and tertiary processing facilities: Despite Uttar Pradesh being the largest producer of guava in India, the extent of processing in the state is extremely low. There are few companies involved in the production of value-added products like guava pulp and ready-to-drink fruit juices, jams, and jelly. These companies are mainly in the informal sector with limited processing capacity (Box 3).

Marketing Gaps

Box 3: Feedback from Exporters, Organized Retailers, and Traders

Given the limited presence of organized farmer collectives dealing with guava in Uttar Pradesh, exporters and retailers prefer to purchase bulk produce from intermediaries and have limited interaction with farmers. Organized retailers said they could offer a premium of 20% over market rates to farmers and FPOs, provided they supplied quality produce by adhering to the recommended agricultural and harvesting practices.

Frequent instances of wilt and nematode infestations have severely affected guava production in the cluster. The average life of an orchard in the region has declined to 8-10 years.

There is limited awareness among orchard owners on GAP and the impact of this on the quality of produce and orchard lifespan.

Lack of quality planting material is a major concern.

Continued on next page

⁶⁵ NABARD. 2018. National Level Paper - PLP 2019-20. <https://www.nabard.org/auth/writereaddata/CareerNotices/2708183505Paper%20on%20FPOs%20-%20Status%20&%20%20Issues.pdf>.

Box 3: *continued*

Guava has a short shelf life and there are no cold storage facilities in the major production clusters.

Most companies indicated a lack of postharvest infrastructure in major production clusters such as collection centers and packing houses. Lack of cold storage facilities is the major constraint in procuring more produce from Uttar Pradesh. Some farmers had received better prices and increased profits by 20%–25% when they collectively sold guava to markets in Agra or Delhi.

Limited availability of soil testing facilities is a major constraint in production clusters. Labs in the region do not have the essential infrastructure for testing micronutrient requirements, which makes their recommendations less effective. If soil health information cards with prescriptive doses of micronutrients are made available to farmers, they can suitably control fertilizer use.

Source: Field interviews with exporters, traders, and organized retailers.

Access to real-time market flows and price information: Farmers are mostly dependent on informal market information sources such as other farmers, traders, commission agents, and input dealers for market and price information. Whenever there is a glut in the market, prices come down and farmers find it difficult to sell their produce at remunerative prices. Guava is a perishable crop and cannot be stored for a long time without controlled temperatures; hence farmers need to sell it quickly. Most fruit growers, therefore, prefer to lease out their orchards or sell their produce to preharvest contractors at predetermined rates to avoid postharvest responsibilities.

Mandi cess (tax): During the interviews conducted between 2019 and early 2020, the mandi cess of 2.5% was perceived to be high by commission agents, and trade commission agents were of the view that the rates prevailing in neighboring states were lower (Appendix 8).

Access to Finance

High cost of finance: Guava farmers have little access to credit and are highly dependent on contractors for marketing their produce as well as for credit and advance payment; this reduces their bargaining power. When growers approach commission agents in the local APMC markets for credit, they are forced to sell their produce only through those agents.

E. Market Assessment

Product Map for Guava

Guava is traded globally in various forms, such as fresh fruits, pulp, dried, squash, and juice, as depicted in Figure 34.

Import–Export Trade Analysis Global Scenario

Global data on guava trade remain difficult to obtain as the HS trade data on guava are reported together with those on mangoes and mangosteens. According to an FAO estimation, combined global exports of mangoes, guava, and mangosteens were 1.7 million MT in 2017, of which guava is estimated to account for only 5% of the total (85,000 MT).⁶⁶

Exports of Guava and Guava Products India Scenario

Despite being the largest producer of guava in the world (4 million MT annually), India exported a negligible volume of 14,242 MT in 2018–2019.⁶⁷ However, exports have shown an increasing trend over the past few years. This has owed to the increased export of value-added guava products, which account for more than 90% of the total export volume as well as value. The share of fresh and dried guava in exports is 7%–8%, and the remaining share is from other prepared and preserved beverage products, such as guava squash (Table 28).

Table 28: Trend in Share of Guava Product Exports from India, 2014–2015 and 2018–2019

HS Code	Product	2014–2015		2016–2017		2018–2019	
		'000 MT	\$ million	'000 MT	\$ million	'000 MT	\$ million
08045010	Guavas fresh/dried	0.9	0.6	1.4	0.9	1.0	0.7
20079920	Guava jams, jellies, marmalade	3.4	2.6	8.9	6.3	13.1	7.3
20089994	Guava squash	0.4	0.3	0.02	0.02	0.2	0.1
Total		4.7	3.5	10.5	7.4	14.3	8.1

Source: APEDA, AgriExchange.

⁶⁶ Source for 2017 figures: FAO. 2019. Major Tropical Fruits Statistical Compendium. 2017. Source for total figure: S. Altendorf 2019. Major Tropical Fruits Market Review. 2017.

⁶⁷ APEDA. Export Statistics for Guava-Based Products from India including HS Code 08045001 (Guava, Fresh/Dried), 20079920 (jams jellies, and marmalades), 20089994 (Guava Squash prepared/preserved). <http://agriexchange.apeda.gov.in/IndExp/PortNew.aspx>.

The major destinations for guava exports from India in terms of quantity include Nepal (20%), Qatar (13%), the UAE (11%), the UK (10%), Bahrain (8%), and Saudi Arabia (7%). For jam, jelly, and marmalade products, the leading markets are Saudi Arabia (27%), Indonesia (16%), Sudan (15%) and the Republic of Yemen (9%). Some exports go to the Netherlands, the US, the UAE, and Kuwait. Collectively, Indonesia (25%), Sudan (22%), Saudi Arabia (17%), and the Netherlands (8%) account for more than 70% of the trade. The export of guava squash is mainly to Nepal (98%), with limited quantities exported to Bhutan and a few other countries.

Import of Guava and Guava Products from India

India's total imports of guava products are negligible and mainly limited to the import of fresh and dried guava. Imports have been declining over recent years. Imports of fresh and dried guava are mainly from Thailand, while guava-based jams and jellies come from Bhutan (Table 29).

Table 29: Trend in Share of Guava Product Imports from India

HS Code	Product	2014–2015		2016–2017		2018–2019	
		MT	INR million	MT	INR million	MT	INR million
08045010	Guavas fresh/dried	490	0.58	362	0.47	13.5	0.45
20079920	Jams, jellies, marmalades	0	0	0	0	16.3	0.11
20089994	Guava squash, prepared or preserved	0	0	3.9	0.01	0	0.01
Total		490	0.58	365.90	0.48	29.80	0.57

Source: APEDA. AgriExchange.

Share of Uttar Pradesh in India's Trade of Guava and Guava Products

Despite significant production levels, Uttar Pradesh's share in the volume and value of domestic exports of guava remains at less than 1% and is restricted to the export of fresh and dried guavas to Nepal (100%). Export from Uttar Pradesh declined drastically after 2018–2019 (Figure 35). In comparison, exports of guava and guava-based products from Maharashtra, West Bengal, and Gujarat have improved gradually over the past few years and remain diversified (Table 30).

Figure 35: Export of Fresh and Dried Guavas from Uttar Pradesh, 2014–2019

Source: APEDA, AgriExchange.

Table 30: State Exports of Guava and Guava Products 2018–2019

Product	State	Quantity (MT)		Major Destination Markets 2018–2019
		2014–2015	2018–2019	
Guavas fresh/dried	Maharashtra	178.69	495.45	UK (19%), UAE (15%), Oman (13%), Bahrain (12%), Saudi Arabia (10%), Qatar (9%)
	West Bengal	9.36	126.94	Nepal (44%), Qatar (43%), Singapore (13%)
	Odisha	-	124.80	Nepal (100%)
	Tamil Nadu	613.04	88.01	Netherlands (40%), PRC (19%), Saudi Arabia (19%), Poland (10%)
	Karnataka	1.89	59.50	Qatar (34%), Maldives (34%), Bahrain (30%)
	Gujarat	1.06	31.49	UAE (98%)
	Uttar Pradesh	2.40	11.20	Nepal (100%)
Jams, jellies, marmalades	Tamil Nadu	1,379.96	10,003.79	Saudi Arabia (35%), Sudan (16%), Indonesia (13%), Republic of Yemen (11%)
	Maharashtra	1,839.16	2,867.29	Indonesia (26%), Sudan (15%), UK (8%), US (8%), Netherlands (5%)
	Karnataka	122.24	178.46	Netherlands (76%), Tanzania (19%), Sri Lanka (5%)
	West Bengal	-	54.62	Bhutan (99%)
	Bihar	28.56	18	Nepal (100%)
	Gujarat	-	7	Qatar (100%)
	Kerala	1.05	5.33	UAE (94%), Qatar (5%)
	Uttar Pradesh	15	0.2	Australia (100%)
Guava squash prepared or preserved	West Bengal	-	1.42	Bhutan (100%)

Source: APEDA, AgriExchange.

Demand Outlook

According to the National Survey Report by the Ministry of Statistics and Program Implementation published in June 2014, the annual per capita consumption of guava shows major variations between urban and rural sections of the country. In 2011–2012, the average annual per capita consumption for urban populations was 0.62 kg and rural consumption was 0.33 kg. According to the 2011 Census, the urban–rural ratio was 31.16% to 68.81% with an annual population growth rate of 1.1%. The total estimated consumption of fresh guavas at present is 0.55 million MT. According to the recommended dietary allowance (RDA), a moderate diet would comprise 100 g/day of fruit. Guava consumption equivalent to that on a population basis, according to a National Sample Survey Office study, would be 1.43 million MT. Therefore, current production is sufficient to meet current national consumption levels and RDA requirements. In Uttar Pradesh, current production of guavas is 0.93 million MT against an RDA requirement of 0.35 million MT, which means current production is sufficient to meet current consumption and RDA requirements (Figure 36).

Given the high perishability of fresh guava fruit, global trade in processed forms is expected to increase, particularly guava puree, which is used in a range of products such as baby food, beverages, bakery and snack items, ice cream and yogurt, and dressing and sauces. According to a market report, the revenue generated from guava puree was valued at \$313.8 million in 2017 and is projected to increase at a CAGR of 5.6% during the forecast period (2017–2025).⁶⁸ By region, Asia Pacific dominates the guava puree market, with India as a major producer of fresh fruits and derived products. The US sources most of its guava puree from South America, predominantly from Brazil and the Dominican Republic, while India exports most of its guava puree to Middle East countries. Thus, there is potential for Indian market actors to diversify into newer markets. For example, makers of bakery products, beverages, ice creams, and yogurts are experimenting with guava puree. There is growing demand for tropical fresh fruit flavors, and their appealing color and texture is encouraging the use of fresh fruit purees like guava as an ingredient. New product development offers opportunities for expanding the overall guava trade in domestic and export markets.

⁶⁸ Transparency Market Research. 2018. *Guava Puree Market: Global Industry Analysis and Forecast 2017–2025*. Transparency Market Research, Pune, India.

F. Potential Interventions

Based on the gaps identified in the guava value chain, potential interventions are outlined here.

Institutional Development

- Encourage and support farmers to adopt better harvesting and postharvest techniques with a focus on improving produce quality.
- Promote and strengthen grower collectives to enable them to undertake aggregated sales and marketing and dissemination of advanced technologies among members.
- Strengthen market intelligence and price discovery mechanisms for providing real-time information on fruit arrivals and grade-specific pricing at different markets within and outside the state to help increase farmers' value realization by enabling them to make well-timed sales.

Infrastructure Support

- Establish hi-tech nurseries to produce disease-free planting material for setting up and maintaining healthy orchards.
- Promote the use of drip irrigation systems in guava orchards by leveraging assistance under existing state and central schemes supporting the implementation of micro-irrigation.
- Set up modern packing houses with facilities for sorting, grading, packing, and cold storage.
- Promote value addition by setting up integrated facilities for pulping and juicing (Figure 37).

V. Focus Crop—Gram

A. Market Overview

Global Production

The chickpea (*Cicer arietinum*) or gram is one of the most important pulses in India. In 2017–2018, world production of gram was 17.2 million MT.⁶⁹ India dominates global production, accounting for 66%, followed by Australia accounting for 6% and Myanmar at 4%. Other top producers of gram are Turkey, the Russian Federation, the US, Ethiopia, Myanmar, Mexico, Pakistan, and Canada. These 10 countries account for 95% of world production.

Indian Production

India is the largest producer of pulses in the world. During 2017–2018, pulses were cultivated on 29.3 million ha, with a production volume of 24.5 million MT.⁷⁰ Under the individual crop category, gram is the most important pulse crop grown in India in terms of production. In 2017–2018, India's total production of gram was estimated to be 11.2 million MT from an area of 10.5 million ha, accounting for 45% of total pulse production in India and 36 % of total pulse acreage.

Madhya Pradesh is the leading producer of gram in India, with 34% of the total area and 41% of production.⁷¹ Other major producing states are Maharashtra (16%), Rajasthan (13%), Karnataka (7%), Uttar Pradesh (6%), and Andhra Pradesh (6%).

B. Gram Production in Uttar Pradesh

Area and Production

Uttar Pradesh ranks sixth in terms of area and production of gram in India. However, gram is a major cultivated pulse crop in the state, accounting for nearly 26% of the total state production of pulses. In 2017–2018, the state reported pulse production of 2.2 million MT from an area of 2.3 million ha. Of this, gram alone is estimated to account for 0.57 million MT production and an area of 0.50 million ha (Figure 38).

⁶⁹ FAOSTAT. 2018. <http://www.fao.org/faostat/en/#data/QC>.

⁷⁰ MoAFW. 2018. Pulse Revolution from Food to Nutritional Security. Crop Division. <http://dpd.gov.in/Retrospect%20and%20Prospects/Pulses%20Revolution%20From%20Food%20to%20Nutritional%20Security%202018.pdf>.

⁷¹ MoAFW, DAC&FW, Directorate of Economics and Statistics. 2018. Agricultural Statistics at a Glance 2018. <http://agricoop.gov.in/sites/default/files/agristatglance2018.pdf>.

Figure 38: Pulses Production and Area in Uttar Pradesh, 2017–2018

Source: Government of Uttar Pradesh, Department of Agriculture. Statistical Diary Uttar Pradesh. 2020. Economics and Statistics Division. [http://updes.up.nic.in/esd/reports/dbank_march21/Diary%202020\(English\).pdf](http://updes.up.nic.in/esd/reports/dbank_march21/Diary%202020(English).pdf).

Gram Production Regions

Gram cultivation in Uttar Pradesh is predominantly rainfed. In terms of agro-climate zones, gram cultivation is most prominent in Bundelkhand, which alone accounts for more than 60% of the area and more than 50% of the gram production in the state. The crop is also cultivated in the mid-plain and Vindhyan agro-climate zone in the state. Collectively, these three agro-climate zones account for more than 85% of the gram production in the state. Banda, Hamirpur, and Fatehpur are the major gram-producing districts, accounting for 42% of state production. Chitrakut, Kanpur Dehat, Jhansi, Kanpur Nagar, Mirzapur, Jalaun, Mahoba, Lalitpur, Allahabad, and Sonbhadra are the other producer districts (Table 31).

Table 31: District and Agro-Climatic Area and Production of Gram in Uttar Pradesh 2017–2018

District	Agro-Climatic Zone	Area		Production MT		Productivity (MT/ha)
		Ha	% Share in State Total	MT	% Share in State Total	
Banda	Bundelkhand	96,314	19	87,395	15	0.91
Hamirpur	Bundelkhand	92,802	19	86,721	15	0.93
Fatehpur	Mid-plain	42,140	8	67,919	12	1.61
Chitrakut	Bundelkhand	46,218	9	49,629	9	1.07
Kanpur Dehat	Mid-zone	23,396	5	39,040	7	1.67
Jhansi	Bundelkhand zone	29,135	6	29,399	5	1.01
Kanpur Nagar	Mid-plain	14,996	3	28,403	5	1.89
Mirzapur	Vindhyan	1,3800	3	19,558	3	1.42
Jalaun	Bundelkhand zone	13,715	3	19,371	3	1.41
Mahoba	Bundelkhand zone	27,027	5	18,627	3	0.69
Lalitpur	Bundelkhand zone	13,725	3	17,774	3	1.30

Continued on next page

Table 31: *continued*

District	Agro-Climatic Zone	Area		Production MT		Productivity (MT/ha)
		Ha	% Share in State Total	MT	% Share in State Total	
Allahabad	Mid-plain and Vindhyan	12,013	2	16,382	3	1.36
Sonbhadra	Vindhyan	11,298	2	15,574	3	1.38

Source: Government of Uttar Pradesh, Department of Agriculture.

Major Gram Varieties

Based on size, color, time of sowing, and other characteristics, gram can be classified into three types: native or desi species (timely sown varieties), late sown varieties, and Kabuli varieties. The popular varieties cultivated in the state include Avrodhi, Pusa-256, Radhe, JG-315, Pusa-372, Pragati, Rajasthani Chanta (a local name for small seeds), JG 322, JG11, RNG, and GNG 1958. Table 32 summarizes the maturation period of some of gram varieties grown in Uttar Pradesh.

Table 32: Maturation Period of Gram Varieties Grown in Uttar Pradesh

Variety	Days
Pusa-256	140–150
Avrodhi	150–155
Pant-G-20186	150–155
JG-315	145–150
Radhe	150–155
Pusa-372	150–155
Uday	130–145

Source: Government of Uttar Pradesh. State Agriculture Department.

Seasonality

Prevalent cropping systems for gram are rotation of rice-gram and intercropping with wheat-barley and gram-lentil. Gram is generally sown from October to November and harvested between February and March. However, in rice-based cropping systems, sowing gram is delayed beyond the optimum date because of the late harvest of rice. In such cases, farmers use late varieties of gram that can be sown in the third week of November and be ready for harvest by the end of April the following year (Figure 39).

Figure 39: Sowing and Harvesting Season of Gram in Uttar Pradesh

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Uttar Pradesh		Harvesting								Sowing		

Source: Deloitte India field data. 2020.

C. Value Chain Analysis

Major Actors in the Gram Value Chain in Uttar Pradesh

The various agents operating along the gram value chain are identified in Table 33.

Input suppliers: Fertilizers are generally purchased from Indian Farmers Fertilizer Cooperative Limited (IFFCO) cooperatives and retailers. For seeds, farmers depend mainly on supplies through state seed cooperatives, district sales centers, and private dealers. Some farmers buy seeds of new varieties developed by agriculture universities. Many farmers in the survey area were observed using seeds saved from previous crops, which adversely affects productivity. One FPO in Bundelkhand is involved in certified seed production.

Growers: The gram farmer undertakes crop cultivation from October to March (the rabi, or winter, season). The farmer is responsible for all crop cultivation activities including land preparation, seed sowing, irrigation, nutrient application, thinning and weeding, harvesting, and threshing. After threshing, farmers save some produce for their own consumption and sell the remainder at the nearest APMC market or to local millers. A few farmers also route their sales through village aggregators or actively operating FPOs.

Commission agents, traders, and millers: Licensed commission agents and traders generally operate from APMC markets. They receive farmers' produce, clean and grade it, then ship it to wholesalers in other states, to a distant market, or to millers via brokers. Some traders operate a milling business in parallel and buy produce directly from the market for milling.

Secondary processors: Small and medium units are processing gram into value-added products. Traditionally, gram is processed into gram dhal and the residue is sold as animal feed. Some processing units are also engaged in the production of other products such as besan (gram flour), dhal paste for restaurants, ethnic food items such as papads, and namkeen (savory) food snacks.

Table 33: Agents and Activities Operating in the Gram Value Chain in Uttar Pradesh

Activity	Agent	Output
Input supply	IFFCO, private vendors, societies and cooperatives, Uttar Pradesh and Tarai Development Cooperation, FPO	Seeds, fertilizers and micronutrients, pesticides, farm machinery
Training and subsidies	KVKs, agriculture universities (Jawaharlal Nehru Krishi Vishwa Vidyalaya Madhya Pradesh), Govind Ballabh Pant University (Uttarakhand), Indian Agricultural Research Institute (Pusa, Delhi), State Department of Agriculture	Training cultivation and use of hybrid seeds, soil testing, subsidies on input supplies (machinery, chemicals, planting material)
Production	Farmers	Gram
Postharvest management	Farmers, laborers	Harvesting, threshing, cleaning, and packing of gram seeds
Transportation and sales	Transport service providers, mandi councils, private seed testing labs, commission agents, traders	Logistics assistance, packing and cleaning, determination of oil percentage and quality; a small percentage of raw gram seeds sold as spices
Secondary processing	Traders and millers	Chana (chickpea) dhal and besan (gram flour), packaging, branding, marketing
Wholesale and retail distribution	Wholesalers, commission agents, retailers	Marketing and sales of chana (raw chickpeas) and chana dhal within state and to distant markets

Source: Deloitte India field data as of 2020.

Commodity Flow Analysis

Based on stakeholder interactions, four marketing channels were identified (Figure 40)

Figure 40: Trade Channels for Marketing of Gram in Uttar Pradesh

Channel 1: Marketing through commission agents and traders. Farmers sell 50%–60% of all produce through commission agents or traders in nearby markets. The agent or trader is responsible for cleaning, sorting, grading, and packing before transportation for sale in distant markets, and they bear the cost of these activities, including the market cess (tax). During the purchase process, agents or traders discount at least 3%–5% of the produce. In some mandis, farmers get better value as the produce is cleaned and graded in their presence. Cleaned and graded produce fetches a higher price and farmers get paid for 100% of the weighted produce, as traders do not discount the cleaned produce. The cost of cleaning in the markets is borne by the farmers who take the residue. In most mandis there is no established mechanism for analyzing quality. The cleaned and graded produce is then marketed to traders in distant markets, which is then sold to bigger traders or to mill operators for processing. The big traders sell part to millers for processing; the remainder is packed and sold to wholesalers or retailers for direct sale to consumers as raw chana (chickpeas).

Channel 2: Marketing to traders cum millers and wholesalers. This is similar to trading through an agent or trader, except the produce is sold to traders who own mills or are in touch with traders. These traders clean, pack, and grade the produce and sell approximately 50% to distant traders or wholesalers in other markets. The rest is processed as dhal or besan (gram flour), for which they also establish contact with traders or wholesalers in distant markets. A few traders connect with brokers to sell their produce to distant markets.

Channel 3: Marketing through village aggregators. Some farmers (5%–10%) sell their produce through village aggregators to save on the cost and time for transportation. The aggregator buys the produce at a relatively lower price than is offered by a market, then sells it to a local trader or commission agent, who subsequently sells it to a processor through brokers for onward processing and sale as chana dal, feed, and raw chana.

Channel 4: Marketing through FPOs. This is emerging as a trade model. Member farmers sell their produce to the FPO, which is responsible for aggregating the produce and carrying out the primary processing activities. Agencies such as SFAC, NABARD, and Uttar Pradesh Bhumi Sudhar Nigam have been promoting FPOs in the state. In interviews with FPOs, out of 18 FPOs with members engaged in gram cultivation, three were found to be active, as most FPOs are in the initial years of operation (Appendix 3). Three examples are:

- Vikas Path FPC (Lalitpur) is involved in certified gram seed production. It is diversifying its activities to vegetable cultivation and manufacturing biofertilizers, bio-insecticides, and compost under its own Bhumi brand.
- Bamaur FPC (Jhansi) is actively involved in the procurement of produce from member farmers, covering 25 villages and marketing it in distant markets. The FPO owns a facility in Bamaur submarket and is well connected with traders in other markets. The FPO also sells through the eNAM platform.
- Prayag Raj FPC Limited (Allahabad) is not involved in direct marketing; however, it facilitates supplies of seed and fertilizer inputs to farmer members.

Case 8: Success Stories of Farmer Producer Organizations Engaged in Gram Cultivation in Bundelkhand Region in Uttar Pradesh

Vikas Path Farmer Producer Company, Lalitpur, Uttar Pradesh

The FPO has been promoted by NABARD and its partner Vikas Path NGO. Vikas Path is engaged primarily in marketing certified seeds of gram, lentils, peas, and wheat. Through support from the NGO and NABARD, the FPO's turnover has increased from ₹2 million in 2017–2018 to ₹10 million in 2019–2020. The FPO has linked up with 34 distributors across the state to sell their seeds.

The FPO has diversified its activities to vegetable cultivation, manufacturing biofertilizers, bio-insecticides, and compost under its own Bhumi brand. For this, it has established links with local municipal cattle pond owners to procure cow dung. In return, Vikas Path has promised to share 70% of profits on the sale of biofertilizers and associated products.

The FPO builds its own seed grading and sorting plant and has ventured into producing organic value-added products such as dalia and dhal. Similarly, the FPO has initiated production and sale of fruits and vegetables produced by its farmer members.

Bamaur Farmer Producer Company, Jhansi

Promoted by SFAC, the FPO was formed in 2014. It received funding support from SFAC and is presently purchasing and marketing crops for farmers. The main crops are gram, mustard, and wheat. The FPO covers 25 villages and has active members and a Goods & Services Tax (GST) registration, and has taken a shop on rent in Bamaur Mandi. It is one of the few FPOs in the region to receive equity grant support from SFAC and has been able to sell produce

Continued on next page

Case 8: *continued*

in distant markets through eNAM. From sales in distant markets, it has earned a margin of ₹600–₹700/quintal on gram. It has established relationships with distant traders in Kanpur, Lucknow, and Mirzapur. It has processed gram into dhal at their level and sold it in local markets. Apart from marketing agriculture produce, the FPO is engaged in marketing seeds and fertilizers.

Source: Field survey by Deloitte. 2019.

Most FPOs have only been recently incorporated (2015–2017). Presently, less than 1% of the total gram produced is marketed through this channel. Given the limited support provided post-incorporation of the FPO, many have ceased operations due to lack of capacity. There is also an absence of backward and forward links on top of basic infrastructure such as input supply services, aggregation and marketing, facilities for storage and transport, quality assessment, and trading outlets. The operating FPOs expressed a need for continued support in the form of capacity-building on aspects of business development, governance and trade mechanisms; exposure visits to other markets; and assistance in setting up trading outlets and facilitating credit access (Case 8).

Price Buildup Analysis: Production, Marketing Functions, and Activities

Preharvest Activities

Land preparation and sowing: Gram requires deep plowing. Some farmers use hand plows and plow the field four or five times. However, this adds to the cost of labor and time and many farmers are now using tractors (owned or hired). For sowing, most farmers used to broadcast seed, which adversely affected productivity. Gradually, a number of farmers started using seed drills. The cost of land preparation is estimated at ₹6,900/ha and the sowing cost at ₹2,100/ha.

Seed inputs: The recommended seed rate for gram depends on the seed size, as detailed in Table 34. Farmers in the surveyed area generally apply an excessive seed rate of 100–150 kg/ha for small and medium seed weights. This adversely affects crop production and increases the overall cost of establishment. The cost of seed varies significantly from ₹50/kg at the government stores to ₹90/kg at private dealers. Most farmers said they bought seed from private dealers. The cost of seed is estimated at ₹7,560/ha. Uttar Pradesh farmers apply a limited dose of fertilizers at a rate of 60 kg of DAP and zinc sulfate. Some farmers apply farmyard manure before plowing. The overall cost of fertilizer inputs is estimated at ₹2,000–2,300/ha. Farmers normally employ labor to apply fertilizer, which costs ₹1,500/ha, bringing the overall cost for nutrient management to ₹3,500–3,800/ha.

Table 34: Recommended Gram Seed Rate by Size

Seed Size (100 Seed Weight)	Seed Rate (kg/ha)
Small (less than 20 g)	60 kg
Medium (2–30 g)	90 kg
Large (30–40 g)	120 kg
Extra-large (more than 40 g)	150 kg

Source: Directorate of Pulses Development; Bhopal Department of Agriculture, Co-operation & Farmers Welfare; and Government of India, Ministry of Agriculture & Farmers Welfare. <http://dpd.gov.in/English%20%20pamphlet/01Chickpea.PDF>.

Water management: Gram is mostly grown as a rainfed crop; however, if irrigation is available, one irrigation each at sowing and the pod development stage helps increase yields.⁷² Tube wells are the main source of irrigation water in gram-producing areas. The cost of irrigation in dry regions is high and adds significantly to the overall cost of production. The cost of irrigation also varies by region. Based on field data, the average cost of irrigation for gram is estimated at ₹4,800/ha.

Intercultural operations: Gram is a low maintenance crop but, being a dwarf crop, it suffers from weed infestation and requires thinning and weeding. An average weeding and thinning operation costs ₹3,500–3,700/ha.

Plant protection: In general, gram is prone to soil-borne diseases such as Fusarium wilt. For this purpose, *Trichoderma viride* and *Trichoderma harzianum* mixed with farmyard manure is recommended before sowing, which is practiced by some farmers. Pod borers, cutworms, and termites are the major pests affecting crop productivity. The cost of pesticides for diseases and pests is estimated at ₹2,700/ha.

Miscellaneous costs: Some additional expenses of ₹900–1,000/ha were reported. This usually accounts for fluctuations in cost, labor, transportation, and extra commissions.

Harvesting and Postharvest Activities

Harvesting and threshing: Gram is harvested and threshed on farm. These are labor-intensive activities and the cost is estimated at ₹7,800/ha.

Sorting, grading, and packaging: There is a lack of primary processing facilities near farms and markets. Generally, cleaning and grading are done at the market level by commission agents or traders using hired labor.

Storage: Farmers usually store their produce at home as storage is relatively simple. Traders store gram in their shops in the market or at private warehouses. Processing units and mills have their own storage facilities. Farmers and traders seldom use warehouses to store gram.

Transportation: On average, farmers travel 10–15 km to sell their produce at a market. If the market is far away, villagers come together and hire a vehicle to reduce costs. The average cost incurred for transportation, including labor charges for loading and unloading, is estimated at ₹600/MT. Hence, the total cost of transportation is ₹810/MT, calculated for an average yield of 1.35 MT/ha as observed in the surveyed area.

Procurement and grading: The quality of the produce, presence of foreign matter, and moisture content affect the market price. Gram can be graded on the basis of multiple parameters (e.g., AGMARK [quality certification mark by the Directorate of Marketing and Inspection], National Agricultural Cooperative Marketing Federation of India Ltd. [NAFED] standards, NCDEX specifications). Although these standards are in place, in most markets there is no standard provision or facility for assessing the quality of the produce.

Sales and marketing in major markets: A comparative analysis of the major markets within and outside Uttar Pradesh was conducted on the basis of market arrivals and price data for 2018 (January–December 2018). The major markets for gram traded within the state are Lalitpur, Orai (Jalaun), Gorakhpur, Kanpur (Grain), and Varanasi (Grain). Other leading gram-producing districts in the state are Lalitpur, Jalaun, and Kanpur. Thus, arrivals in these markets are primary arrivals. Gorakhpur and Varanasi markets record secondary arrivals from the major gram-producing regions of Uttar Pradesh. This was corroborated during interactions with market actors during field visits.

⁷² Directorate of Pulses 2018. Development. *Pulses in India: Retrospect and Prospects*. <http://dpd.gov.in/Retrospect%20and%20Prospects/Pulses%20in%20India%20Retrospect%20&%20Prospects%202018.pdf>.

A significant quantity of produce is dispatched to markets outside the state, in particular to Madhya Pradesh, which is a major gram producer. The markets in Madhya Pradesh charge lower taxes compared with Uttar Pradesh. Major markets for gram outside Uttar Pradesh include Vidisha (Ganjbashoda) in Madhya Pradesh, Latur (in Maharashtra), Pali (in Rajasthan), Surat (Vyra) in Gujarat, and Gadag (Karnataka).

Market prices: Based on an analysis of the mean of the daily modal prices, both Gorakhpur and Varanasi market, which record secondary arrivals, offer the best price realization for gram among the major markets within Uttar Pradesh. However, the price realization is better in major markets outside the state (Table 35).

Secondary and tertiary processing of gram: According to FSSAI data, there are 343 licensed gram processing units operating in Uttar Pradesh with a combined capacity of 300 MT/day.⁷³ Of these units, 287 are state-licensed and 56 are centrally licensed.⁷⁴ Only 12% (41 units) manufacture gram-only products and the remaining 88% (302 units) are engaged in manufacturing various products in addition to gram (Table 35, Case 9).

Table 35: Comparative Analysis of Market Arrivals and Mean of Daily Modal Price of Gram, January to December 2018

Location	Major Market	Arrivals (MT)	Mean of Daily Modal Prices (₹/quintal)
Within Uttar Pradesh	Lalitpur	41,714	3,629
	Orai, Jalaun	23,152	3,704
	Gorakhpur	20,117	4,808
	Kanpur (Grain)	18,035	3,915
	Varanasi (Grain)	17,426	4,892
Outside Uttar Pradesh	Vidisha (Ganjbashoda)	632,870	3,524
	Latur, Maharashtra	143,024	3,703
	Pali, Rajasthan	121,250	4,195
	Surat, Gujarat	82,024	3,816
	Gadag, Karnataka	50,722	3,846

Source: AGMARKNET and NHB.

Farm-Level Economics of Gram Cultivation and Marketing

Based on the overall analysis, the cost of gram cultivation is estimated at ₹31,380/ha. Farmers bear the cost of harvesting, threshing, and transportation to a nearby APMC market. The reported average yield in the surveyed area is 1.35 MT/ha and a market price of 1 quintal of gram is taken as ₹4,270/quintal. The trader or commission agent discounts roughly 4% of the produce as waste or foreign material while weighing and inspection. Therefore, the effective price realization of farmers is ₹55,350/ha, for a net profit earned by the farmer of 14,415/ha (Table 36).

⁷³ For capacity calculations, the following assumptions were made for state licensees' average capacity: 2 MT and for central licensees' average capacity: 8 MT; 20% capacity is used for gram and other product units.

⁷⁴ According to FSSAI classifications, state licensees are those with a capacity of 100 kg to 2 MT/day, whereas central licensees have capacities above 2 MT/day.

Case 9: An Economic Analysis of Chickpea and Its Value-Added Products in an Agro-Export Zone for Pulses in Madhya Pradesh

A study was conducted in Vidisha and Narsinghpur Districts of Madhya Pradesh. The farmers in these districts primarily grow chickpeas and other gram. Information was collected from a sample of 120 farmers from each district. The study indicated that some farmers were engaged in value addition activities, which include preparation of dhal, namkeen (savory snacks), roasted grain, and chickpea flour. Preparation of dhal is the most economically viable activity, yielding a return of ₹9.08 on an investment of ₹1.00.

Other value-added activities are also yielding good returns. An additional investment of ₹1 each for preparation of namkeen, roasted dhal, and sweet dhal gives an estimated return of ₹7.39, ₹7.60, and ₹7.20, respectively. The study also highlighted the fluctuation in yield, high yield gap, and lack of quality inputs including seed as the main constraints affecting the profitability of chickpea production in the area.

Source: Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Agro-Economic Research Centre 2009. *An Economic Analysis of Chickpea and Its Value-Added Products in an Agro-Export Zone for Pulses of Madhya Pradesh and Chhattisgarh*. <http://jnkvv.org/PDF/AERC/Study-97.pdf>.

Table 36: Estimated Cost for Cultivation and Marketing of Gram Produce at Farmer Level

	Cost Details	Unit Cost (₹)	Frequency	Value (₹/ha)
1	Cost for land preparation	6,900/ha	1 time	6,900
2	Cost of sowing	2,100/ha	1 time	2,100
3	Cost of planting materials	50–90/kg	100–150 kg/ha	7,560
4	Application of fertilizer inputs (including labor)	3,720/ha	1 time	3,720
5	Irrigation charges	2,400 per irrigation	2 times	4,800
6	Cost of weeding	3,500–3,700/ha	–	3,600
7	Cost of plant protection	2,700/ha	–	2,700
8	Total cost of gram cultivation			31,380
	Average yield per ha		13.5 Q/ha	
	Cost of cultivation per quintal			2,324
9	Cost of harvesting and threshing	–	–	7,800
	Cost of harvesting and threshing per quintal			57.82
10	Cost of transportation to market	600 per 1 MT	13.5 Q/ha	810
	Cost of transportation per quintal			60
11	Miscellaneous expenses	70 per Q	13.5 Q/ha	945
	Miscellaneous expenses per quintal			70
12	Total income @ average price realized by farmer of 4,100/Q		13.5 Q/ha	55,350
13	Net profit earned by farmers (per ha)			14,415
	Farmer's profit margin per quintal			1,068

Source: Based on data and information collected during the field survey.

Summary of Price Buildup

The value chain of 1 quintal of gram when sold as raw chana (chickpeas) indicating the various activities and cost buildup has been mapped in Figure 41.

Because 4% of 1 quintal of produce sold is discounted while grading, weighing, and inspection, the effective price at which the farmer sells to a commission agent or trader when the market price is ₹4,270/quintal is ₹4,100, making the profit on 1 quintal of gram ₹1,068, which is nearly 33% of the production cost. This 1 quintal for which a farmer is paid ₹4,100, increases to ₹5,941 when it reaches the consumer, an increase of 45%. The trader's margin in the overall value chain is low (₹45/quintal) whereas wholesalers enjoy a high margin of ₹400/quintal. Approximately 10%–12% losses are reported in the value chain from traders to retailers.⁷⁵ In Uttar Pradesh, large volume traders usually do the processing, thus eliminating intermediary traders and other agents and increasing their margin per quintal.

Another common value chain in gram is when the produce is processed in a mill to manufacture chana (chickpea) dhal. The cost of procurement of 100 kg of raw gram for the mill is estimated to be ₹4,344, which includes market tax and cess, grading, and cost of transportation. The other costs borne by the mill are operational costs including processing, packaging, labor, and other staff, and there are overhead costs, which include marketing and distribution. The cost and margins at different levels after processing are given in Table 37.

⁷⁵ Damaged produce, foreign material, processing loss, storage loss, items expired.

Table 37: Cost to Consumer and Margins at Different Level of Gram Processing

Cost Details	Dhal	Feed	Chunni
Cost to wholesaler (₹/quintal)	5,700	2,100	1,800
Secondary transportation costs (₹/quintal)	70	35	35
Wholesaler's cost and waste (₹/quintal)	231	43	37
Wholesaler's margin (₹/quintal)	600	174	94
Cost to retailer (₹/quintal)	6,601	2,352	1,965
Retailer's waste (₹/quintal)	132	24	20
Retailer's margin (₹/quintal)	269	95	79
Consumer's cost per quintal (₹/quintal)	7,002	2,470	2,064

Source: Calculations based on Deloitte India field data.

The mill generates three products: dhal, animal feed, and chunni (a cheaper animal feed). The miller sells dhal to a wholesaler at around ₹57/kg but when it reaches the consumer it costs ₹70/kg. In this process, the millers' margins are low at ₹75/quintal (less than 2%). Within the value chain it is usually the wholesalers who enjoy the best margins (Box 4).

Box 4: Feedback from Farmers, Millers, Traders, and Mandi Officers

Judicious use of fertilizers, maintaining the recommended distancing, critical irrigation, nipping, and quality seed can improve yields.

Focusing on controlling production costs and productivity can improve farmers' incomes.

Farmers usually bring un-cleaned and nongraded produce to market so traders and commission agents discount 4% of the weight when purchasing. This reduces the farmers' price realization.

Farmers are regularly forced to sell gram below the minimum support price (MSP). The procurement of gram and other pulses at the MSP is frequently delayed in Uttar Pradesh. Farmers reported delays in payments for their produce if they sold at the MSP to government agencies.

In some markets such as Rath, where it is compulsory to clean and grade produce before an auction, farmers take the leftovers to use as feed. This practice helps farmers get a better price.

Inadequate facilities for soil health cards and limited understanding of good agricultural practices affect productivity.

Source: Field interviews with farmers, millers, traders, and mandi officers.

Farmers tend to reuse seed from previous crops to save costs, but this affects productivity and makes the crop more susceptible to diseases.

The lack of adequate storage facilities in markets, high market fees and taxes, limited staff, and lack of trained staff for assaying and sampling as well as frequent power cuts were highlighted as key constraints.

Some FPOs in the region are involved in supplying inputs and seeds to farmers. The price realization for selling certified seed is ₹10–₹15/kg. Some farmers are selling gram in distant markets and getting ₹6–₹7/kg.

Dhal processing can provide higher benefits to farmers if they do it themselves. Bamuar FPO in Jhansi experimented with dhal processing and was able to get an additional margin of ₹8–₹10/kg by selling it in the local market.

Source: Stakeholder interviews.

D. Gaps in Gram Value Chain

Production Gaps

Seed input application: Most farmers use a seed rate of more than 100 kg/ha, which is higher than the recommended rate of 50–90/kg/ha for small and medium seed weights. Some farmers were observed to be regularly using seed saved from previous crops. This adversely affects crop productivity and makes the crop prone to diseases.

Fertilizer input application: Fertilizer requirements depend on the nutrient status of the field and thus doses should be based on the results of regular soil testing. The generally recommended doses for gram include 15–20 kg nitrogen (N) and 50–60 kg phosphorus (P) per ha.⁷⁶ Farmers in the surveyed area were observed to be applying the equivalent of 10 kg of N and 30 kg of P. There is limited focus among farmers on the application of micronutrients like zinc, molybdenum, iron, sulfur, and boron, which is critical for gram crops, and a lack of awareness among farmers about soil testing facilities. Farmers generally have limited accessibility to KVKs and limited access to extension officers.

Intercultural operations: Weeding is not done in time. Nipping is done casually, which affects plant growth.

Irrigation: Irrigation is mostly done with water from tube wells, especially in the Bundelkhand region, which increases the overall cost of cultivation. Micro-irrigation techniques are mostly not used but would help save costs and water resources.

Plant protection: Farmers lack awareness about new varieties being developed by research institutes and agriculture universities or are constrained by their limited availability. Farmers also expressed concerns about the limited availability of bio-fungicides such as *Trichoderma* spp., which is known to effectively control wilt.

Harvesting: Harvesting is recommended when the leaves begin to fall, the stems and pods turn brown or straw colored, and seeds are hard and rattle, indicating approximately 15% moisture. Farmers were observed to be practicing early harvesting, thus affecting moisture level and quality.

Postharvest Management Gaps

Primary processing: It was observed that most farmers do not grade their produce and end up getting a lower price owing to discounted rates from traders.

Market infrastructure: There is a lack of enabling infrastructure in major markets for gram such as equipment for cleaning and grading, calibrated weigh scales and measurements, and facilities for quality assaying and storage. A lack of adequate personnel in these markets slows the overall trading process.

Secondary processing: The processors interviewed during the survey said that frequent power cuts disrupted production operations and increased dependency on diesel generators, which adds significantly to the milling cost.

⁷⁶ MoAFW, Directorate of Pulse Development. <http://dpd.dacnet.nic.in/Chickpea.pdf>.

Marketing Gaps

Linking FPOs: The predominance of small and marginal holdings results in smaller absolute volumes of sales, thus lowering bargaining power and limiting marketing opportunities. There are a few active FPOs in the state engaged in marketing gram through owned-retail outlets in some markets. These FPOs and new ones should be supported through capacity-building programs to impart technical expertise and managerial skills to their members and to enable them to take up primary processing, packaging, possible secondary processing, and other value addition activities. Support can also be provided to farmer groups and FPOs to participate in buyer–seller meetings in distant markets to help them network with potential buyers and develop new market links outside the state.

Price-related: The modal price analysis of gram in the two major markets of Uttar Pradesh⁷⁷ (Lalitpur and Kanpur) reveals that, while there have been some monthly fluctuations in price, overall gram prices have not increased much in the past 3 years (2016–2017, 2017–2018, 2018–2019). There was a surge in prices in November and December 2016. To control this, the government increased gram imports during it and prices declined by March 2017. In the subsequent period, gram production has been steadily increasing across the country and imports have been reduced by 15% to keep a check on prices. The price of gram has been mostly steady over the past few years. While such trade moves have been an advantage for consumers, it has been of little benefit to the grower community as the cost of cultivation at farm level continues to increase each year. Whereas the MSP for gram has increased, the market prices of gram in Uttar Pradesh remain below MSP levels owing to delayed procurement at the MSP in the state. Hence, the government can help price realization for farmers by ensuring timely procurement of gram at the MSP. To increase the profitability of gram cultivation further, the focus at farmer level should be on reducing the cost of cultivation through GAP and improving productivity (Figure 42).

Mandi cess (tax): Many actors in the value chain, including commission agents, traders, and millers, expressed concerns about the mandi cess of 2.5% in Uttar Pradesh, which is higher than in neighboring states (1% in Rajasthan, 1.5% in Madhya Pradesh, and 1% in Haryana; Appendix 8). The interviews were conducted between 2019 and early 2020.

⁷⁷ MoAFW, AGMARKNET.

Access to Credit Services

High cost of finance: Farmers face difficulties obtaining credit from formal sources for cultivation. They tend to depend on informal sources of financing such as local money lenders, who charge a much higher interest rate. Sometimes, farmers approach commission agents and traders in the local APMC markets for advances and become bound to sell their produce only through those intermediaries.

Other Factors

Late procurement and payment from NAFED: Gram is covered under the MSP scheme of the Government of India. NAFED is the agency that buys from farmers at the MSP. Interactions with gram farmers revealed that the procurement operations of NAFED in Uttar Pradesh generally start late, forcing farmers to sell their crop at a loss. For instance, for the 2018–2019 cropping season, NAFED procurement was initiated toward the end of May 2019. By then, most farmers had sold their produce at prices between ₹3,900 and ₹4,350 per quintal, compared with the recommended MSP of ₹4,620/quintal, rendering the MSP mechanism ineffective. Most smallholder and marginal growers lack holding capacity and adequate storage arrangements to wait for market prices to go up.

Reluctance to direct benefit transfer (DBT): Farmers often have significant debt. When a payment is transferred directly into their account under DBT, the bank immediately credits that amount toward the settlement of any outstanding debt. This usually happens when an account is a nonperforming asset. Farmers who have nonperforming assets and debts with the bank prefer to take cash for their produce to fulfill their immediate needs, even if the rate they are getting is lower.

Crop insurance: The Government of India has been trying to cover farmers under the Pradhan Mantri Fasal Bima Yojana insurance scheme; however, reluctance was noted among farmers as a result of past experiences of delayed or nonpayment of claims and the scheme requirement for farmers to pay a premium. While the scheme has its limitations and operational issues, it is an important safeguard for farmers from the risk of repeated instances of drought and disease in key production clusters of Uttar Pradesh. There is limited awareness of crop insurance and its benefits among farmers and it is important to promote the scheme.

E. Market Assessment

Gram Product Map

Most gram produced globally is consumed in grain form (dried and shelled); a minor portion is processed as flour, fortification additives, or feedstuff for livestock. Figure 43 depicts the various forms in which gram is traded globally.

Import–Export Trade Analysis Global Scenario

Exports of Gram in Form of Dried-Shelled Grain

According to estimates by UN Comtrade, the global gram trade in 2019 was 1.2 million MT. This comprised 99% of the total exports of gram in the form of dried-shelled grain and the remaining 1% as flour.⁷⁸

As illustrated in Figure 44, global exports for gram significantly declined from 3.17 million MT in 2017 to 2.01 million MT in 2019. This may have owed to a drastic reduction in exports from Australia as a result of a severe drought that curtailed chickpea and other pulse crop production.

Australia's export share of the world trade in gram fell from 60% in 2017 to 21% in 2019. The Russian Federation has emerged as the leading producer, with 23% of the total gram export trade. The other leading exporter countries are the US (8%), Canada (6%), Turkey (6%), India (6%), and Mexico (6%).

Imports of Gram and Gram Products

Pakistan (21%) is the leading importer of chickpeas, followed by India (20%) and Bangladesh (12%). Other importer countries include the UAE (5%), Algeria (4%), Saudi Arabia (3%), Spain (3%), and the UK (3%). Together these countries account 70% of world exports of gram.

⁷⁸ UN Comtrade and ITC statistics.

India has been a major gram-importing country; however, gram imports significantly declined from 1.5 million MT in 2017 to 0.3 million MT in 2019 as a result of import quotas set by the Government of India.

Import–Export Trade Analysis India Scenario

Exports of Gram and Gram Products from India

According to APEDA export statistics, the total export volume of gram from India in 2018–2019 was 228,700 MT estimated at \$206 million (Table 38).⁷⁹

The value of gram exported from India showed a fluctuating trend from 2015 to 2018. Gram contributes the single largest share to India's export basket of pulses, registering a 63.73% and 70.92% share in total pulse exports during 2017 and 2018, respectively.⁸⁰

The major destination markets for India's gram exports are Algeria (19%), the UAE (11%), Sri Lanka (9%), Turkey (6%), Morocco (5%), Saudi Arabia (4%), Pakistan (4%), Egypt (4%), Iran (4%), and Iraq (3%).

Table 38: Trend in Share of Gram Product Exports from India, 2014–2015 and 2018–2019

HS Code	Product	2014–2015		2016–2017		2018–2019	
		MT	\$ million	MT	\$ million	MT	\$ million
7132010	Kabuli chana					130,493	123
7132090	Other chickpeas	190,226	168	87,509	126	55,493	51
7132020	Bengal gram (desi chana)					42,715	32
Total		190,226	168	87,509	126	228,700	206

Source: APEDA. AgriExchange.

Gram Imports

India is a major importer of gram. In 2017–2018, gram imports comprised almost 17% of total pulse imports⁸¹; however, the volume of gram imports in 2018–2019 declined to a meager 21,035 MT and a share of 7.3% in total pulse imports (Table 39).

Chickpea imports remain free of restrictions, however, the slump in imports during the period may be attributed to the revision of import tariffs imposed by the government to manage domestic oversupplies and boost prices. In December 2017, the Ministry of Finance announced a 30% tariff on import of desi chana, which was further raised to 40% in February 2018 and to 60% in March 2018.

⁷⁹ Government of India, APEDA. AgriExchange Export Statistics for Export of gram-based products from India including HS Code 071320 (Dried, shelled chickpeas "garbanzos," whether or not skinned or split); 7132010 (Kabuli chana); 7132090 (Other chickpeas); 7132020 (Bengal gram/desi chana).

⁸⁰ Government of India, Directorate General of Commercial Intelligence and Statistics.

⁸¹ MoAFW. 2019. Commodity Profile for Pulses. September. <http://agricoop.gov.in/sites/default/files/Pulses%20profile%20for%20the%20month%20of%20September%2C%202019%20%28Updated%20as%20on%2024.09.2019%29.pdf>.

Table 39: Trend in Share of Gram Product Imports in India, 2014–2015 and 2018–2019

HS Code	Product	2014–2015		2016–2017		2018–2019	
		MT	\$ million	MT	\$ million	MT	\$ million
7132010	Kabuli chana					13,961	87
7132090	Other chickpeas	412,899	214	1,080,633	907	7,074	23
7132020	Bengal gram (desi chana)					0	0.5
Total		412,899	214	1,080,633	907	21,035	110

Source: APEDA, AgriExchange.

Share of Uttar Pradesh in India's Trade of Gram and Gram Products

The state's share in India's export of chickpeas remains low (less than 0.3%). Maharashtra (60%) and Gujarat (32%) are the largest exporters of gram. Other exporting states include Madhya Pradesh (2.4%), West Bengal (3%), Tamil Nadu (1%), and Bihar (1%) (Figure 45).

Gram exports from Uttar Pradesh are limited to Nepal and the US. Minor quantities are exported to the UAE and other countries (Table 40).

Figure 45: State Export of Gram from India, 2018–2019

Source: APEDA, AgriExchange

Table 40: Desi Gram Exports by State, 2018–2019

State	MT	\$ million	Major Destination Markets
Maharashtra	26,074.52	19.95	UK (25%), UAE (17%), Qatar (11%), Canada (10%), Sri Lanka (7%), Bangladesh (5%), Turkey (3%), Malaysia (3%), US (3%), Mauritius (3%), Saudi Arabia (3%)
Gujarat	8,095.12	5.89	UAE (37%), US (18%), Bangladesh (21%), Qatar (10%), Algeria (6%)
West Bengal	26,19.80	1.75	Nepal (99%), Bangladesh (0.5%), US (0.5%)
Bihar	21,04.00	1.38	Nepal (100%)
Tamil Nadu	12,43.81	1.07	Sri Lanka (47%), Singapore (19%), UAE (16%), Malaysia (6%), France (3%), UK (3%), Fiji (1%)
Madhya Pradesh	1,046.35	0.80	US (34%), UK (24%), Canada (22%), France (8%), Singapore (6%), Japan (3%)
Uttar Pradesh	377.29	0.32	Nepal (75%), US (17%), UAE (1%)
Rajasthan	156.01	0.20	US (34%), UK (29%), Singapore (15%), Australia (11%), Gabon (4%), Canada (4%), Philippines (2%), Malaysia (1%)

Source: APEDA, AgriExchange.

Requirements According to Recommended Dietary Allowance

Currently, an estimated 9.93 million MT of gram is available for consumption in the country (per capita availability of 22 g/day). The RDA is 31 g/day.⁸² It is estimated that the requirements for gram will grow to 16.8 million MT in 2024 (Table 41).

Table 41: Demand Estimation for Gram

Factors	Amount
Production of gram (2017–2018)	9.08 million MT
Adjusting gram exports (2017–2018)	0.13 million MT
Gram imports (2017–2018)	0.98 million MT
Total gram available for consumption (2017–2018)	9.93 million MT
Current population	1.21 billion
Current per capita availability	22 g/day
Recommended per capita consumption of grams	31 g/day
Estimated population in 2024	1.39 billion
Estimated requirement of gram in 2024	14 million MT
Factoring for losses, seeds @ 20%	2.8 million MT
Total requirement for gram in 2024	16.8 million MT

Source: Estimates calculated on RDA requirements.

In the case of Uttar Pradesh, the current production of gram is 0.58 million MT against an RDA requirement of 2.41 million MT. Thus, production may not be sufficient to meet consumption and Uttar Pradesh relies on imported gram from Madhya Pradesh and Rajasthan to meet its domestic requirements.

⁸² According to Indian Council of Medical Research, National Institute of Nutrition, the RDA for pulses is 90 g/day. In the current consumption of pulses in the country, gram accounts for 35% of total pulses consumed. Therefore, the RDA for gram is calculated to be 31 g/day (35% of 90 g/day).

F. Potential for Interventions

Based on the gaps identified in the gram value chain, potential interventions and envisaged benefits (Figure 46) are outlined as follows.

Institutional Development

- Encourage farmers to adopt proven best practices for cultivation such as mulching and drip irrigation.
- Conduct training and capacity-building for farmers on postharvest management of produce, including encouraging them to adopt modern sorting, grading, and cleaning practices and increasing farmer awareness on quality and standards.
- Promote and strengthen farmer collectives to enable them to undertake aggregated sales and marketing and dissemination of advanced technologies among members.
- Expose farmers to other trading platforms such as eNAM and encourage them to use web-based applications such as agriculture market information systems for real-time market intelligence, especially grade-specific pricing and transparent price discovery.

Infrastructure Support

- The quality of produce sold by farmers is considered low as a result of factors such as lack of uniformity in grain size, percentage of moisture, and presence of impurities. Thus, investment in facilities for sorting and grading to ensure market standards would lead to an increase in price realization for farmers.
- Create dry storage infrastructure to cater to the requirements of smallholder farmers for storage of their produce.
- Storage losses account for 5%–10% of postharvest losses.⁸³ Given this trend, investment in appropriate storage structures both on farm and in the market would reduce postharvest losses and improve output quality.
- Except for processing into dhal, gram processing in the organized sector in the state is not yet strong. This presents an opportunity for farmer collectives and investors to venture into gram processing as a value addition initiative. Assistance is recommended to help set up small-scale processing units to support product diversification through value addition.

⁸³ IIPR. 2007. *Technical Bulletin on Postharvest Management of Pulses*. <https://iipr.icar.gov.in/pdf/postbulletins2may13.pdf>.

Figure 46: Envisaged Benefits of Potential Infrastructure in the Gram Value Chain

Source: Deloitte India field data. 2020.

VI. Focus Crop—Mustard

A. Market Overview

Global Production of Rapeseed-Mustard

Rapeseed-mustard (RM) is a group of crops comprising rapeseed (toria, brown sarson, and yellow sarson) that are cultivars of *Brassica campestris* or *Brassica rapa* and Indian mustard (*Brassica juncea*), black mustard (*Brassica nigra*), and taramira (*Eruca sativa*). Rapeseed and mustard are widely grown across the world, with Canada leading in terms of area under cultivation (8 million ha), followed by the PRC (7 million ha) and India (6.8 million ha). Most of these countries grow rapeseed; India has the largest area under mustard cultivation.⁸⁴

Indian Production of Rapeseed-Mustard

India is one of the largest producers of oilseeds in the world. Among the nine oilseed crops grown in the country, seven are edible oilseeds (soybeans, groundnuts, RM, sunflower, sesame, safflower, and niger) and two nonedible oils (castor and linseed). The share of RM makes up 24% of the total area under oilseed cultivation and a major share (5%) of total oil production from primary sources of vegetable oils.⁸⁵ RM seeds are processed into mustard oil and oilcake and the seeds are used as a spice and seasoning in Indian cuisine.

In 2017–2018, production of RM in India was 8.32 million MT, from an area of 5.96 million ha.⁸⁶ Globally, India accounts for 10% of the total area under RM cultivation. Within India, Rajasthan is the leading producer, accounting for 40.8% of production (3.4 million MT) and 36% of the area under cultivation (2.18 million ha). Other producer states are Haryana (13.3%), Madhya Pradesh (11.7%), Uttar Pradesh (11.3%), and West Bengal (8.7%). Collectively, these states account for 80% of the total domestic production and area under mustard cultivation (Figure 47).

⁸⁴ National Mission on Oilseeds and Oil Palm. 2017. *Status Paper on Rapeseed and Mustard*. http://nmoop.gov.in/Publication/StatusPaper_RandM_2017.pdf.

⁸⁵ In addition to nine oilseeds, 3 million MT of vegetable oil is being produced from secondary sources like cottonseed, rice bran, coconut tree-borne oilseeds, and oil palm.

⁸⁶ DAC&FW, Directorate of Economics and Statistics. 2018. *Agricultural Statistics at a Glance*. <http://agricoop.gov.in/sites/default/files/agristatglance2018.pdf>.

Figure 47: State Productivity of Mustard in India, 2017–2018

Source: Government of India. 2018. Agricultural Statistics at a Glance.

B. Rapeseed–Mustard Production in Uttar Pradesh

Area and Production of Mustard

Uttar Pradesh is the fourth-largest producer of RM in the country, accounting for 11% of the total area and production. Within the state, RM accounts for 83% of total production and 70% of the total area under oilseed crops. In 2017–2018, production of RM was estimated at 0.95 million MT from an area of 0.68 million ha. However, the state lags in productivity compared with other producer states. Front-line demonstrations conducted by ICAR have shown that an average productivity of 1.94 MT/ha is achievable, indicating significant scope for improvement, but efforts are needed to bridge this yield gap of almost 73%.

Mustard Production Regions

The major production clusters for mustard in Uttar Pradesh are the adjoining districts of Agra, Mathura, and Aligarh, which collectively account for approximately 25% of state production. Other production clusters are Badaun (6%), Kanpur Dehat (4%), Etawah (3%), Bareilly (3%), Sitapur (3%), Kheri (3%), Kasganj (3%), and Etah (3%), as shown in Table 42.

Table 42: District and Agro-Climatic Area and Production of Mustard in Uttar Pradesh, 2017–2018

District	Agro-Climatic Zone	Area		Production MT		Productivity ₹/ha
		₹/ha	% of State Total	₹/MT	% of State Total	
Agra	Western subtropical	53,836	8	113,912	12	2.1
Mathura	Western subtropical	45,267	7	88,769	9	2.0
Badaun	Mid-western plain	36,387	5	59,112	6	1.6
Aligarh	Western subtropical	24,014	4	39,410	4	1.6
Kanpur Dehat	Mid-plains	23,273	3	39,257	4	1.7

Continued on next page

Table 42: *continued*

District	Agro-Climatic Zone	Area		Production MT		Productivity ₹/ha
		₹/ha	% of State Total	₹/MT	% of State Total	
Etawah	Mid-plains	15,336	2	29,410	3	1.9
Bareilly	Mid-plains	15,509	2	27,605	3	1.8
Sitapur	Mid-plains	26,634	4	25,242	3	0.9
Kheri	Bhabhar terai	27,064	4	25,039	3	0.9
Kasganj	Western subtropical	11,739	2	24,781	3	2.1
Etah	Western subtropical	12,327	2	24,150	3	2.0
Auraiya	Northeastern plain	14,635	2	23,378	2	1.6
Firozabad	Western subtropical	12,563	2	21,433	2	1.7
Kannauj	Mid-plains	9,874	1	21,195	2	2.1
Unnao	Mid-plains	17,256	3	18,937	2	1.1
Fatehpur	Central plain	15,170	2	18,692	2	1.2
Jalaun	Bundelkhand	15,568	2	18,043	2	1.2
Shahjahanpur	Mid-plains	14,441	2	17,734	2	1.2
Hathras	Western subtropical	10,841	2	17,011	2	1.6

Source: Government of Uttar Pradesh, Department of Agriculture.

RM crops are low resource-intensive dryland crops and preferred by farmers in regions with low water availability or rainfed cultivation systems. In such regions, mustard is usually grown as a single crop during the rabi season (October–March). In the mid-western zones, RM is mostly grown as an intercrop with guava in Badaun. In the eastern regions of Uttar Pradesh, a short-duration RM crop such as toria (*Brassica rapa* var toria) is sown as a catch-crop between the kharif (July–October) and rabi seasons to earn additional income. In some regions (e.g., Agra and Mathura), mustard is also cultivated under irrigated conditions.

Major Varieties Cultivated

RM crops in Uttar Pradesh broadly comprise (i) *Brassica juncea* (Indian mustard), known locally as rai or laha; (ii) *Brassica rapa* L. var. toria (Indian toria or rapeseed), known locally as lahi or toria; (iii) *Brassica rapa* L. var. or brown sarson, known locally as Bhuri sarson; (iv) *Brassica rapa* L. var. or yellow sarson, known locally as Pilli sarson; and (v) *Brassica Napus* L. (Gobhi sarson). The preferred RM varieties are Varuna, Rohini, Krishna, Kranti, Pusa Bold, and Pioneer 45S46, 45S42, 45S35 (supplied by private seed companies). The Varuna and Kranti varieties are mostly grown in unirrigated conditions, while Krishna, Pusa Bold, and Pioneer require irrigation. Pioneer 45S46 is reportedly the most widely cultivated variety in Uttar Pradesh.

Seasonality

RM is generally sown between September and November and harvested between February and April. An early sowing between the last week of September and the second week of October is recommended for higher productivity and to prevent aphid attacks. However, under rainfed conditions, sowing may be delayed if the temperature rises

above 32°C.⁸⁷ The recommended period of sowing for shorter duration RMs such as toria is the last week of August to the first fortnight of September (Figure 48).

Figure 48: Mustard Sowing and Harvesting Season in Uttar Pradesh												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Uttar Pradesh		Harvesting								Sowing		

Source: Deloitte India field data. 2020.

RM crops usually take 5–6 months to mature, although a few early sowing varieties can mature in 4 months. The period of maturity also depends on the temperature. In moist and cold conditions, mustard takes more time to mature. The typical period of maturity for different RM crops is shown in Table 43.

Table 43: Mustard Crop Duration

Crop	Days
Toria	70–100
Indian mustard	105–160
Yellow sarson	120–155
Brown sarson	100–235
Taramira	140–150

Source: AGMARKNET.

C. Value Chain Analysis

Major Actors in the Mustard Value Chain in Uttar Pradesh

The actors operating along the mustard value chain are described next.

Input suppliers: Fertilizer inputs are generally purchased from IFFCO outlets and private retailers. Seed is procured through authorized dealers of private seed brands and through Uttar Pradesh seed cooperative stores and district sales centers. Some farmers save some produce for seed for the next season.

Growers: Mustard farmers undertake crop cultivation in the rabi season (October–March). The average area of mustard cultivation ranges from 1.2 to 1.6 ha per farmer.⁸⁸ The main operations carried out by farmers include land preparation, sowing, irrigation, weeding, application of manure and fertilizers, thinning, and disease and insect pest management. Once the crop is ripe, the farmer does the harvesting, threshing, and cleaning at farm level. Farmers sell the bulk of the produce at APMC mandis to commission agents or traders.

Commission agents and traders: Licensed commission agents and traders generally operate from an APMC market and buy produce from farmers. The produce is cleaned and graded by the commission agent or trader before sale to millers (through brokers) or to wholesalers in other states and distant markets. The cost associated

⁸⁷ P. Sharma, H. Sharma, and P. Rai. 2018. Strategies and Technologies for Enhancing Rapeseed–Mustard Production. *Indian Farming*. 68 (01). pp. 44–48. <https://icar.org.in/sites/default/files/Strategies%20and%20technologies.pdf>.

⁸⁸ This represents a small percentage of smallholder farmers.

is borne by the agent or trader and includes the market cess (tax), the GST, and labor, transportation and brokerage charges.

Secondary processors: This includes small-, medium-, and large-scale milling units engaged in processing mustard seed for oil and production of oilcake as a by-product. There are some solvent extraction units that further process mustard oilcake for the production of de-oiled cakes, which are used as animal feed. These units mostly buy from traders through brokers based on criteria such as oil percentage, moisture content, foreign matter, and erucic acid value (Table 44).⁸⁹

Table 44: Agents and Activities in the Mustard Value Chain in Uttar Pradesh

Activity	Agent	Output
Input supply	IFFCO, private vendors, societies, cooperatives, Uttar Pradesh and Terai Development Cooperation	Seed, fertilizers and micronutrients, pesticides, farm machinery
Training and subsidy	KVKs, Agriculture University, private seed brands, state departments for agriculture and extension services, ICAR Directorate of Rapeseed-Mustard Research (Bharatpur, Uttar Pradesh)	Training on cultivation and use of hybrid seeds, subsidies on input supply (machinery, chemicals, planting material)
Production	Farmers	Mustard seeds
Postharvest management, transportation and sale	Farmers, hired laborers Transport service providers, state marketing board, private seed testing labs, commission agents, traders	Harvesting, threshing, cleaning, packing mustard seeds Logistics assistance, trade facilitation, determination of oil percentage and quality, cleaning, packing, marketing produce
Secondary processing	Expellers and millers	Mustard oil and oilcakes, packaging, branding and marketing, exports
Wholesale and retail distribution	Wholesalers, commission agents, retailers	Distribution and retail marketing of oil and oil seed cake within the state and to distant markets

Source: Deloitte India field data. 2020.

Commodity Flow Analysis

Based on stakeholder interactions, four marketing channels have been identified as illustrated in Figure 49.

⁸⁹ Erucic acid is known to cause the following health risks: accumulation of triglycerides in the heart; development of fibrotic lesions of the heart; increases in the risk of lung cancer; and anemia.

Figure 49: Trade Channels for Marketing of Mustard in Uttar Pradesh

Channel 1: Marketing through commission agents and traders to nearby large processors. About 60%–70% of RM farmers sell their produce to commission agents or traders in nearby APMC markets, who in turn grade and pack the produce and sell to nearby large oil processing units through brokers. Traders prefer to sell to nearby units as it saves transportation costs and assures more timely payment. Each oil processing unit has its own set of procurement standards, which are known to the supplying traders and brokers. For example, for manufacturing export-quality oil, processors prefer seeds with a low erucic acid level.⁹⁰

Channel 2: Marketing through commission agents and traders. Trading in this channel is the same as under Channel 1, except that some traders and commission agents sell the produce to traders in distant markets, who then sell to bigger traders or brokers. Brokers facilitate transactions between oil mills and traders. Some brokers also invest in mustard seed futures. A small share of mustard seeds is sold by traders to wholesalers and retailers for direct marketing to consumers as spices.

⁹⁰ Erucic acid is a naturally occurring compound in vegetable oil. It is not a safety concern for most consumers as average exposure is less than half the safe level. It may be a long-term health risk for children up to 10 years of age who consume high amounts of foods containing this substance.

Channel 3: Marketing to traders-cum-oil producers. In this channel, producers sell directly to large traders who own expellers or small mills.⁹¹ These small mills and expellers are important actors in local markets. In markets where such traders are present, farmers prefer to sell directly to them, as observed in Jagnair and Sonkh markets, where there are multiple oil expellers and small processing units. In these markets, RM seed prices fetched by farmers were higher than in other nearby markets. The expellers then sell oil directly to farmers and retailers. Farmers are also able to purchase oilcakes from expellers at a cheap rate, and they are assured of quality as the oil is processed in their presence and less oil is expelled than by the more efficient large-scale processors. A few wholesalers and distributors from distant and nearby markets also purchase oil from these small-scale processors. The cost of transportation is borne by the distributors, but the expellers are required to pay a commission to the broker for the oil sold.

Channel 4: Marketing through village aggregators. Farmers who are unable to make arrangements for distant transportation of their produce or not able to go to a market sell their produce to a village aggregator. Aggregators purchase produce from farmers at lower rates and then sell to local traders or commission agents. Traders subsequently sell to a processor through a broker, who then sells the processed oil and oilcake to wholesalers and retailers.

Price Buildup Analysis: Production, Marketing Functions, and Activities

Preharvest Activities

Land preparation: Generally, five or six plowings are required to get the right soil texture for planting. However, farmers were observed to be practicing as many as eight plowings and only one tilling operation. This adds to the cost of land preparation, which is estimated at 28% of the total cost of cultivation of mustard. The cost of land preparation including the cost of labor is estimated at ₹9,600/ha. Fewer plowing operations help reduce the cost, improve soil structure, and promote soil conservation, and thus increase productivity per hectare. Deep plowing in summer is recommended to prevent weeds and pest attacks. Maintaining proper spacing also helps prevent white rust and saves costs in thinning and weeding operations.

Seed input and sowing operations: The optimum seed rate for mustard is 4–6 kg/ha; however, the recommended seed rate for hybrid varieties such as Pioneer 45S46 is 2.5 kg/ha. Farmers were observed to be applying the standard seed rate for the hybrids as well, adding to the cost of production as these varieties cost ₹700/kg. Thus, the cost of seed input is estimated to be ₹4,200/ha and the cost of sowing ₹1,200/ha.

Nutrient management: In general, the use of green manures and single super phosphate (SSP) and limited doses of urea are recommended for mustard cultivation. Farmers in Uttar Pradesh, however, rely heavily on high doses of urea and DAP (both are nitrogen products). There is little awareness among farmers about soil health cards and soil testing facilities. Farmers apply 180 kg of urea and 200 kg of DAP per hectare. A few progressive farmers apply sulfur to prevent stunted growth and nutrient deficiency. Sulfur applications help increase oil content. For this reason, the use of SSP instead of DAP is recommended for mustard cultivation, as SSP has 12% sulfur. The overall cost of fertilizer inputs is estimated to be ₹6,540/ha.

Water management: Mustard is mostly grown as a rainfed crop; however, irrigation at the vegetative and pod formation stages is recommended for higher productivity. Irrigation during pod formation is critical. The primary source of irrigation in most areas is water from tube wells, which often has a high salt content that affects the

⁹¹ An expeller press is a screw-type machine that mainly presses oil seeds through a caged barrel-like cavity. The pressed seeds are formed into a hardened cake.

quality of RM seeds and their pungency. Owing to electricity shortages, dependence on diesel pumps is increasing. Farmers who do not have the means to irrigate pay other farmers for water from their tube wells. The cost of irrigation varies significantly, ranging between ₹2,200 and ₹5,000/ha for a single cropping system. In the surveyed area, the cost of irrigation is estimated to be ₹4,400/ha.

Intercultural operations: Mustard is a low maintenance crop. In general, thinning is recommended just before the second irrigation; however, weed growth is aided by excessive use of fertilizers, which increases the expense of weeding and thinning. In the surveyed area, the cost of weeding is estimated to be ₹2,800/ha.

Plant protection: Among the major disease and insect pests affecting RM, farmers reported incidences of mustard aphids and fungal diseases such as white rust. Fungicides such as Apron are used for control. On average, the cost of insecticides and fungicides for RM is estimated to be ₹1,600/ha.

Harvesting and Postharvest Activities

Harvesting, threshing, and cleaning: Farmers use harvesters and threshers and hire labor for on-farm seed cleaning. These are labor-intensive activities and the cost of using machines and labor together contribute significantly to the overall cost of field operations. The total cost is estimated to be ₹7,600/ha. This includes the harvesting cost of ₹3,300/ha and the cost of threshing and cleaning at ₹4,300/ha.

Storage: Farmers and traders seldom use warehouses to store mustard and mostly store their mustard seed at home, whereas traders store it in their shops in the market or in private warehouses. Processor units and mills generally have their own storage facilities.

Miscellaneous activities: Additional expenses of ₹800/ha were reported. These are usually fluctuations in the cost of labor and transportation or extra commissions.

Transportation: On average, farmers travel 10–15 km to sell their produce at a market. If the market is far away, villagers come together and hire a vehicle to reduce costs. The average cost incurred by the farmer for transportation (including labor charges for loading and unloading) is estimated to be ₹825/MT. Hence, the total cost of transportation is ₹1,320/ha, calculated for an average yield of 1.6 MT/ha.

Procurement and grading: Quality of the produce, presence of foreign matter, and moisture content affect the market price of mustard. Mustard can be graded on the basis of multiple criteria (e.g., AGMARK standards, NAFED standards, NCDEX specifications). While these standards are in place, in most markets there are no facilities for assessing quality.

Major market sales (within and outside the state): A comparative analysis of the major markets within and outside Uttar Pradesh was conducted on the basis of market arrivals and price data for the year 2018 (January–December). Within the state, Agra is the top producing district for mustard and reports the highest number of arrivals. Samsabad market in Agra records a substantial volume of secondary arrivals from other districts in Uttar Pradesh and other states such as Rajasthan and Madhya Pradesh, given the presence of a large number of oil mills in the region. Sitapur, Aligarh, Kanpur (for grain), and Kasganj are among the major markets in Uttar Pradesh that trade in mustard. Kanpur is a major market for secondary arrivals of a number of commodities, including mustard. Mathura District accounts for nearly 7% of production in the state and does not have a significant number of market arrivals of mustard seed. A significant quantity of produce is sent to markets outside Uttar Pradesh. Alwar in Rajasthan, which is near Agra and Mathura, is a major market that records the highest number of mustard seed arrivals outside Uttar Pradesh. This may owe to the presence of several oil mills in Alwar and the adjoining Bharatpur region.

Market prices: Based on an analysis of mean of daily modal prices, little price variation is seen in markets within and outside the state except for the Burdwan market in West Bengal, which has a higher price realization because of the greater consumption of mustard oil in the state of West (Table 45).

Table 45: Comparative Analysis of Market Arrivals and Mean of Daily Modal Price of Mustard, January–December 2018

Location	Major Market	Arrivals (in MT)	Mean of Daily Modal Price (₹/quintal)
Within Uttar Pradesh	Agra (Samsabad)	81,042	3,681
	Sitapur	40,612	3,427
	Aligarh	32,907	3,702
	Kanpur (Grain)	24,059	3,700
	Kasganj	20,138	3,595
Outside Uttar Pradesh	Alwar, Rajasthan	76,398	3,780
	Banaskanth	47,595	3,601
	Bhiwani (Jui)	21,151	3,947
	Bhind (Mehgaon)	14,053	3,580
	Burdwan, West Bengal	9,934	4,217

Source: AGMARKNET and NHB.

Owing to the lack of adequate market infrastructure for quality assessment in most markets, finalization of the price between farmers, commission agents, and traders depends on the buyer's assessment of quality. Typically, mustard oil content varies between 36% and 42%. On average, the oil content of mustard seed in the region is 40%. Traders tend to discount the price, as illustrated in Table 46.⁹² For an oil content above 42%, a premium of ₹60/quintal is paid above the market price.

Table 46: Mustard Seed Price Received by Farmer According to Oil Content

Scenario	Price (₹/quintal)				
Oil content (%)	43	42	41	40	39
Scenario 1	3,590	3,530	3,446	3,362	3,278
Scenario 2	3,460	3,400	3,319	3,238	3,157

Source: Deloitte India calculations based on field data.

Secondary and tertiary mustard processing in Uttar Pradesh: According to FSSAI data, there are 177 licensed mustard processing units in Uttar Pradesh, with a combined capacity of 1,240 MT/day.⁹³ Of these, 154 units are state-licensed and 23 are centrally licensed.⁹⁴ Of the total processing units, 36% (64 units) manufacture only mustard products and the remaining 64% (113 units) are engaged in the manufacturing of other oilseed products. An analysis of the geographic spread of these units indicates they are mostly based in 44 of 75 districts in

⁹² For each 1% deduction from the standard oil content rate of 42%, a value equivalent to 1% is deducted from the price, i.e., calculated at base market price divided by 42%.

⁹³ For capacity calculations, the following assumptions were made: for state licensees the average capacity is 2 MT/day; for central licensees the average capacity is 50 MT/day. As mustard is a major oilseed crop in Uttar Pradesh, 80% capacity is assumed to be used in units manufacturing mustard and other products.

⁹⁴ According to the FSSAI classification, state licensees are those with a capacity of 100 kg to 2 MT/day and central licensees have capacities above 2 MT/day.

Uttar Pradesh, with the majority located in the districts of Bareilly (8%), Muzaffarnagar (8%), Mathura (6%), Agra (6%), Varanasi (5%), Kanpur Nagar (5%), and Meerut (5%).

Agra is a hub for large processing units like Mahesh Edible Oil Mills (capacity of 874 MT/day) and BP Oil Mills (capacity of 300 MT/day). Mathura also has smaller but well-established oil mills like Hari Oil Mills (capacity 80 MT/day) and Ghanshyam Oil Mills and Shiv Oil and Dal Mills (capacity 50 MT/day). In addition, a large number of smaller units and expellers are operating in the Jagnair and Khairagarh regions of Agra and the Sonkh region of Mathura. These expellers and oil mills generally cater to the local population but a few small units, like Baba Oil Mills in Jagnair, supply oil to other parts of Uttar Pradesh. Depending on demand, small expellers can process 2–10 MT of mustard seeds per day.

Farm-Level Economics of Mustard Cultivation and Marketing

Based on the overall analysis, the cost of cultivation of mustard is estimated at ₹30,340/ha. Farmers bear the cost of harvesting, threshing, and transportation to nearby APMCs. Considering the average yield of 1.6 MT/ha in the surveyed area at a market price of ₹3,362/quintal with 40% oil content, the effective price realization is estimated to be ₹53,792/ha with a net profit earned by the farmer of ₹13,732/ha (Table 47).

Table 47: Estimated Cost for Cultivation and Marketing of Mustard Produce at Farmer Level

	Cost Particulars	Unit Cost (₹)	Frequency	Value (₹/ha)
1	Cost for land preparation	9,600/ha	1 time	9,600
2	Cost of sowing	1,200/ha	1 time	1,200
3	Cost of planting materials	700/kg	6 kg/ha	4,200
4	Application of fertilizer inputs (including labor)	6,540/ha	1 time	6,540
5	Irrigation charges	2,200 per irrigation	2 times	4,400
6	Cost of weeding	2,800/ha	–	2,800
7	Cost of plant protection	1,600/ha	–	1,600
8	Total cost of mustard cultivation			30,340
	Average yield per ha		16 Q/ha	
	Cost of cultivation per quintal			1,896.2
9	Cost of harvesting and threshing	–	–	7,600
	Cost of harvesting and threshing per quintal			475
10	Cost of transportation to market	82.5/quintal	16 Q/ha	1,320
	Cost of transportation per quintal		82.5	
11	Miscellaneous expenses	50/quintal	16 Q/ha	800
	Miscellaneous expenses per quintal			50
12	Total income at average price realized by farmer of 3,362/quintal		16 Q/ha	53,792

Continued on next page

Table 47: *continued*

	Cost Particulars	Unit Cost (₹)	Frequency	Value (₹/ha)
13	Net profit earned by farmers (per ha)			13,732
	Farmer's profit margin per quintal			858

Source: Based on data and information collected during the field survey.

Summary of Price Buildup

An analysis of the price buildup of mustard seed from farm to Common Kachhi Ghani Oil Mills is detailed in Figure 50.

On selling 1 quintal of produce, the value equivalent of less oil content is discounted while grading, weighing, and inspection, so the effective price at which the farmer sells the produce to a commission agent or trader when the market price is ₹3,530/quintal is ₹3,362 per quintal. The profit on the sale of 1 quintal of gram is ₹858, which is nearly 34% of the production costs. This 1 quintal for which a farmer is paid ₹3,362 fetches to ₹4,683 per quintal when it reaches the processor level. The trader's margin in the overall value chain is low, at ₹30/quintal, whereas the processors' margins are ₹168/quintal. Typically, the average recovery from kachhi ghani (cold press) mills is 35 kg of oil (38 L) and 65 kg of oilcake from 100 kg of raw material. Thus, the margins in processing are less than 4% as the wholesale prices of pure mustard oils are affected by competition with cheaper oils mixed with rice bran and palmolein oil by local retailers and competing oil units. The millers' profits are mainly realized from the sale of oilcake. Mills that use the solvent extraction method have a higher recovery of 37 kg of oil (3 L) and 63 kg of oilcake. The established brand using the traditional kachi ghani method results in a conversion ratio similar to common oil mills; however, they purchase high-grade produce and produce high-quality oil and oilcake. The cost and price buildups for these three different types of mills are given in Table 48.

Table 48: Costs and Price Buildup from Oil Seeds to Oilcakes

Cost Heads	Common Kachhi Ghani Mills (35% oil conversion ratio of the seed) (₹)	Solvent Extractors (37% oil conversion ratio of the seed) (₹)	Premium Price (35% oil conversion ratio of the seed) (₹)
Price received by farmer (100 kg seeds)	3,362	3,362	3,590
Taxes	252	252	269
Commission agent charges	50	50	54
Trader costs	290	295	303
Trader margin	30	30	35
Processor costs	519	560	639
Processor margin	169.7	283	483
Wholesaler cost and losses on oil	184	192	196
Wholesaler cost and losses on oilcakes	43	42	45
Wholesaler margin oil	266	196	209
Wholesaler margin oilcakes	56	54	62
Retailer waste oil	81	82	88
Retailer waste oilcake	11.75	11.36	13.09
Retailer margin oil	124.2	125.7	134.5
Retailer margin oilcakes	47	46	53
Consumer cost of oil	4,265	4,315	4,617
Consumers cost of oilcake	1,231	1,193	1,375
Consumer cost of oil and oilcake	5,496	5,508	5,993
Minimum consumer costs (per liter of oil)	112	108	122
Minimum consumer costs (per kg of oilcakes)	19	19	21

Source: Based on field survey and stakeholder interactions.

Solvent extractor units have marginally higher operational costs, but, since they produce a higher percentage of oil, their profit margins are higher than the other two types. In the case of premium brands, the prices realized by farmers are high as those brands purchase only high-quality seeds. They also conduct multiple tests and screenings before purchase. Their operational costs are high as they focus on maintaining quality, a specific acid percentage, and a specific level of pungency. Premium brands incur higher costs, but they also market their produce at a premium. For example, mustard oil from the premium brands such as Engine, Hari Oil Mills, and Hathi BP Oil Mills is sold at higher prices in the wholesale market with a premium of at least ₹10/L over regular brands. The profit percentages of oilcake and oil in the market and the minimum retail prices paid by consumers for all three cases are detailed in Table 49.

Table 49: Cost to Consumer and Margins at Different Levels of Mustard Processing

Margins and Prices	General Case	Use of Solvent Extractors	Kachhi Ghani Premium
Producer margin (%)	3.76	6.32	6
Price paid by wholesaler for oil (₹/liter)	95	93	105
Price paid by wholesaler for oilcake (₹/kg)	16.5	16.5	18.5
Minimum retail price oil per liter (₹)	112	108	122
Minimum retail price oilcake per kg (₹)	19	19	21

Source: Stakeholder consultations and field visits conducted by Deloitte. This is based on information gathered during stakeholder consultations and field visits conducted by Deloitte as a part of the study.

The wholesale prices for oil and oilcake for 1 L of oil and 1 kg of oilcake are ₹95 and ₹16.5, respectively, while the price paid by the consumer is at least ₹112 for 1 L of oil and ₹19 for 1 kg of oilcake. The retail price per kg of oil packs is much higher, ranging from ₹135 to ₹140. As the difference between the wholesale price and the maximum retail price is significant, this leaves substantial scope for retailers and wholesalers to make a profit. In the value chain, the combined profits of wholesalers and retailers can be 25%–40% of value added. The units using solvent extractors can sell their produce at relatively lower prices since they have a better oil conversion ratio of the seed. As can be seen in Table 49, these units can price their product at a lower rate and enjoy better margins than their competitors. If needed, they have the flexibility to reduce the price further. Margins of general mills, however, are reduced in the event of a price increase.

D. Gaps in Mustard Value Chain

Production Gaps

Seed application: Most farmers use a seed rate of more than 6 kg/ha as against the recommended rate of 2.5–3 kg/ha for the hybrid varieties, thus adding to the cost of cultivation through the high price of hybrid seeds marketed by private brands. The productivity of some newer varieties developed by the ICAR Directorate of Rapeseed and Mustard Research (DRMR) such as Giriraj (DRMRIJ 31) is at par with private brand varieties such as 45S46. The cost per kilo of seeds of this variety is estimated at ₹100/kg. Thus, enhanced production of certified seeds like these should be made available to farmers in adequate quantities. Farmers should be encouraged to adopt the recommended cultivation practices such as the correct seed rate, seed treatment, timely sowing, management of insect pests and diseases, and planting techniques to enhance crop productivity.

Fertilizer application: There is a lack of awareness among farmers about soil testing facilities. Farmers are applying urea and DAP fertilizers in excess of the recommended doses. Higher quantities of urea and DAP help plant growth but inhibit seed production and cause increased vegetative growth, which makes the crop susceptible to pests and diseases. Thus, correctly measured applications of urea and replacing DAP with SSP can help reduce the cost of fertilizers in mustard cultivation and improve yields and seed quality. To improve overall soil health and reduce soil moisture loss, organic green manure crops and vermicompost should be encouraged.

Intercultural operations: Weeding and thinning should be done at the right time to maintain optimal plant growth and branching.

Irrigation: Irrigation is done mostly with water pumped from tube wells using diesel pumps, which increases the overall cost of cultivation. The furrow-irrigated raised-bed method can save water and fuel and improve yields, while sprinklers save water and increase seed yield and reduce soil salinity.

Harvesting: A significant number of farmers harvest their crops early owing to constraints in the availability of labor. Early harvest impacts seed quality since such seeds have a higher moisture content, which affects their market price. Early harvesting should be discouraged.

Postharvest Management Gaps

Market Infrastructure

- **Quality assessment:** There is a lack of infrastructure and few mechanisms in place at markets to measure seed quality. Farmers depend on a trader's assessment or a report from a private quality testing lab.
- **Labor availability:** There is a lack of labor, which slows the overall trade process.
- **Storage:** In the absence of adequate modern storage infrastructure, farmers tend to sell their produce within 20–30 days of harvest.

Processing

Mandi cess and related taxes: The processors interviewed were of the view that high taxes like the mandi cess and GST impact the procurement costs of millers and, since margins are low in the oil processing industry, the benefits are not transferred to farmers. They also suggested they were on a par with mandi cesses in neighboring states (Appendix 8).

Competition from rice bran and palmolein: A number of mills and local retailers mix cheaper rice bran and palmolein with mustard oil and sell the produce at lower prices. This makes it difficult to sell pure mustard oil profitably. The margins are low and, if seed prices go up, it is difficult to maintain a profitable business. The availability of cheaper blends and low awareness among young consumers about the health benefits of mustard have also affected the demand for pure mustard oil in India.

Marketing Gaps

Price-related: Over the past few years, the price of mustard seed has declined. For example, as can be seen in Figure 51, the price of mustard seed on 1 May 2016 at Khairagarh Mandi was ₹4,100/quintal, whereas on 1 May 2019 the price declined to ₹3,400/quintal. Similarly, the price of mustard seed in Mathura on 29 April 2016 was ₹3,960/quintal and on 1 May 2019 it declined to ₹3,300/quintal.⁹⁵ Declining prices since 2016 and increasing production costs are affecting farmers' profitability. A sudden drop in prices during the harvest season forces farmers to sell their produce early to make ends meet. Many farmers said they did not have information about the rate at which seeds are sold. None of the farmers were aware of initiatives like eNAM and its benefits, and even millers and traders were not clear about these. Farmers reported a lack of training and extension activities on farming practices and marketing initiatives by the government.

Malpractice by unscrupulous parties: A few traders said that, while dealing with unknown parties, they faced significant losses owing to nonpayment of dues. Appropriate mechanisms should be put in place to address such concerns. The mandi parishads (council or assembly) can take note of such cases and display the names and details of defaulters on its website as a precaution to traders.

⁹⁵ AGMARKNET. <https://agmarknet.gov.in/>.

Figure 51: Analysis of Mean of Daily Modal Prices of Mustard in Uttar Pradesh for 2016–2019
Modal prices of mustard seed in Khairagarh Mandi Agra

Modal prices of mustard seed in Mathura Mandi

Source: AGMARKNET.

Access to Credit Services

High cost of finance: Farmers face difficulties obtaining credit from formal sources for cultivation and tend to depend on local money lenders who charge high interest rates. Sometimes farmers approach commission agents or traders in the local APMC markets for advances and as a result they become bound to sell their produce only through those intermediaries.

Procurement and payment: Mustard is covered under the MSP scheme of the Government of India. NAFED is the agency that buys mustard from farmers at the MSP. Farmers said NAFED bought in bulk from markets at MSP prices during March and April. Hence, procurement by the government at the MSP will be effective only if it is done from March to April. NAFED sometimes sells oilseed at rates lower than the prevailing market rates; therefore, oil

processors find it cheaper to buy from NAFED than from farmers. In Uttar Pradesh, studies have been conducted on rapeseed and mustard production (Case 10).

Crop insurance: The Government of India has been trying to cover farmers under the Pradhan Mantri Fasal Bima Yojna insurance scheme. The field survey observed that some farmers are reluctant to participate in the scheme owing to concerns about delayed or nonpayment of claims and the requirement to pay a premium.

E. Market Assessment

Case 10: Lessons Learned from Research and Success Stories

Mustard is seen as a low-risk, medium-return crop. Usually, it is intercropped and is a good source of green fodder for animals. The oilcakes made from mustard seeds are also an important source of nutrients for animals. A study conducted in western Uttar Pradesh showed that, while the production of rapeseed and mustard has improved, there is a significant yield gap that needs to be covered by the adoption of good production technology and practices.

Another study, conducted in Lakhimpur Kheri District of Uttar Pradesh, showed that the key constraints in mustard cultivation are the unavailability of good quality seed, training, and access to credit. The top three suggestions made by the study are use of good quality seed, use of scientific practices, and application of balanced doses of nutrients.

Success stories on the KVK Raebareilly website highlight how the overall profitability and farm health of farmers have improved after diversifying from intensive wheat paddy systems to a diversified cropping system that includes mustard and green fodder.

Source: R. Ahmad, R. Verma, V. Sengar, K. Singh, and A. Singh. 2019. Constraints analysis of mustard cultivation in Lakhimpur Kheri District of Uttar Pradesh. *Journal of Pharmacognosy and Phytochemistry*. 8 (3). pp. 6–8; P. Kumar, K. Singh, and S. Singh. 2017. Cost of cultivation on mustard (*brassica olerasia*) in Meerut District of western Uttar Pradesh, India. *Plant Archives*. 17 (2). pp. 1492–1494. Impact of KVK and success stories. <http://raebareilly.kvk4.in/impact.html>.

Mustard Product Map

Mustard is traded globally in various forms, including crude oil, refined oil, mustard preparations (sauces), oil cake, and aroma oil. Mustard oil is the most significantly traded form.

Import–Export Trade Analysis Global Scenario

Exports of rape, colza, and mustard oil: According to estimates by UN Comtrade, the global trade of mustard in 2018 was 7.2 million MT.⁹⁶ Canada was the largest exporter of mustard oil, accounting for 45% of world exports, followed by Germany (12%), the Russian Federation (7%), and Belgium (4%). These four countries accounted for 70% of the global export trade of rape, colza, and mustard oil. Over the years, the export volume of mustard oil from these countries has continued to grow.

⁹⁶ ITC calculations based on UN Comtrade and ITC statistics.

Import of rape, colza, and mustard oil: The US is the world's largest importer of mustard oil (24%), followed by the PRC (18%) and the Netherlands (11%). Imports of mustard oil in the US and the PRC have risen steeply over the past years (Figure 52 and 53).

Figure 52: Major Importing Countries of Mustard Oil

Source: ITC calculations based on UN Comtrade and ITC statistics.

Figure 53: Major Exporting Countries of Mustard Oil

Source: ITC calculations based on UN Comtrade and ITC statistics.

Import–Export Trade Analysis India Scenario

Exports of mustard oil from India: According to Directorate General of Foreign Trade (DGFT) Notification No. 01/2015-2020 dated 6 April 2018, the export of mustard oil is permitted only in branded consumer packs of up to 5 kg with a minimum export price of \$900/MT.⁹⁷ The quantity and price restrictions discourage its export. Limited quantities of mustard oil are exported from India, mainly to Australia, Canada, Bhutan, Nepal, the US, and the UAE (Table 50, Figure 55).

⁹⁷ Ministry of Commerce and Industries, DGFT. 2018. Notification No. 01/2015-202, Export Policy of Edible Oil. <https://content.dgft.gov.in/Website/Noti%2001%20dated%2006.04.2018%20edible%20oil%20Eng.pdf>.

Table 50: Exports of Mustard Oil from India, 2016–2019

Year	Total Oil Export (nine oilseeds)		Export of Mustard Oil	
	MT	Value in INR Crores	MT	Value in ₹ Crores
2016–2017	673,726.3	6,806.41	3,614.7	47.2
2017–2018	741,850.3	7,236.31	3,354.6	44.5
2018–2019	636,454.5	4,956.05	2,508.3	34.1

Note: 1 crore = 10 million.

Source: Ministry of Commerce and Industries.

Imports of mustard oil by India: At present, imports of all varieties of edible oils are free of quantity restrictions. India imports a substantial amount of edible oils for its domestic consumption; an estimated 14.92 million MT.⁹⁸ Among all edible oils imported into India, palm oil import accounts for 58%, followed by soybean oil (29%) and sunflower oil (10%). The share of mustard oil imports in total edible oil imports is relatively low at 3% (Figure 54).

Data and statistics on exports and imports of mustard and mustard products from Uttar Pradesh were not available.

Figure 54: Indian Imports of Edible Oils, 2015–2016

Source: National Food Security Mission.

Requirements According to per Capita Consumption

At the current consumption level of 19 kg per person per year, the national requirement for edible oils for direct consumption is an estimated 25 million MT. With an increasing number of institutional buyers making use of vegetable oils for food products and consumer goods, and requirements for quality feed for livestock, the consumption of edible oils is expected to continue to grow in India.

At present, total domestic production is 10.50 million MT of oil produced from primary sources (soybean, rapeseed and mustard, groundnut, sunflower, safflower, niger) and secondary sources (oil palm, coconut, rice bran, cotton

⁹⁸ MoAFW. 2019. Commodity Profile of Edible Oil for September. <http://agricoop.nic.in/sites/default/files/India%20-%20South%20Africa%20agri%20trade%202018-19.pdf>.

seeds, tree-borne oilseeds). India imports 14.92 million MT of edible oils, indicative of a significant gap between demand and supply.

Because of its capacity to grow under diverse agro-climatic conditions and characteristics, such as low input requirements, RM has emerged as a major strategic component in enhancing domestic production of edible oils and oilseeds. Exploiting the potential of these crops for domestic oilseed production and productivity could be a cornerstone of a strategy to attain edible oil self-sufficiency. According to estimates by DRMR under ICAR, the requirement for vegetable oilseeds is projected to rise to 71.45 million MT by 2050. Assuming a share of 20%–25% of RM in total annual oilseed production, DRMR estimates the requirement for mustard at 14.29 million MT by 2030, i.e., double the current production of 7.2 million MT (Table 51).

Table 51: Estimates of Annual Oil Seed Crops by 2050

Item	2020	2030	2040	2050
Expected population (INR billion)	1.32	1.43	1.55	1.68
Per capita consumption (kg/annum)	16.43	17.52	18.62	19.16
Vegetable oil requirement for direct consumption (million MT)	21.6876	25.054	28.861	32.189
Vegetable oil requirement for nonindustrial uses (million MT)	3.57	6.34	8.88	10.65
Total vegetable oil requirement (million MT)	25.2576	31.394	37.741	42.839
Vegetable oil availability from secondary sources (million MT)	5.05	5.89	6.85	7.18
Total vegetable oil availability from annual oilseed crops	20.2076	25.504	30.891	35.659
Total vegetable oilseed availability from 9 annual oil seed crops	67.37	71.45	80.65	82.06
Share of RM in total annual oilseeds	13.474	14.29	16.13	16.412
@20% share	13.33	15.3	18.16	20.36
@25% share	16.8425	17.863	20.1625	20.515
Expected area of RM (million ha)	7.50	7.75	8.00	8.00
Productivity of RM desired (kg/ha)	1,796	1,844	2,016	2,051

Source: Directorate of Rapeseed-Mustard Research (Indian Council of Agricultural Research). Vision 2050. <http://www.drmr.res.in/pub/DRMR-vision-2050.pdf>.

F. Potential Interventions

Based on the gaps identified in the mustard value chain, potential interventions are outlined here.

Institutional Development

Encourage and support farmers to adopt better cultivation practices and harvesting and postharvest techniques and improve their knowledge of quality requirements and standards.

Promote and strengthen farmer collectives to help them undertake aggregated sales and marketing and disseminate advanced technologies among producer members.

Encourage the use of web-based models of agriculture market information systems among farmers and their collectives for accessing real-time market intelligence, especially grade-specific pricing and transparent price discovery.

Provide training and capacity-building for farmers and their collectives and also for traders and intermediaries to improve their understanding and knowledge of trading requirements and standards for quality, grading produce, and pricing.

Infrastructure Support

Strengthen quality testing infrastructure in major markets, for example, equipping facilities with cleaning and grading machines, moisture meters, and oil content analyzers to ensure fair and transparent price setting.

Create and augment dry storage infrastructure to cater to the needs of smallholder farmers for storage of mustard produce (Figure 55).

VII. Warehousing and Storage Infrastructure in Uttar Pradesh

There are 47 central warehouses in Uttar Pradesh with a combined capacity of 1.14 million MT. Of these, 38 are in the Lucknow region and nine in the Delhi region.⁹⁹ Uttar Pradesh State Warehousing Corporation owns 110 warehouses with a capacity of 2.5 million MT. The state corporation also manages 15 rented warehouses and 30 other warehouses with a combined capacity of just over 1.4 million MT.¹⁰⁰ In addition, there are 260 Food Corporation of India warehouses with a capacity of nearly 4.7 million MT. Uttar Pradesh Mandi Parishad (council/assembly) has also constructed warehouses on the market premises of 66 districts in the state with a combined storage capacity of 568,000 MT.

A. Processing Infrastructure Availability

Uttar Pradesh has high potential for agro-processing and value addition, owing to its large consumer base and proximity to large markets like Delhi, as well as high output in the agriculture and horticulture sectors.

The state has 2,373 installed cold storage units with an overall capacity of 14.52 million MT (2018 figures), which account for 40% of the total installed cold chain capacity of the country.¹⁰¹ There are 20 packing houses, of which only three are APEDA-approved.¹⁰² Of the three approved packing houses, the mandi council owns two (one in Lucknow, the other in Saharanpur); the third is a private packing house in Gautam Buddha Nagar. All three are designed for mangoes and some vegetables, including bottle gourd, bitter gourd, and chilies. There are four food parks in Uttar Pradesh, one each in Varanasi, Saharanpur, Barabanki, and Gorakhpur Districts. The state also has agro-parks in Varanasi and Barabanki, and 247.6 acres have been earmarked for a mega food park in Baheri.

The major processing clusters of Uttar Pradesh are detailed in Figure 56.¹⁰³

⁹⁹ Central Warehousing Corporation. 2019. 62th annual report 2017–2018. <http://cewacor.nic.in/staticResources/annual%20reports/62th%20CWC%20Annual%20Report.pdf>.

¹⁰⁰ Uttar Pradesh State Warehousing Corporation. <http://upswc.com/>. (accessed 3 February 2021).

¹⁰¹ Lok Sabha Starred Question No. 103, 18 December 2018.

¹⁰² APEDA and NHB.

¹⁰³ MoFPI. Preliminary Analysis by Deloitte.

Figure 56: Major Agro-Processing Clusters in Uttar Pradesh

B. Market Infrastructure and Institutional Systems

The Uttar Pradesh Agricultural Produce Marketing Committee Act of 1964 governs the marketing and trade of agricultural produce in the state. The Act divides the state into notified APMC areas with regulated markets under their jurisdiction. The objective of developing a network of physical markets is to provide farmers with a suitable place for sale and trade and to ensure reasonable price realization for farmers. Toward this end, the APMCs frame their rules and by-laws in accordance with the APMC Act and try to promote the fair trade of agricultural commodities in their market areas (Figure 57).

The state has 251 regulated markets (two of A+ grade, 45 of A grade, 75 of B grade, 108 of C grade). There are 381 regulated submarkets across the state, which act as auxiliary markets to the main markets and help bring the marketplace closer to the farm gate. In addition to the regulated markets and submarkets, there are rural markets, wholesale markets and yards, and rural warehouses, which form an integral part of the agricultural marketing system.

Of these 251 markets, according to the NAM, 125 have been linked with the eNAM portal and presently 82 are conducting online trading through the Government of India portal.¹⁰⁴ The state also provides a unified license for processing and trade of agricultural produce, which can be obtained online from <http://emandi.upsdc.gov.in/>.

Figure 57: Marketing Infrastructure in Uttar Pradesh

Source: Deloitte India field data. 2020.

¹⁰⁴ National Agriculture Market portal. <https://www.enam.gov.in/web/> Accessed 10 May 2020.

C. Uttar Pradesh State Agricultural Produce Markets Board

The Uttar Pradesh State Agricultural Produce Markets Board was established in 1973 under the provision of Section 26-A of the Uttar Pradesh Agricultural Produce Marketing Committee Act, 1964 (last updated in 2018). The Uttar Pradesh Mandi Parishad (council/assembly) was established to organize, control, and guide activities and APMC welfare schemes and acts as the head office for numerous regulated markets across the state.

The Mandi Parishad, through the regulated mandi committee, collects a tax on the trade of agricultural commodities within the state and 115 agricultural commodities have been identified for levy of this tax. A tax of 2% plus a development cess of 0.5% is levied across all notified commodities except for mentha products, betel nut, cumin, and fennel.

VIII. Private Sector Consultations and Policy Environment

A. Assessment of Potential Buyers and Coinvestors

In most existing schemes, programs, and policies in the agribusiness sector, there has been limited private sector involvement during planning. This frequently leads to limited interest and participation among private sector actors. It is critical that the demand side actors of the value chain, comprising mainly private sector agribusinesses and service providers, participated in the study in terms of expectations of the proposed program. The aim was to identify and assess constraints to their development and their willingness to operate in the state and to seek their suggestions on bridging the existing gaps.

To gather inputs, a database of 115 private sector stakeholders involved in various aspects of agribusiness was developed from primary and secondary research data. All stakeholders in the database were then contacted. Discussions were initiated through email, telephone conversations, and face-to-face meetings (Table 52).

Table 52: Private Sector Consultation Company Type

Type of Company	Number of Companies
Direct procurement and trading	29
Procurement for food processing	40
Exporters	12
Agro-infrastructure companies	06
Agro-input companies	04
Agro-services (including technology providers)	12
Logistics service providers	03
Others	10

Source: Deloitte India field data as of 2020.

Detailed discussions were held with more than 50 companies. These interactions helped understand the private sector perspective of on-the-ground realities and explore potential areas of collaboration and co-investment with private sector organizations for value chain development of selected commodities.

B. Framework for Private Sector Consultations

The underlying principles adopted while developing the framework for private sector consultations included the following:

- exploring the market potential of crops and their value-added products in domestic and international markets;
- establishing links between the key agribusinesses and farmers and FPOs for long-term market opportunities;
- encouraging investments and co-investments by private sector businesses to establish vital postharvest and processing infrastructure to ensure the viability of the potential infrastructure and market links; and
- identifying their specific infrastructure needs and developing subprojects based on their business interests.

The key parameters on which the information was collected from the private sector included:

- crops of interest;
- existing procurement systems;
- crop target volume of procurement;
- possibility of procurement from farmers and FPOs directly;
- existing challenges in procurement from farmers and FPOs;
- existing challenges for investment in value chains in the state;
- understanding the potential for marketing and value addition;
- needs and plans for development of infrastructure and soft interventions;
- willingness to co-invest in the supply chain; and
- support required from the state government.

C. Summary of Private Sector Interactions

While most stakeholders have operations in multiple states and deal with multiple commodities, the major focus crops identified during these interactions were:

- fruits: mango, guava, watermelon, muskmelon, banana, aonla (Indian gooseberry), papaya, and jackfruit
- vegetables: potato, spinach, peas, chili, and onion
- grains: rice, wheat, maize, gram, peas and beans (mung bean), arhar (pigeon pea), urad, and masur (lentils) and
- oilseeds: mustard, linseed, and soybean

The discussions focused on the five focus commodities (potato, mango, guava, gram, and mustard). Suggestions are summarized in the following section.

D. Promotion and Capacity-Building of Farmers and Farmer Producer Organizations

- Most of the consulted stakeholders are willing to engage with FPOs or small farmer groups in various capacities, but they indicate lack of operational FPOs in the state as their primary concern. Most private actors are engaged in processing, direct procurement, and exports and are willing to procure directly from FPOs, provided they can obtain graded and sorted produce of a specific quality.
- Since market prices of produce vary according to quality and grade, awareness needs to be developed among farmers. Farmers should be able to segregate their produce into specified grades and classes. However, the

challenge for farmers or FPO members is to sell lower-grade produce. To do this, small processing units owned by farmer collectives could be established in key production clusters for processing lower-grade produce to ensure higher returns. The FPOs in the state also need to be promoted and strengthened since few FPOs remain active after registration. To encourage participation, FPOs need capacity-building and financial and technical support in the first few years of formation.

- Some private sector actors reported a lack of farmer awareness about good harvesting practices, even where FPOs are active. Most farmers do not properly perform segregation and sorting of produce according to quality, grade, and variety.
- Farmers require support for storage facilities so they can hold their produce and sell it at the right time. To enable this, credit support can be provided to FPOs for establishing small cold storage facilities (Case 11 and 12).
- It was suggested that the government could initiate programs for promoting FPOs in important production clusters. Some stakeholders also highlighted the need to develop effective organizational and business management leadership within the FPOs. The state government could provide support for storage and value addition by farmer collectives in major production clusters; these groups could then be linked with exporters and leading actors engaged in wholesale and organized retail markets (Case 13).
- The reluctance of banks in providing credit facilities to farmers or farmer groups is a major bottleneck, leading to a lack of localized infrastructure and storage facilities in the state. It was suggested that awareness programs for farmers and FPOs regarding electronic warehouse receipts and access to easy finance from empaneled banks and micro-finance institutes be conducted.

Case 11: Biomass-Powered Cold Storage GreenCHILL

As a result of the lack of cold storage facilities, postharvest waste of fruits and vegetables reduces the earnings of small and marginal farmers. Large cold storage facilities mostly remain out of the reach of these actors. Cold chain technologies such as GreenCHILL, an off-grid biomass-powered small cold storage facility, offer a solution to reduce waste by 50% by helping farmers store their produce before transporting it from the farm. GreenCHILL storage can be customized to capacities ranging from 10 MT to 30 MT to meet the needs of farmers, FPOs, and food processing enterprises and is eligible for subsidies under government schemes such as MIDH and Pradhan Mantri Kisan SAMPADA Yojana.

The cost of a 15 MT cold store is ₹1 million, and it can be used by FPOs or by individual medium-sized farmers with landholdings of 10 acres or more, providing a solution to store produce, get higher prices, and increase income. Several farmers across Maharashtra, Punjab, Gujarat, and Madhya Pradesh have successfully installed these units. In one case, farmers from Neemuch District, Madhya Pradesh, have installed 10 units for lemons, oranges, tomatoes, and cauliflower. Lemon farmers received five times the market price at ₹60/kg after storing lemons for 6–8 weeks and fully repaid the bank loan for the unit in 18 months. Similarly, farmers from Navsari District in Gujarat earned ₹40/kg after ripening mangoes in cold storage instead of earning ₹20/kg selling raw mangoes without storage.

Source: New Leaf Dynamic. <https://newleafdynamic.com> and analysis by Deloitte India.

Case 12: Solar-Powered Cold Storage EcoFrost by Ecozen Solutions

Lack of access to storage at farm level leads to the distress of selling produce at low prices during peak season, and the farmers are deprived of higher price realization. Ecozen Solutions has designed a stand-alone portable solar-powered cold storage unit called EcoFrost, which can be installed at packing houses or markets, or on farm. Farmers are offered customized cold storage in terms of capacity, cooling requirement, and battery-less backup with Internet of Things-enabled remote monitoring and life-long maintenance.

These cold storage units are of two types: (i) portable 5 MT capacity, which costs ₹1.5 million, and (ii) fixed room units with 10 MT capacity for ₹1.25 million. Farmers are offered the option of buying or leasing a unit. Rental is ₹30,000/month for a portable unit based on requirements. Several FPOs in Andhra Pradesh, Karnataka, Maharashtra, and some other states have installed these cold storage units, and these have proven to be a major attraction for exotic fruit growers, vegetable farmers, and flower growers.

In one case, an FPO in Kurnool District installed a unit for mixed fruits and vegetables and farmers realized a three times price increase after storing their produce for 2–6 weeks, as compared with the price from selling without storage. In another case, strawberry farmers from Mahabaleshwar and Maharashtra realized a five times price increase for their produce after storing their produce for 2–3 weeks.

Source: Ecozen Solutions. <https://www.ecozensolutions.com/#> and analysis by Deloitte India. 2020.

E. Agro-Input Supply

- Farmers face difficulties accessing agricultural inputs such as good quality seeds and planting materials, fertilizers, pesticides, insecticides, biofertilizers, and vermicompost, which are critical for assured production and better quality. Some stakeholders highlighted that agricultural inputs sold to farmers by local vendors and cooperatives often lacked quality, negatively affecting productivity and produce quality. It is always better to purchase either directly from manufacturers or from recognized suppliers.
- Some agro-service providers suggested it was always better and more cost effective to buy by aggregating demand of agro-inputs through farmer collectives. They also showed their interest in providing credit for the purchase of agriculture inputs to farmer groups through their association with credit providers such as NABKISAN, NABFIN, Samunnati Value Chain Finance, and other similar organizations.

F. Crop Advisory and Improved Production Practices

- Most private sector stakeholders highlighted the need for improved production practices and harvesting techniques for better price realization. Most farmers apply fertilizers and pesticides in excess of the recommended amounts and irrigate more than required. This affects quality and results in lower oil and higher moisture content. In view of this, most large mustard processing units in Uttar Pradesh said they were procuring mustard seeds from Rajasthan and Madhya Pradesh, as the mustard grown there is of better quality.
- Businesses involved in buying and processing guava, potato, and mango also noted the higher perishability of these crops in Uttar Pradesh owing to excessive application of urea and DAP. One agro-service provider suggested promoting the judicious use of fertilizers through soil testing, subject to adequate training in best practice soil sampling, by distributing portable smart-soil testing kits to farmers and FPOs to assess NPK, pH, and micronutrients. The nutrient requirements can then be determined for each crop based on the soil test report.

Case 13: Assured Quality and Reasonably Priced Inputs—Prayag Raj

Members of the Prayag Raj Farmer Producer Company Limited set up multiple retail outlets to provide quality, reasonably priced inputs to farmer members in Jasra near Allahabad in Uttar Pradesh. Before this intervention, farmers bought agricultural inputs from retail shops, often spending a whole day buying inputs at a high price without fully understanding if or how these met their needs. The FPC established five retail units that buy and stock various agricultural inputs in bulk and sell them to the farmer members at lower than retail prices.

The members get a discount of up to ₹50 on purchases of 50 kg of manure, ₹20–50 on urea, and around 2%–3% on other inputs. Around 300 farmer members have benefited from retail units in their vicinity while also saving on transportation costs, time, and effort. The quality is assured as the FPC buys from authorized distributors only. On average, each farmer member saves around ₹100–200 every month on input costs by buying from these retail units.

Several input manufacturing companies have directly contacted the retail stores to sell their products. The FPC is planning to buy agro-inputs directly from manufacturing companies at distributor prices after obtaining the necessary licenses, which would result in increased margins to the FPC and more discounts to member farmers.

Source: SFAC. <http://sfacindia.com> Analysis by Deloitte India.

- It was also highlighted that personalized crop advisories to FPOs and farmers in terms of weather forecasts and market information were important for the overall improvement of value chains. Some agro-service providers that are engaged in developing solutions for climate-smart agriculture and climate-resilient farming indicated their willingness to partner with local institutions to support these initiatives. Since many of these providers are startups, it is important to explore whether the services they offer translate into actual benefits for farmers.

G. Harvesting and Postharvest Management

- Time of harvest, method of harvesting, and grading are critical parameters that determine the quality of harvested produce and marketability. Early harvesting and unsustainable harvesting practices adversely affect quality. Almost all businesses stressed the need for better harvesting practices and sorting and grading at the farm level. For most mango and guava production, harvesting, sorting, and grading are done by orchard lessees, hence both farmers and lessees should be encouraged to adopt better practices.
- There is considerable domestic and international demand for fresh and value-added potato products. Similarly, the Dussheri mango is popular in southern India and the Middle East. It was stressed that, by maintaining a consistent supply of quality produce, these markets can be tapped.
- Many farmers prefer to harvest potatoes early to prepare their fields for the next crop (mostly maize). This severely affects the quality, especially in the processing varieties used for chips and fries. The bulk of such produce is thus rejected by processing units and farmers fail to fetch good prices.
- For mango and guava, harvesting is done mostly in only one or two rounds, to reduce costs, which adversely affects quality and marketability. Harvesting at maturity is a key factor in price determination. Examples from Maharashtra and Gujarat were cited whereby farmers harvest mangoes 10–15 times during the season according to the maturity of the fruits. Farmers are more aware in these states, and they understand the benefits of staggering harvesting according to the maturity of the fruits.
- One exporter highlighted that they had not bought mangoes from Uttar Pradesh in the past 3 years owing to quality issues. The respondent highlighted that farmers should be encouraged to use tools like fruit-picking sticks and crates or boxes for packing.

- Potato farmers usually grow two or three varieties and mix them at harvest. The cold storage facilities do not segregate produce properly and multiple varieties are mixed in a single lot. Thus, companies find it difficult to segregate produce, which ultimately results in variation in processed output. As the quality of produce bought and processed from Uttar Pradesh varies across different batches, this negatively affects export potential. Segregation of produce at farm level and in cold storage will ensure that processing companies are buying standardized produce and will help them maintain uniform standards across batches of their product. Similar problems are faced with mangoes and guava. Stakeholders stressed the need for segregation of produce at farm level and requested more efficient operations at packing houses and collection centers.
- It was highlighted that sensitization is needed among orchard owners, farmers, and postharvest contractors, so they are made aware of the importance of segregation and price associated with types and grade of produce.

H. Infrastructure and Storage

- Most companies indicated as major challenges the lack of postharvest infrastructure at the village cluster level such as collection centers, packing houses, cold storage facilities, and processing. Most cold storage facilities in Uttar Pradesh are used for storing potatoes, and there is a need to encourage multi-commodity, multichamber cold storage with humidity control.¹⁰⁵ This will help farmers hold their produce during peak harvest season and maintain appropriate moisture levels for a longer duration.
- Small packing houses, precoolers, and cold storage facilities could be established for groups of farmers in key production clusters (Case 12 and 13). Similarly, most infrastructure for storing nonperishable produce is used for wheat; there is a need to develop storage facilities for pulses and oilseeds. Farmers generally store these commodities at home for a limited period. However, there is potential for higher returns from longer storage. Moreover, developing modern warehouses can help small farmers with warehouse receipt financing facilities, which are presently lacking.
- Integrated infrastructure for storage and ripening (cold storage, cold rooms, ripening chambers), grading, marketing, and input supply should be promoted through agro-enterprises and farmer collectives at submarket level in major production clusters. These facilities can act as procurement centers for exporters, processors, and retail chains since they prefer to purchase quality produce in large quantities.
- Some companies proposed that the state government fund the establishment of collection centers and capacity-building for farmers and FPOs at procurement locations.
- Some companies proposed the government subsidize the establishment and management of small cold storage facilities and ripening chambers. Biomass cold storage and ripening chambers should be encouraged as they use agricultural waste for power generation.
- There is a lack of refrigerated reefer transport in the state for transporting perishable products, owing to a lack of awareness and investment.
- Processing units, especially the smaller ones, raised concerns about power supply interruptions that affect their operations and increase costs through the need to use diesel generators.

I. Financial Support and Incentives

- Access to favorable credit or through partial loan guarantee schemes from banks and other financial institutions has been a major challenge for private agribusinesses. Small oil mills and mill owners complained about the lack of industrial incentives for mustard oil mills in the state.

¹⁰⁵ MIDH. 2014. *Study on Cold Storage*. https://midh.gov.in/PDF/HANSA_REPORT.pdf.

- Some units also raised concerns over high power tariffs as this increases the cost of production for processing units and mill owners.
- Many processing units indicated that the mandi tax in Uttar Pradesh was high at 2.5%, and they would like to see it reduced in line with rates in neighboring states (Appendix 8).
- It has been recommended that there be provision of soft loans from banks with the support of state government as the process of availing credit for cold storage and ripening chambers is very slow in Uttar Pradesh.
- It was also recommended during the consultations that dedicated agribusiness venture capital funds be attracted to provide financing for incubation support to private sector businesses.

J. Innovation

- Some organizations are willing to work with farmers by providing individualized fee-based artificial intelligence data-driven crop advisory services for climate-smart farming.
- Mobile app soil testing kits and aggregation of farmers for procurement of agro-inputs through online platforms were suggested by one stakeholder.
- Some start-ups have shown willingness to provide market support through fee-based dissemination of price information and development of market links.
- Some organized retailers and exporters expressed the need for solutions at the farm level, like fruit bagging for mangoes and guava. This would reduce pest attacks and the need for pesticides and insecticides, leading to better quality produce with a longer shelf life.
- There is a need for irradiation facilities in the state that can be used to increase the shelf life of perishable crops like mangoes and guava for export markets. Presently, there are few such facilities. However, they are being promoted by the Government of India through a centrally sponsored scheme encouraging the private sector to set up irradiation facilities with government grants.
- One organization highlighted the advances made in refrigerated transportation technology. It has a new line of trucks that can transport goods requiring temperatures between -15°C and -25°C . These trucks have low maintenance costs and do not require an additional energy source for cooling. This kind of technology can be explored in Uttar Pradesh for perishable produce.

IX. Recommendations

There are gaps in the focus product value chains in the state that present opportunities for improvement through appropriate interventions. Major gaps and challenges were identified during the value chain assessments of the focus crops in terms of both soft and hard interventions for developing value chains, from production to marketing, as well as links with evolving markets and private sector actors who are buying or plan to buy such products from Uttar Pradesh. Important lessons were learned in terms of the major challenges and bottlenecks in the implementation of the schemes and programs being implemented in the agriculture sector in Uttar Pradesh. The main lessons are summarized in Figure 58.

Figure 58: Lessons Learned

A. Interventions Across Value Chains

It is important to focus on integrated value chain development to achieve an overall strengthening. Interventions have been proposed at each level of the value chain with the objective of increasing value addition (including processing levels), reducing waste, and raising marketability and value realization for the major stakeholders, especially farmers.

B. Coverage of Hard and Soft Interventions

It is imperative to focus on both “hard” and “soft” interventions in the focal crop value chains, including developing effective market links to achieve sustainable development in the agriculture and horticulture sectors. In view of this, it is proposed to include interventions that would cover both hard and soft components.

Hard infrastructure interventions would focus on the creation of value addition facilities across the value chains, such as modern nurseries, equipment banks, micro-irrigation, modern packing houses, ripening chambers, small-scale processing units at the farm level, reefer vehicles, large-scale processing units, modernization of existing cold stores, creation of modern warehouses, R&D on solutions and technologies for postharvest management, ventilated transportation vans along with refrigerated or insulated vans, market and retail outlets, and transportation infrastructure. Soft interventions would focus on promotion and capacity-building of farmer groups and FPOs, promotion of improved cultivation practices, postharvest management, enhancing credit access through warehouse receipt financing, provision of revolving funds for FPOs, seed capital, venture capital, and affordable working capital for agribusiness enterprises.

C. Promotion and Capacity-Building of Farmers and Farmer Producer Organizations

There are a limited number of active FPOs in the state for the focus crops. Some of the reasons offered for this were lack of support to the FPOs, several socio-political challenges, constraints in developing direct market links with buyers, and limited access to affordable credit and working capital. Therefore, it is necessary to promote the formation of FPOs in the major production clusters of the focus crops and to provide them with the necessary technical and marketing support to sustain their business operations. Moreover, most existing operational FPOs lack capacity in terms of management, entrepreneurship, and business planning. The program would focus on promotion and capacity-building of the farmer collectives related to governance, management, marketing, and business planning. This would be aligned with the recently launched scheme of MoAFW on Formation and Promotion of 10,000 FPOs, which covers similar interventions.

FPOs and cooperatives have been more successful where they are industry-linked. Hence, their revitalization in the state will require active involvement from the agroindustry in Uttar Pradesh. The key for FPO promotion and support would include developing forward links with distant markets and processing industries along with long-term support and capacity-building and access to credit.

Farmer collectives should also be sensitized regarding the quality standards expected by buyers, exporters, and processing industry actors so that direct links are established with the private sector. This would help increase

farmer collectives' share in the overall price realization. The proposed program aims to develop farmer collectives into commercially viable business enterprises that would engage in production and set up value addition facilities in terms of packing houses, innovative cold storage, and processing facilities at the farm level. Some of these facilities will be viable only if there is a minimum scale and hence it is important to promote large FPOs with a geographical reach beyond the village. Collaborations within multiple FPOs may also help achieve a larger scale.

There is a need in many FPOs for a greater separation between the board and the management team. Farmer collective enterprises need professional support for business operational, financial, and technical service aspects. In activity terms, this would translate into professional expertise for developing business and marketing plans and planning investments.

D. Enhancing Value Addition and Processing Capacity for Focus Crops

The present value addition and processing capacity of the focal crops is limited. The exception is mustard cultivation, where the smaller processors, which constitute a large percentage of total processing capacity, buy mustard grown in Uttar Pradesh. Even the large, organized processors in the state buy some mustard locally because of its easy availability, although they prefer mustard from other states.

Considering these low capacities in value addition and processing, it is proposed that the program focus on the creation of such facilities to increase value addition and enable the processing of focus crops, which would lead to higher value realization for both the farmers and farmer collectives and the private sector companies, including agribusiness small and medium-size enterprises (SMEs) that are a part of the value chains. For potatoes and mangoes, this will require a significant change in farmer behavior in terms of the varieties planted and the level of farm management, which are currently resulting in unsuitable products for processors.

E. Flexibility to Develop Customized Projects

The private sector seeks flexibility in project development in terms of land, location, capacity, and focus crops. Private sector actors prefer to work in specific areas of the value chain based on their interest and expertise rather than investing in the entire value chain, and are reluctant to invest in land owned by the government with a fixed concession period. Often, private sector actors focus on developing certain parts of the value chain instead of investing all along the value chain. Moreover, single private investors investing across the whole value chain may sometimes lead to monopolies. To ensure private sector participation and project viability, it is proposed that the program provide flexibility to the private sector that allows actors to customize individual projects and subprojects in terms of location, size and capacity, focus crop, and stage of the value chain based on their interests.

In this regard, the focus should be on enterprises that, as part of their proposal for project support, provide higher levels of own-contribution, better benefits for smallholder and marginal farmers and farmer organization participation, greater value addition, and higher farmer price share, and are more climate change responsive. These enterprises should be competitive and hence would be prioritized for support under the program.

F. Feedback from the Private Sector on Program Design

It has been observed that the private sector's participation in programs during implementation could be greatly enhanced if its feedback is incorporated into program design. During this study, private sector actors presently operating in the sector were contacted for feedback in terms of their interests and the challenges they faced in agriculture and horticultural supply chains. These interactions focused on the type of projects and commodities in which they were interested and the support they would expect from the state government. To ensure private sector participation in large numbers in the proposed program, the suggestions and feedback received have been given due consideration in designing the proposed interventions.

G. Program Contours

Based on these considerations, it is proposed that the program contours would include the following interventions. These should cover the entire value chain and target all major stakeholders, including farmers and their collectives, agribusiness SMEs (including processors), and large agribusiness actors. The proposed interventions are classified into four categories:

- (i) promotion of improved cultivation, harvest, and postharvest practices;
- (ii) promotion and strengthening of farmer collectives and FPOs;
- (iii) promotion of SMEs in the agribusiness sector; and
- (iv) facilitating overarching development of agricultural value chains.

For each category, soft interventions in the form of institutional support and hard interventions in the form of infrastructure are proposed to upgrade value chains and create an enabling environment for linking farmers with evolving markets by developing capacity, providing access to finance and technology, and creating infrastructure. The interventions proposed under the program are summarized in Figure 59.

H. Program Intervention Details

Details of potential interventions are described as follows.

Institutional Development

Promotion of Improved Cultivation, Harvest, and Postharvest Practices

The cultivation practices most farmers employ are out of date and not in line with recommended practices. This has led to increased incidence of pests and diseases, over-use of nitrogen-based fertilizers, increased cost of cultivation, excess water use, and reduced quality and yields. In addition, unscientific harvest and postharvest practices followed by farmers and lessor commission agents and traders have resulted in low value addition, high levels of waste, and low price realization. There is, therefore, an urgent need to develop the capacities of farmers and lessors in terms of best cultivation practices and postharvest management. The following interventions are proposed.

Figure 59: Project Components

Capacity-Building for Farmers and Farmer Collectives on Improved Cultivation, Harvest and Postharvest Practices

It is imperative that farmers and farmer collectives are trained in GAP and postharvest management. Postharvest contractors need to be included, as many farmers prefer to lease out their orchards.

Capacity-building can lead to the adoption of advanced cultivation techniques such as the use of mulching, seeding, and drip irrigation, as well as building awareness and knowledge regarding optimal harvest timing, storage temperature, quality indices, maturity indices, injuries, handling protocols, postharvest injuries and decay, ripening processes and the use of ripening agents, use of suitable packaging, and transportation. In time, farmer collectives could play a pivotal role in acting as technical and knowledge partners by ensuring that their member farmers are informed about improved cultivation and postharvest practices and monitor their adoption (Case 14).

In terms of funding for capacity-building initiatives and support, these activities could be financed by the state government. Private sector involvement should be explored, preferably through value chain stakeholder arrangements. Convergence with work being implemented through corporate social responsibility programs could also be explored.

Implementation model

These interventions are proposed by the state government through its implementation partners, including the private sector. The primary beneficiaries will be farmers and farmer collectives. These initiatives should be marketed and implemented in close partnership with and with continuous feedback from the private sector about the utility of the interventions.

Promotion and Strengthening Farmer Collectives and Farmer Producer Organizations

Promotion of Farmer Collectives and Farmer Producer Organizations

There are a limited number of active FPOs operating in the state for the focal crops. To leverage benefits from economies of scale, organizing farmers into farmer collectives and FPOs would improve the viability of their operations and create economies of scale.¹⁰⁶

Case 14: Using Nets for Harvesting Fruits

Most mango growers harvest their fruit by beating the branches with bamboo poles or by climbing the tree and vigorously shaking the branches. This results in bruised and damaged fruits and waste on the order of 10%–15% of the crop, compared with under scientific harvesting practices.

One reason cited for not using a mechanical harvester is that the process is time consuming and requires more labor. As an alternative, nets can be strung under the canopy of the trees to collect falling fruit, thereby preventing physical damage.

For example, mangoes used to be harvested in Nepal using the long-stem or pick-and-throw method, which punctured 10%–12% of the fruits. These losses were more evident at the retail level, where the punctures showed signs of decay. As a result of these high postharvest losses, harvesting with improved tools and nets designed by the Bangladesh Agricultural Research Institute was introduced, leading to almost zero loss of fruit through handling damage.

Source: Deloitte India field data. 2020.

This would increase the bargaining power of member farmers for marketing, help them gain access to new technologies, and raise capital for setting up primary processing and value addition facilities. The FPOs can also act as knowledge partners to promote GAP among their members. It is proposed that such a program focus on promoting and supporting new farmer collectives and FPOs in the major production clusters.

Enterprise Management and Operation Handholding for Farmer Producer Organizations

The field study showed that most existing operational FPOs lack capacity in terms of management, entrepreneurship, and business planning. Many FPOs have been registered for 4–5 years but are now as a result of a lack of professional managerial and technical support. These FPOs could revive their business operations if the appropriate support is provided. Similar feedback was received from private sector actors.

As a part of such a program, it is proposed to assist FPOs in hiring qualified professionals who would help them manage their business operations and develop effective marketing links for their produce. It is also proposed to make consistent efforts to build the capacities of the existing leadership of the FPOs, in terms of enterprise management skills, including in accounting, governance, postharvest operations, market development, and branding.

¹⁰⁶ Refer to Appendix 4 for a synopsis of the recommendations on FPO promotion through the proposed program.

Market Intelligence and Price Discovery

Most farmers who market their produce themselves have limited bargaining power, owing to their lack of market price information and low quantities of produce. Moreover, the information flow from traders to the farmers is generally not transparent.

Market intelligence, especially grade-specific pricing, and transparent price discovery mechanisms are essential to maximize farmers' margins. It is proposed to promote web-based agriculture market information systems, such as AGMARKNET, eNAM, and Kisaan to farmers and farmer collectives. These can provide real-time information on arrivals and grade-specific pricing at markets within and outside the state. This market information could be supplemented with information on sowing and harvesting the same crops in neighboring and other major production states, along with forecasts on price trends. This information, supplemented with the necessary quality testing infrastructure, such as moisture meters and oil content analyzers, would help farmers grade their produce and thus get the best prices.

Developing Effective Marketing Links and Branding for Farmer Collectives

Farmer collectives can be provided with support to develop market links with agribusiness companies, modern retailers, processors, and exporters. Brands could be developed for the focal crops based on their geographical characteristics, along with attractive packaging. Initiatives for promoting FPO-owned brands could be explored through collaboration among FPOs operating in similar product niches, and they could be encouraged to ensure adequate volumes for effective branding. A statewide federation of FPOs supported by the government could also be facilitated to work toward development of collective branding and market links. Market development initiatives should also be promoted for organic and pesticide-free certification, organizing buyer-seller meetings,

Case 15: Abhinav Farmers' Club

In 2004, a group of 12 progressive farmers formed the Abhinav Farmers' Club in Pune District of Maharashtra under the guidance of NABARD. These farmers were involved in the cultivation of roses and carnations under the protected conditions of a polyhouse. The club enabled individual farmers to aggregate their produce and market it effectively in Mumbai and Delhi. The club then developed an innovative 1-acre hi-tech integrated organic farming concept, in which it would grow fruit, leafy vegetables, exotic vegetables, and pulses. This is an integrated model, which focuses on growing a diverse set of products in small quantities needed every day by consumers and supplying them directly to the end user. The unique selling proposition of this model is that high-quality organic produce is directly marketed to retail consumers, thereby eliminating intermediaries. This ensures higher margins to the member farmers.

The current membership is not limited to Pune and has spread to six states. The total membership is close to 150,000 farmers who produce organic fruits, vegetables, and pulses on 1-acre plots, and directly supply end consumers. Coordination among these member farmers is facilitated through farmer leaders from each group (257 farmer leaders across the country) who are connected through a WhatsApp group and meet regularly. The club provides technical expertise on production and marketing to new member farmers through farmer leaders.

This club has transformed into a peer-to-peer knowledge-sharing platform, in which farmers brainstorm aspects of farming, and, as a result, their farming methods and productivity have vastly improved. The farmer members grow organic vegetables and flowers in polyhouses and sell them through links with established retail chains. They have collectively achieved an annual turnover of ₹400 million–₹500 million with a higher amount of profits being shared with farmers.

Source: Abhinav Farmers Club. <http://www.abhinavfarmerclub.org> and study by Deloitte India.

Case 16: Sales Through More Remunerative Channels—Rameshwar Farmer Producer Company Limited, Varanasi

The members of this FPO set up a wholesale outlet at Rajatalab near Varanasi in Uttar Pradesh to facilitate sales of vegetables and fruits. Before the intervention, farmers used to sell vegetables to local brokers or to the wholesalers at the mandis. At the mandis, the farmers were had to pay a 6% commission to the wholesaler. The farmer producer company decided to set up their own wholesale unit and charge a commission of 3% from farmer members and 5% from nonmembers.

A total of 200 members of the FPO have been supplying vegetables regularly to the wholesale counter owned by the FPO. Additionally, 50 nonmember farmers from other villages sell vegetables through the wholesale counter. The FPO has appointed sales counter staff and a helper to facilitate sales. The use of electronic weighing machines has led to savings of 2%–3% for farmers compared with under traditional practices at mandis, where under-weighing is prevalent. The FPO has also hired permanent transport vehicles to transport produce to the mandis, thus reducing transport costs by 20% and saving the time of individual farmer members.

Source: SFAC. <http://sfacindia.com> and analysis by Deloitte India. 2020.

participation in commodity fairs in major cities, and encouraging farmers and farmer collective members to attend national workshops and exhibitions (Case 15 and 16).

During the stakeholder consultations, it was observed there is a lack of awareness about currently operational e-marketplaces, including eNAM. There is an urgent need for training on e-marketplaces, auctions, and other digital marketing services. Incentives could be provided to buyers and sellers who would trade through e-market places such as eNAM, to encourage and popularize these platforms. These awareness-raising initiatives should be undertaken by the state government under the proposed program.

Implementation Model

These interventions would be proposed by the state government through its implementation partners, including the private sector. Initiatives should be market-led and implemented in close partnership with and with continuous feedback from the private sector (agribusiness companies and export houses) regarding the utility of the proposed interventions.

Promotion of Small and Medium Enterprises**Promotion of Innovative Practices and Technology**

The agriculture sector in Uttar Pradesh exhibits limited innovation and use of modern technology, especially for postharvest management of agriculture commodities. Adoption of innovations and new technologies would help improve crop yields and quality, increase shelf life, add value, and reduce waste along the value chain. This would, in turn, help with better access to markets and fetching higher returns.

Technologies that could be promoted are micro-irrigation systems, deep placement of urea, bagging fruits during cultivation to prevent insect and pest attacks, use of mobile soil testing kits, use of technology for real-time quality assessment of agricultural produce, and innovative packaging and treatments. These interventions could be included in an updated package of practices for each crop, developed with agribusiness participation. To promote agriculture sector innovations, the state government could promote and fund pilot testing and commercialization of innovations once financial benefits are established.

Brand and Market Development for Forward Links and Exports

It is proposed to encourage market development through initiatives such as the promotion of digital e-market places, direct links with emerging domestic agribusiness markets and private sector actors, and export promotion. During the stakeholder interactions, some emerging domestic agribusiness actors and exporters said they needed support in developing market links. If they were provided with such support, they would be able to access emerging domestic and export markets, which would, in turn, benefit farmers in the state. Private sector agribusinesses in need of critical support for marketing and promotion in both domestic and export markets could be supported under a scheme offering professional services, provided they buy a prescribed percentage of their raw material directly from farmers and FPOs. Commodity-specific strategies could be developed depending on the priority of domestic and export markets. For example, mangoes and guava could target distant domestic and export markets, whereas the priority target in the case of potatoes, mustard, and gram should be domestic markets.

Creation of Backward Links

To promote direct links between farmers, farmer collectives, and agro-produce marketing organizations (including e-market places), incentives could be provided for forging long-term partnerships with farmers and their collectives for buying their produce.

Implementation Model

The state government would propose capacity-building and institutional development for SME promotion in the agribusiness sector by providing subsidies, conditional loans, and venture capital to beneficiaries directly (mostly private agribusiness enterprises and FPCs). The state government would engage a program management agency for program design, overall implementation, management, and monitoring.

Facilitating Overarching Development of Agricultural Value Chains

Access to Finance and Creation of Seed Capital and Venture Capital Funds

Interactions with farmers and FPOs revealed that accessing timely credit from banks and other financial institutions was a major challenge. Most banks and other financial institutions generally seek as a minimum collateral 150% to 200% of the loan value from the collectives. Also, banks many times undervalue FPO assets. It is difficult for farmers' groups to arrange the necessary collateral for loans to set up value-added processing facilities. Difficulty in accessing working capital often forces farmers to borrow from informal sources, which typically involves high costs.

Most government subsidy schemes are credit-linked, such as the Cold Chain Scheme, the Scheme for Creation of Backward and Forward Links, and the Scheme for Creation and Expansion of Food Processing and Preservation Capacities (Ministry of Food Processing Industries [MoFPI]). Term loans for a certain percentage of the project cost are mandatory for subsidy eligibility. Many farmer collectives and smaller agribusiness companies are unable to apply to these subsidy schemes because of their inability to raise bank loans. Considering the difficulty farmer collectives and small agribusiness companies face, it is recommended that guarantees for loans (both term and working capital) be provided to farmer collectives and private agribusiness companies.

Seed and Venture Capital

Agro-enterprises, especially startups, that are operating and planning to operate in the state have an acute need for seed and venture capital along with business and enterprise incubation. Some existing funding and incubation programs have been quite successful. For example, the Innovative Ventures and Technology for Development program, which has Uttar Pradesh as a focal state, has received encouraging responses, and several startups have been funded and incubated under this. Recently, the India Agritech Incubation Network was set up at the

Indian Institute of Technology, Kanpur with a target to reach 50,000 farmers through 60 enterprises working on technological applications for agriculture.

The need for seed and venture capital, as well as business and enterprise incubation, was confirmed during interactions with private sector actors. This is particularly important in the early stage of startups when they need a supportive environment to improve their business, entrepreneurial, and marketing skills.

It is proposed to create a fund under the program for the incubation of agribusiness enterprises, including FPOs and startups. The fund would provide financial assistance through grants or equity through identified incubators in the state, which would provide incubation support with specified outcomes. For managing and due diligence, a qualified fund manager would be appointed.

Promotion of Postharvest Research and Development

To promote postharvest innovations, it is proposed to create an R&D fund to develop innovative solutions and technologies for postharvest management and commercial models for innovation. Leading research institutions in the state can be engaged and value chain actors integrated into the fund implementation. Collaborations with foreign universities and research organizations should also be encouraged. Development of innovations such as low-cost solar and biomass-powered precoolers and cold storage facilities at farm level, packaging based on biopolymers derived from renewable resources, low-cost ethylene dispensers for uniform and healthy ripening of fruits, and advanced modified atmospheric packaging can be encouraged under this fund. The fund should be driven by the private sector and publicly co-financed. Partnerships between R&D organizations and the private sector would lead to result-oriented and demand-driven action research.

Creation of Quality Standards

The pricing of agricultural commodities is determined by their grade and quality. AGMARK has standardized the grade and class specifications for major agricultural and horticultural commodities; however, these standards are mostly followed only for export commodities. It was found that, in most markets, produce is typically graded into two grades, Grade A and “the rest.” Quality is determined through visual observation by traders. Thus, the price discovery mechanisms are skewed in favor of traders and farmers end up getting less for their produce.

It is imperative that all stakeholders have a common understanding regarding the quality and grading standards so there is transparency in the pricing mechanism. There is a need to widely disseminate these standards among all stakeholders. These initiatives would include improving traceability (GS1 standards and barcoding) and GAP standards for safe and nutritious food (e.g., Hazard Analysis and Critical Control Point [HACCP], International Organization for Standardization [ISO]).

Implementation Model

The state government proposes capacity-building and institutional development for facilitating overarching development in the agribusiness sector by providing appropriate subsidies, conditional loans, and venture capital to the beneficiaries directly (mostly private agribusiness enterprises and FPCs). The state government would engage a program management agency for program design, overall implementation, management, and monitoring.

Creation of Infrastructure

Under the proposed program, infrastructure creation is envisaged for enabling the supply of quality planting material, promotion of scientific irrigation, value addition, processing, logistics, and marketing at three levels: for farmers and farmer collectives, for agribusiness SMEs, and at the sectoral level. The objective is to create suitable

facilities and infrastructure at all stages of the value chain, which, along with the institutional interventions, would lead to upgraded value chains.

In the potato and gram value chains, the focus should be on developing value addition and processing capacities, given present low levels in this regard. Processing varieties of potatoes are already being grown in the state and adoption of such varieties should be encouraged along with the development of processing infrastructure. This would lead to higher returns to farmers. In the case of gram, promoting transparent price discovery infrastructure is important for increasing farmers' price realization.

Fruit value chains are still in the early stages of development in Uttar Pradesh as evidenced by the existence of only four APEDA-recognized packing houses, it is proposed, therefore, to focus on encouraging farmers, farmer collectives, and the private sector to set up modern facilities. In the case of mustard, the current estimated processing capacity in the organized sector is more than 70%. There is also a large number of unorganized small expellers involved in mustard oil production. Considering such a high percentage of existing processing and value addition capacity and that the key players prefer to source their raw materials from other states, the focus has been on promoting scientific cultivation, improving quality, and establishing a transparent price discovery infrastructure.¹⁰⁷ The following facilities and infrastructures are proposed at different levels of the value chains of the focus crops (Figure 60).

Proposed Facilities and Infrastructure at Farmer and Farmer Collective Level

Development of appropriate infrastructure at farm level is one of the biggest challenges, given the limited productivity and capital of individual farmers. Promoting such infrastructure under the program through FPOs and

¹⁰⁷ Presently, some of the major mustard oil mills in the state buy their produce from neighboring states, owing to better quality in terms of high oil and low moisture content. Moreover, the grading and price discovery mechanism is nontransparent and skewed in favor of traders, given the lack of scientific testing infrastructure and storage.

private sector participation would enable individual farmers to access these facilities at much lower cost without having to invest capital.

The adoption of the farmer collective approach would enable aggregation of produce from many farmers, thus leveraging economies of scale for which infrastructure facilities can be established. This would provide stability to operations, in terms of scale and sustainability, and lead to an increase in the quality and shelf life of the produce. This collective approach would enable risk sharing, improved marketing, and negotiating power for producers. To ensure economies of scale, large FPOs should be promoted and facilitated to establish the proposed facilities, with long-term support provided for management and the operational and executive teams. The following section describes the facilities and infrastructure proposed.

Equipment bank: Considering that most farmers in the state are smallholders and are short of labor during sowing and harvesting, it is proposed to create equipment banks at block level. This would help reduce the capital investment for small and marginal farmers, who would then be able to hire equipment and services at a reasonable rate. Use of modern machinery would help improve crop yields, reduce waste, and address the issue of labor shortages. It is proposed that equipment banks be facilitated under the program and set up by farmer collectives and local entrepreneurs. These banks would typically have the agricultural equipment for crops grown in the local areas (e.g., one 55 HP tractor, one seed drill, and one harvester; Case 17).

Case 17: Farmer Machinery Banks and Custom Hiring Centers

The Government of India has been promoting mechanization and postharvest technologies. The centrally sponsored Sub-Mission Agricultural Mechanization (SMAM) provides financial assistance for buying machinery and equipment. One of its objectives is to promote Custom Hiring Centers (CHCs) as small and marginal farmers are generally not able to individually afford farm equipment and machinery. According to the latest data on the SMAM website, 49,027 CHCs have been registered and 18,078 CHCs, machinery banks, and high-tech hubs have been established. These centers are being run by entrepreneurs, farmers, and societies.

As it is a centrally sponsored scheme, both central and state governments assist the CHCs. Many states have dovetailed their own schemes and initiatives to promote such facilities. An analysis of CHCs promoted by the scheme in 2017 revealed that most (62.3%) were being run by rural entrepreneurs, followed by self-help groups (17.2%). FPOs, cooperatives, and KVKs together operate 20.5% of the total CHCs.

Source: SMAM. 2019. Operational Guidelines; 2018. Monitoring, Concurrent Evaluation and Impact Assessment of Sub-Mission on Agricultural Mechanization. <https://agrimachinery.nic.in>.

Some examples of successful CHC models are given here.

Rahul Dhoot from Sehore District of Madhya Pradesh enrolled in the entrepreneurship development program run by the State Agriculture Department and was subsequently trained at the Central Institute of Agricultural Engineering. He made an investment of ₹2.15 million to establish a CHC in April 2014. He purchased two tractors, a rotavator, a front dozer blade, seed drills, a multi-crop thresher, a straw reaper, and a trolley. He rented this equipment to more than 100 farmers in the region who grow crops including soybeans, wheat, and chickpeas. His rentals resulted in additional income of ₹800,000 a year with a net profit of ₹250,000.

Renu Tomar from Vidisha District in Madhya Pradesh made an investment of ₹1.8 million in 2013 in a CHC. She received 50% of her investment as a subsidy. She purchased a tractor, an Mouldboard plow, a rotavator, a cultivator, seed drills, a spray pump, a straw reaper, and a thresher. She rented this equipment for 1,030 hours in 2013 and 1,320 hours in 2014–2015 to farmers in nearby villages. The investment yielded a net profit of ₹500,000 in 2013–2014 and ₹780,000 in 2014–2015. The profits are helping her upgrade her inventory and expand the business.

Source: CIAE Bhopal. Success Stories. <http://ciae.nic.in/WriteReadData/CMS/success%20stories.pdf>.

Promotion of hi-tech tissue culture nurseries: In the case of horticulture crops, it was observed there were a limited number of good nurseries in the state. The seed and planting materials available through the Horticulture Department are limited. Most farmers are presently buying planting material from older nurseries, which is generally costly, and they sell genetic material susceptible to diseases like wilt and to nematode attacks. There is a limited availability of quality, disease-free, and disease-resistant planting material. To ensure a sufficient supply, it is proposed that hi-tech tissue culture nurseries is promoted under the program in the major production regions of mangoes, guava, and potatoes. This would enable the supply of disease-free planting material on a large scale that is hardened in a greenhouse before being transplanted in orchards and fields. This would reduce incidence of pests and soil-borne diseases (Box 5).

Box 5: High-Tech Potato Production System Developed by the Central Potato Research Institute

ICAR-CPRI noted that the availability of quality planting material was important for a vegetatively propagated crop like potatoes. Potatoes are susceptible to soil-borne diseases, which negatively affect overall yield.

ICAR-CPRI has standardized a system based on tissue culture techniques and micro-propagation. There are a total of 14 firms in Haryana, Punjab, Uttar Pradesh, and West Bengal involved in the production of potato minitubers using the ICAR-CPRI technique. Each firm is licensed to produce 1 million minitubers per year. Thus, the total production capacity is 14 million minitubers (700 MT).

The total seed requirement for the state of Uttar Pradesh is around 22 million MT, based on the recommended seed rate of 30–35 quintals/ha. Thus, there is scope to promote more hi-tech seed production nurseries in Uttar Pradesh.

Source: ICAR-Central Potato Research Institute, Shimla.

It is proposed to gradually replace the old rootstock for mangoes and guava with high-quality plants. In the case of potatoes, considering the significant acreage of potato cultivation and the high quantity of seed potatoes required for 1 ha, it is proposed to set up demonstration nurseries in the major production clusters. These are expected to encourage the private sector and farmer collectives to set up units in other production clusters.

Promotion of micro-irrigation: Most farmers practice flood irrigation, which leads to increased water use and promotes weed growth. Given the concerns about water scarcity and falling water tables, it is important to promote water-efficient cultivation techniques like micro-irrigation. These techniques help reduce water requirements and lead to an overall increase in yields. There are already state and central government schemes providing subsidies for adopting micro-irrigation; however, adoption by state farmers is negligible. Sensitization of farmers to the benefits of drip irrigation would increase adoption, particularly in districts where water tables are dropping. The state's performance in this area could be improved through central schemes to promote micro-irrigation such as Pradhan Mantri Krishi Sinchayee Yojana (More Crop Per Drop; Box 6).

Packing houses: Packing houses are generally the first point of aggregation for farm produce, where minimal processing is undertaken to extend shelf life. A modern packing house comprises a building (pre-engineered or otherwise), a grading and sorting area with suitable process lines, precoolers, multi-commodity cold rooms, ripening chambers, crates, material handling equipment, and a laboratory. Packing house operations enable FPOs to segregate produce into table grades (Grade A and B) and processing grades (Grade C and D). This would be a paradigm shift, as farmer collectives would be able to earn higher prices for table grade produce and sell the processing grades. Packing houses and market links help farmers and farmer collectives add value and gain better bargaining power with postharvest contractors and traders, leading to higher price realization. Postharvest contractors can also use the packing houses for similar benefits.

Processing interventions would provide a market for processing grades. These interventions would result in adding value to the produce by increasing shelf life and changing the physical nature of the produce, which will improve availability over a wider geographic area. These interventions would leverage technological advancements in processing and value addition. Although there are different components in a packing house based on the crop, the main components are as follows.

Box 6: Advantages of Drip Irrigation

Drip irrigation is an effective and water-efficient method of irrigation. Water is supplied directly to the root zone of plants through a network of High Density Poly Ethylene pipes laid across fields and orchards. Fertilizers and nutrients can be mixed with the water and supplied to the plants (fertigation), which greatly reduces fertilizer requirements. Drip irrigation reduces the water requirement and helps improve overall yield and quality. In the case of potatoes, drip irrigation leads to increased yields and consistency in the size of the tubers. In case of mangoes and guavas, there is a water savings of 40%–50% and a yield increase of 23%–40%.

Source: http://agritech.tnau.ac.in/agriculture/agri_irrigationmgt_dripirrigation.html

Another advantage of drip irrigation is the energy savings in terms of electricity and fuel needed to pump water. Even though the initial investment is high, the benefits are worthwhile. Drip irrigation leads to:

Increased water efficiency: 50%–90%

Energy consumption savings: 30.5%

Fertilizer use savings: 28.5%

Irrigation cost savings: 31.9%

Increase in farmers' income: 42%

Source: Irrigation Association of India in collaboration with FICCI and Grant Thornton India LLP. 2016. *Accelerating Growth of Indian Agriculture: Micro Irrigation an Efficient Solution*. <https://www.grantthornton.in/insights/articles/accelerating-indian-agricultural-growth-micro-irrigation/>.

Precooling: Temperature management is one of the most important factors with regard to the quality of fresh produce. There is an optimum storage temperature for all products. The product must be cooled to the appropriate temperature and then held in refrigeration at the same temperature prior to departure. Precooling is the first step in good temperature management. Rapid cooling after harvest has been clearly shown to prolong the shelf life of freshly harvested produce. During busy harvest times, it is important to have practical systems in place to minimize the amount of field heat accumulating in harvested fruit, as well as having an efficient system for removing that heat at the cool store.¹⁰⁸ Most storage rooms designed for holding produce under refrigeration do not have the refrigeration capacity or the air movement needed for rapid cooling. Precooling refers to the rapid removal of field heat shortly after the harvest of a crop. Field heat should be removed as fast as possible since, for most produce, an hour delay at field conditions of 35°C will lead to a loss in shelf life of a day even at optimal storage conditions (Case 18).

Cleaning, sorting, and grading: Processing techniques, including minimal processing activities such as cleaning, sorting, screening, grading, trimming, and de-stemming, are necessary to obtain the required uniformity and acceptable quality of the raw commodity required by processing industries and consumers. Under this program, automated sorting and grading lines are proposed for packing houses.

¹⁰⁸ Field heat is defined as the difference in temperature between the temperature of the crop harvested and the optimal storage temperature of that product.

Case 18: Reduction in Postharvest Losses in Mangoes with Improved Cold Chain Infrastructure Development

A study conducted by the Institute of Postharvest Engineering and Technology showed that harvesting, sorting, and transportation losses accounted for a major share of the losses in the mango value chain. The study also indicated that the overall total loss in mangoes in the Alphonso variety growing areas of Maharashtra in the western plateau and hill region was estimated at 4.91%, compared with a loss of 10% reported in the middle and upper Gangetic Plain region of Uttar Pradesh, where Dussheri and Langra varieties are grown. This indicates that, with improved postharvest handling and cold chain infrastructure development, losses along the value chain can be significantly reduced.

Source: Deloitte India field data. 2020.

Ripening chambers: Ripening chambers are proposed for some mango packing houses that are near consumer markets. A number of fruits and vegetables naturally produce ethylene. However, the level as well as concentration of ethylene production varies from crop to crop, which is why crops do not ripen uniformly. To ensure uniform ripening, controlled ripening conditions have to be maintained by way of exposure to ethylene gas at the correct level and intervals at prescribed temperature and carbon dioxide levels. Such treatment in a ripening chamber has helped with the uniform ripening of bananas and mangoes and added tremendous market value.

Multi-commodity cold stores: These are multichamber cold store facilities for multi-commodity storage under variable conditions. They include a pre-engineered insulated building, processing area, grading and sorting lines, multiple cold rooms, pallet racks, material handling equipment, docks, laboratory, and sanitation facilities.

Packaging to minimize loss: Using the right packaging materials and the right stacking and storing techniques can reduce losses. Packaging fresh fruits and vegetables is one of the more important steps in the long and complicated journey from grower to consumer. Bags, crates, hampers, baskets, cartons, bulk bins, and palletized containers are convenient containers for handling, transporting, and marketing fresh produce. The trend is toward greater use of bulk packages for processors and wholesale buyers and smaller packages for consumers. Under the program, the following packing house facilities are proposed (Table 53).

Table 53: Creation of Potential Packing House Infrastructure for Mango and Guava

Crop	Facilities Proposed	Capacity (MT/day)
Mango	De-sapping area, sorting and grading line, packing line, ripening chamber, small cold store (100 MT)	15
Guava	Sorting and grading line, packing line, small cold store (100 MT)	15

Source: Deloitte field data. 2020.

Modern packing houses are proposed for FPO and village clusters. These would be mostly owned and operated by farmer collectives. Modern packing houses would enable farmer collectives to forge marketing links directly with wholesalers and organized retailers for high-quality products, leading to increased margins for farmers and reductions in waste. The lower grades (Grade C and D) of produce can be sold to processors. Wholesalers and organized retailers would benefit through procurement of high-quality fruits from the packing houses at lower rates by bypassing intermediaries in the value chain. In the case of mangoes, modern packing houses would enable farmer collectives to link directly with exporters, who would then prefer to buy properly processed and graded produce (Case 19).

Case 19: Best Practices in Cold Chain Management Systems in India

Some of the best practices are found in grape, beef, fish, and ice cream and milk distribution systems. Good practices can also be seen in businesses that have centralized kitchens for cross-geography markets (e.g., Dominos and McDonalds). Good practices in the cold chain must incorporate HACCP systems, comply with food safety regulations, minimize damage to the environment, manage inventory risk, avoid food loss, prevent energy loss, and support upkeep of machines and equipment while facilitating streamlined movement to the end consumer.

Source: Government of India, National Centre for Cold Chain Development. 2017. General Queries on Cold-chain Development. <https://nccd.gov.in/PDF/General-Queries-Cold-chain.pdf>.

Small-scale potato processing units: There are few processing industries in the organized sector in the state. The demand for processed potato products has been increasing steadily over the past few decades and according to CPRI-ICAR's Vision 2050, the demand for processed potatoes is estimated to grow to 25.06 million MT by 2050 from the present level of 6 million MT. Processing varieties like Chipsona and Frysona have been introduced in Uttar Pradesh in recent years. However, according to field estimates they account for only 10% of the area under potato cultivation in the state. By promoting these processing varieties, Uttar Pradesh could tap the increased demand for processed potato products.

It is proposed, therefore, to set up small-scale potato processing units using dehydration technology for manufacturing value-added products. CPRI has developed innovative products like dehydrated potato cubes and shreds, potato dalia, and premixed potato powder. Promoting potato processing could help reduce the impact of market gluts on farmers, thereby offsetting the high cost of storage in cold stores and creating additional livelihood options and employment generation.

Innovative cold stores: The existing cold storage facilities in Uttar Pradesh are mostly used for potato storage. These cold stores are typically large capacity units with a limited number of chambers and are using outdated, energy-inefficient technology. There are few cold storage facilities for other horticulture crops grown in the state. Moreover, there is a negligible presence of smaller cold storage units at the farm level to which farmers and farmer collectives have easy access. The creation of cold storage facilities at the farm level would enable transportation and temporary storage of horticulture produce immediately after harvesting and help reduce waste and develop better links with distant markets (Case 20).

Considering the grid power shortage in the state and based on evidence of FPO financial viability and management capacity, it is proposed to promote small cold stores with a capacity of 10–120 MT along with small precoolers for quick removal of field heat powered by solar and biomass energy at the FPO and village cluster level in the major production clusters.

Retail outlets: It is essential to develop effective marketing links for farmer collectives to enable them to achieve better price realization for their produce. Some FPOs are also interested in developing direct marketing links with buyers in distant markets. Farmer collectives and FPOs near urban centers can benefit if they have a space to directly sell their produce consumers. The retail outreach of FPOs can be supported and may improve margins for their member farmers. This has been demonstrated by some FPOs where they have been able to market to housing societies in urban areas (Case 21).

Implementation Model

Creation of infrastructure at farm and farmer collective level for value addition and processing is proposed by farmer collectives and agribusiness SMEs, with support from state government through the proposed program

Case 20: Solar-Powered Movable Small Cold Storage

In a study on the economic feasibility of solar-powered movable cold storage units with 10 MT capacity for fruits and vegetables, the load data indicated that the average solar energy production was 65% more than the power consumption. During the analysis, the ambient temperature varied from 27.4°C to 43.4°C, the temperature inside the storage structure varied from 9.5°C to 11°C, and the relative humidity outside and inside the structure was in the range 21.2%–50.3% and 72.6%–95%, respectively. The lower inside temperature and higher humidity helped increase the shelf life of tomatoes to 20 days. The highly perishable tomatoes remained fresh after storage.

The effective operational cost was estimated at ₹6/day. The overall estimated per day operational costs were much less than the overall cost savings from power consumption (at 49/day). The aggregator also received significant margins on tomatoes as the market price increased by more than four times in 20 days. For 1,000 kg of tomatoes, the profit was ₹76,000. After deducting the cost of operation at ₹6/day, the net profit was ₹75,880. The payback period of the system is 9 years. The system can be used for a variety of fruits and vegetables.

The analysis shows that small cold storage structures are economically feasible and can keep produce fresh for up to 3 weeks. As the structure is movable, it can be installed in areas where there is a shortage of electricity.

Source: P.K. Sharma, and H.S. Kumar. 2018. Solar Powered Movable Cold Storage Structure for Perishables. *Current Science*. 114.

Case 21: Mobile Retail Vans

Retail outlets can be promoted as brick-and-mortar stores or in the form of mobile retail vans. Mobile retail vans could be beneficial to FPOs within 100–150 km of major cities. Vans can be equipped with refrigeration and a display area. For example, such mobile retail vans are being used by farmer collectives from Nashik District in Maharashtra to market their produce in Mumbai. The advantage is they can reach a larger consumer base.

Similar interventions are being carried out by tribal collectives in Churachandpur District, Manipur, under the Van Dhan Yojana of the Ministry of Tribal Affairs. Tribal collectives of 300 members received a one-time grant of ₹1.5 million to purchase equipment and machinery for value addition and processing raw forest produce. Members sell their products through a mobile van across the district. The van has been hired at a cost of ₹20,000/month and sales are ₹200,000–₹300,000/month.

Source: P.K. Sharma, and H.S. Kumar. 2018. Solar Powered Movable Cold Storage Structure for Perishables. *Current Science*. 114. <https://www.semanticscholar.org/paper/Solar-Powered-Movable-Cold-Storage-Structure-for-Sharma-Kumar/de22c40a299e5008bf23c91e79e6757d31dda621>.

using subsidies, conditional loans, and other mechanisms. A program management agency would be responsible for program design, overall implementation, management, and monitoring.

Economies of scale are critical to the viability of investments, particularly for the proposed infrastructure, which will be viable only if farmers can work in larger groups (e.g., 500–1,000) to achieve the minimum viable scale. Hence, an overarching principle should be to first assess what processing, storage, handling, and agricultural services are already operating in specific clusters; what the threshold investments are for rural entrepreneurs, FPOs, and farmers; and what kind and scale of technology is needed to compete. These assessments should become a priority during project design.

Another solution might be for FPOs to have equity participation in town-based marketing and processing enterprises while focusing on locally delivering products and services in short supply, including inputs, seed propagation, equipment rental and operation services, tube well drilling and maintenance services, land preparation

and chemical application, drying, sorting, cleaning services for some grain commodities, sorting and handling vegetables, milk and fish collection, and transport services. While the private sector is generally reluctant to engage with FPOs, this model can be promoted through the proposed agribusiness venture funds and private sector actors with FPOs sensitized to the benefits of such collaborations. Gradually, FPOs could co-own town-based FPCs or a market federation of FPOs could be promoted that would be able to invest more in marketing and processing.

Proposed Facilities and Infrastructure at Horticultural Small and Medium Enterprise Level

The interventions proposed in this stage complement the production and primary processing-level interventions proposed in the earlier sections, with the objective of incorporating secondary- and tertiary-level interventions along the focal value chains. The interventions proposed aim to add value in terms of changing the physical nature of the produce and, at times, its chemical composition, by leveraging the latest technology and processes available. This would lead to increased shelf life and make products available in distant markets. Some interventions suggested under this component are crop-specific but can be used for additional crops with slight modifications or changes to processing. These facilities would typically require larger financial investments and hence could be owned and operated mostly by SMEs. The proposed interventions are discussed next.

Mangoes: The major varieties grown in the state are mostly table varieties; hence, the following interventions are proposed: VHT units, an irradiation facility, and an IQF and canning unit.

Vapor heat treatment units. Most mango-importing countries mandate VHT to prevent the growth and multiplication of fruit flies through infected fruit. Fruit flies are a major pest affecting mangoes produced in tropical countries like India. VHT is an effective, natural, and chemical-free method to sterilize fruit fly eggs and larvae. It is accepted as an effective postharvest treatment and can pass the strictest international standards. This facility is currently available at only two packing houses in the state, one in Lucknow and the other in Saharanpur. Both are owned by the Uttar Pradesh Mandi Parishad (council/assembly). Considering the export potential of the major varieties of mango grown in the state, it is proposed that VHT facilities are established in other major production districts, like Unnao and Varanasi.

Irradiation facility. For exports of mangoes to the US, it is mandatory they are irradiated in India. Exposure to gamma radiation kills and sterilizes all eggs and larvae in the fruits and helps extend the shelf life of the produce by 8–10 days at ambient temperature. The interventions proposed under the program to improve cultivation, harvest, and postharvest practices aim at overall quality improvement and may help capture the untapped export potential of the major varieties of mangoes exported to the US. An irradiation facility can also be used for other products, such as onions, spices, and potatoes. Currently, there is only one irradiation center in the state, operated by Impartial Agrotech Pvt. Ltd. at Unnao, Lucknow. This facility undertakes irradiation of food and medical products.¹⁰⁹ It is proposed to set up irradiation facilities under the program.

Individual quick freezing and canning units. The major varieties of mango grown in Uttar Pradesh are table varieties and not preferred for pulping; however, there is a good potential to process and preserve these varieties in the form of tit-bits, dices, and slices, which can be frozen and stored for consumption at a later date. IQF is an effective technology for freezing and uses blasts of cold air directed on the food products. This type of freezing results in free rolling products and prevents the formation of product clumps. This technology ensures that the membrane and structure of the product is not destroyed, leading to better preservation of taste, texture, and nutritional value. In the case of mangoes, the ripened fruits are washed and sorted, then peeled and sliced. These

¹⁰⁹ International Irradiation Association. <https://www.semanticscholar.org/paper/Solar-Powered-Movable-Cold-Storage-Structure-for-Sharma-Kumar/de22c40a299e5008bf23c91e79e6757d31dda621>. <https://iia.global.com/news/brit-announces-construction-of-two-new-gamma-irradiation-facilities-in-india/>.

smaller pieces are then passed through an IQF unit at a controlled temperature and packed, maintaining strict hygienic and product safety conditions. At present, there are few companies in the state involved in production of frozen mango products, mainly because of lack of awareness and limited access to finance. It is proposed that IQF and canning units be promoted under the program. These units would serve as demonstration units and successful operations would encourage other private sector actors to invest.

Guava

Integrated pulping and juicing facility. Guava is a highly perishable fruit with a short shelf life and hence needs to be stored and transported at low temperatures with proper packaging. To reduce waste, the ripe fruits can be processed and used for the preparation of products like fruit juice, jams, jellies, and nectar. There is growing demand for guava pulp and guava juice in both domestic and export markets. According to a market report published by Transparency Market Research titled “Guava Puree Market: Global Industry Analysis and Forecast 2017–2025”, the revenue generated from guava puree was valued at \$313.8 million in 2017 and is projected to increase at a CAGR of 5.6% during the forecast period 2017–2025. Stakeholder consultations showed there was only one major guava juice manufacturer in Uttar Pradesh, at Varanasi, which manufactures thermally processed ready-to-serve guava fruit drinks and juices. It is, therefore, recommended to promote the establishment of pulping and juicing plants in guava production clusters.

Potatoes

Processing units. There are few potato processing units in Uttar Pradesh in the organized sector. According to field estimates, 10% of the potatoes grown in the state are processable varieties. Promoting large-scale potato processing units across the state for these varieties will encourage farmers to increase cultivation and get better returns for their produce. Subject to further financial evaluation, the potential exists for the establishment of processing units to produce products such as potato chips, fries, smileys, and frozen ready-to-eat products

Modernization of cold storage facilities. More than 95% of the cold stores across the state are used for potatoes. Most of these cold stores have been established over the past 2 decades and are using fincoil technology with either glass wool insulation or thermocol polystyrene within brick masonry, which leads to high energy inefficiency. Generally, the storage chambers in these cold stores are large and, if they are operated at partial capacity, the energy requirement is not commensurate with the quantity of produce stored, as the entire space has to be cooled. Generally, there is no provision to control the humidity inside the chambers, which affects produce quality. Modernizing cold stores is thus essential to improve their energy efficiency, increase the shelf life of the produce, reduce waste, and enable storage of multiple commodities. It is considered important that such modernization is taken up under the program after assessing the financial viability on a case-by-case basis.

Gram

According to ICAR’s Indian Institute of Pulses Research, it is estimated that 75% of the total production of pulses in the country is being processed. Of this processed segment, approximately 75% is split dhal and the remaining 25% is processed as value-added products like gram flour and other food items. Although no data on the processing percentage of pulses in Uttar Pradesh are available, it was estimated that the processing capacity for gram in the organized sector is only 1.5% of total production. However, there are a large number small, unorganized units involved in the manufacture of split gram and gram flour. It is proposed to increase the total processing capacity in the organized sector by setting up small-scale units manufacturing gram flour, split gram, and savory snacks.

Implementation Model

Creation of infrastructure for horticulture produce at the SME level for value addition and processing would be proposed by farmer collectives and agribusiness SMEs with support from the state government through the proposed program using subsidies, conditional loans, and other mechanisms. A program management agency would be responsible for program design, overall implementation, management, and monitoring activities.

Proposed Facilities and Infrastructure at Sectoral Level

The interventions proposed in this section aim to complement the capacity-building and institutional initiatives at the sectoral level by creating infrastructure at the state level. The focus of these interventions would be to create modern storage, quality testing, grading, and logistics infrastructure for perishables leading to sectoral development. Based on the gaps identified during the study and feedback received from stakeholders, the following facilities and infrastructure are proposed at the sectoral level under the program.

Creation of Modern Storage and Transparent Price Discovery Infrastructure

Storage. Smallholder farmers cannot hold their produce for better prices because they need money to cover household expenses and to prepare for the next crop. As a result, they are forced to sell their produce just after the harvest season when the price is low. Although the total warehousing and storage capacity in the state is 9.95 million MT, this is used primarily for paddy and wheat. There is a need to promote modern dry storage for other crops like mustard and gram. Storage needs to be linked to the warehouse receipt financing facility after financial viability is assessed on a case-by-case basis. This would enable smallholder farmers to store their produce and take advantage of the increased rates a few months after the harvest season. With a link to the warehouse receipt facility, farmers would be able to get loans at affordable rates. It is proposed, therefore, to establish modern storage facilities for gram and mustard. The locations and individual capacities of these stores would be based on local requirements.

Transparent price discovery infrastructure. For crops such as mustard, prices are determined by moisture and oil content. However, in Uttar Pradesh, scientific testing facilities are not available at most markets, and traders rely on visual methods and physical handling to estimate these. Price discovery mechanisms are skewed in favor of traders, with farmers consequently getting lower prices for their produce. To promote transparent price discovery, it is proposed to set up infrastructure in the form of cleaning and grading machines, moisture meters, and oil content analyzers in major markets for gram and mustard. These facilities can also be used for other field crops. It is proposed to create transparent price discovery infrastructure in at least 50 major agricultural produce markets in the state under the program.

Cold chain logistics. During the field study, it was observed that refrigerated vehicles are not often used for transportation of perishable horticultural produce. Exporters and processors of horticulture produce have expressed a need to develop the cold chain for effective transportation of produce from production clusters to major markets within and outside Uttar Pradesh. It is proposed, therefore, to support the procurement of reefer vans and containers. This is critical for maintaining an uninterrupted cold chain and avoiding temperature shocks. Reefer containers can be mounted on trucks or transported by rail. It is proposed to promote such refrigerated vehicles and containers in the state.

Implementation Model

Creation of infrastructure at the sectoral level would be proposed by the private sector including third-party logistics companies with support from the state government through the proposed program, using appropriate subsidies, conditional loans, and other financing mechanisms for facilities such as modern warehouses and cold chain logistics.

For transparent price discovery infrastructure, it is proposed that the state government through the Mandi Parishads (council/assembly) undertake its implementation in major markets across the state. A program management agency would be responsible for program design, overall implementation, management, and monitoring.

Summary of Estimated Investments and Potential Benefits from the Proposed Infrastructure

The estimated investments per unit of the proposed infrastructure and potential benefits of creating such infrastructure are summarized in Table 54.

Table 54: Estimated Investment per Unit of Proposed Infrastructure

Intervention	Infrastructure	Crop	Unit Cost (₹ million)	Potential Benefits
Promotion of improved cultivation, harvest and postharvest practices and	Packing houses 15 MT/day	Mango	10	Farmer's price realization of ₹25–30/kg instead of ₹18–20/kg
	Ripening chambers near consumption centers with capacity of 10 MT/day			This will lead to an increase of farmer's net margin by 30%–40%
				Packing house operations can lead to a reduction in waste by 30%–35% and increase in shelf life by 25–35 days
Promotion and strengthening of farmer collectives and FPOs				The FPO/packing house margin would be in the range of 20%–30%
				Farmer's price realization of ₹18–20/kg instead of ₹12/kg
		Guava	10	This will lead to an increased net margin for farmers by more than 30%
Promotion of SMEs in agribusiness sector				FPOs and packing house margins would be in the range of 20%–30%
	Small-scale potato dehydration and processing unit for manufacturing dehydrated potato cubes and shreds, potato dalia, potato powder premix, etc. (0.35 MT/day)	Potato	7	Farmer's price realization of at least ₹11/kg instead of ₹8–9/kg owing to higher price of processable varieties
				This will lead to an increase in farmer's net margin of more than 40%
				The processor's margin would be in the range of 20%–30%
	Processing facilities: VHT (2 MT/batch)	Mango	20	Farmer's price realization of ₹25–30/kg instead of ₹18–20/kg
				This will lead to an increase in farmer's net margin by 30%–40%
				The processor's margin would be in the range of 30%–40%

Continued on next page

Table 54: continued

Intervention	Infrastructure	Crop	Unit Cost (₹ million)	Potential Benefits
Processing facilities:				
	Irradiation center (2,000 kCi Cobalt 60)	Mango	310	
Processing facilities:				
	Mango IQF and canning (15 MT/day)	Mango	250	
Processing facilities:				
	Integrated pulping unit (30 MT/day)	Guava	75	Farmer's price realization of ₹7–8/kg for Grade C or D produce presently being sold at ₹5–6/kg This will lead to an increase in value by 25%–40% The processor's net margin would be in the range of 30%–40%
Processing facilities:				
	Chips, frozen ready-to-eat, fries processing unit (24 MT/day)	Potato	250	Farmer's price realization of at least ₹11–12/kg instead of ₹8–9/kg owing to higher price of processable varieties This will lead to an increase in farmer's net margin of more than 40% The processor's margin would be in the range of 30%–40%
Processing facilities:				
	Besan (gram flour), split gram, and savory snacks unit 1 MT/day	Gram	12.5	15%–35% increase in farmer level net margin if sold as dhal and besan
Modernization of cold storage capacity (per MT cost)				
		Potato	0.06	This will promote multi-commodity storage and energy-efficient technologies Will lead to 25%–30% reduction in cost of cold storage operations

Continued on next page

Table 54: continued

Intervention	Infrastructure	Crop	Unit Cost (₹ million)	Potential Benefits
Facilitating overarching development of agricultural value chains				This will lead to farmers getting fair market prices
	Creation of transparent price discovery infrastructure:			Farmer's price realization for gram at ₹4200/q instead of ₹4,100/q leading to a gain of 2.5%
	Cleaning, grading machines, moisture meters, oil content analyzers	Gram-mustard	3	9% increase on the current net margin level for gram farmers
				In the case of mustard, farmer's price realization at ₹3,530/q instead of ₹3360 q leading to a value gain of 5%
				20% increase on the current margin level of for mustard growers
				Farmer's price realization for gram at ₹4,850/q instead of ₹4,100 Q i.e. 18% for farmers
				Will lead to an increase of 50%–60% on the net margin level for gram growers
	Creation of modern storage: ventilated warehouses for storage (per MT cost)	Gram-mustard	0.08	Farmer's price realization for mustard at ₹4,200/q instead of ₹3,360/Q i.e. 25% more for farmers
				Will lead to an increase of 40%–60% on the margin level for mustard farmers

Source: Analysis by Deloitte India study team.

Implementation Model

The following approach is proposed for the implementation of the recommended intervention.

Table 55: Interventions and Implementation Models

Intervention	Implementation Model
Promotion of improved cultivation, harvest, and postharvest practices	These interventions are proposed to be implemented by the state government through its partners (including the private sector). The primary beneficiaries will be the farmers and their collectives. These initiatives should be market-led and implemented in close partnership with, and with continuous feedback from, the private sector (agribusiness companies and export houses) regarding the utility of the proposed interventions.
Promotion and strengthening of farmer collectives and FPOs	
Promotion of SMEs in the agribusiness sector	The capacity-building and institutional development for SME promotion in agribusiness sector is proposed to be implemented by the state government by providing appropriate subsidies, conditional loans, and venture capital directly to the beneficiaries (mostly private agribusiness enterprises and FPCs). A program management agency would be engaged by the state government for program design, overall implementation, management, and monitoring.
Facilitating overarching development of agricultural value chains	
Creation of infrastructure at farm and farmer collective level	Creation of infrastructure at farm/and farmer collective and horticulture SME level for value addition and processing is proposed to be implemented by farmer collectives and agribusiness SMEs with support from state government through the proposed program in terms of appropriate subsidies and conditional loans, and other appropriate mechanisms. A program management agency would be engaged by the state government for program design, overall implementation, management, and monitoring.
Creation of infrastructure at horticulture SME level	
Creation of infrastructure at sectoral level	Creation of infrastructure at sectoral level is proposed to be implemented by the private sector including third-party logistics companies with support from state government through the proposed program in terms of appropriate subsidies and conditional loans for facilities such as modern warehouses and cold chain logistics.
	For transparent price discovery infrastructure, it is proposed that the state government through the Mandi Parishad undertake implementation in major markets across the state. A program management agency would be engaged by the state government for program design, overall implementation, management, and monitoring.

Source: Analysis by Deloitte India study team.

Appendixes

1. Comparative Assessment and Final Scoring Sheet for Selection for Focus Crop
2. Global Trade of Potatoes and Potato Products 2008–2019
3. Details of Farmer Producer Organizations iions the Potato, Mango and Gram Value Chains in Uttar Pradesh
4. Financial Analysis of Guava Orchard in Uttar Pradesh (1 ha, ₹)
5. Synopsis of Recommendations on the Promotion of Farmer Producer
6. Details of Relevant Government Policies and Initiatives
7. Focus Crop Market Regulatory and Control Mechanisms
8. Mandi Tax in Major Neighboring States

Appendix 1: Comparative Assessment and Final Scoring Sheet for Selection for Focus Crop

Comparative Assessment Sheet																		
Crops		Pulses					Oilseeds				Fruits				Vegetables			Fishery
Selection Parameter	Tur	Urad	Moong	Gram	Lentil (Masoor)	Mustard	Groundnut	Sesamum	Mango	Banana	Guava	Aonla	Potato	Green Peas	Tomato	Carp		
Share in All-India Production of the Crop (%)	7.45	12.47	2.40	6.68	30.42	10.84	1.14	10.61	23.28	10.37	24.20	35.65	31.97	46.92	4.01	7.21		
Wastages along the value chain (%)	3.88	7.07	7.00	7.00	1.74	5.08	3.03	5.00	10.01	7.76	12.78	35.00	7.96	7.07	12.44	5.23		
Area under Cultivation in Uttar Pradesh ('000 ha)	338.0	353.0	92.0	562.0	489.0	689.0	94.0	370.2	265.62	69.38	49.53	35.16	514.78	221.00	21.24	432.00		
Share of Agri & Allied sector GVA (%)	0.50	0.51	0.08	0.80	0.66	1.22	0.12	0.17	4.11	2.03	0.48	0.20	3.36	1.47	0.52	1.57		
Price Volatility (%)	14.23	21.16	11.45	9.03	15.03	7.51	16.34	19.64	23.77	21.35	28.55	35.98	36.13	53.43	44.00	32.26		
Scope for Value Addition	40	40	40	60	40	80	70	50	80	65	80	80	95	60	60	30		

Source: Deloitte India data analysis 2020.

Final Scoring Sheet

Crops		Pulses				Oilseeds			Fruits				Vegetables				Fishery
Selection Parameter	Wt. (%)	Tur	Urad	Moong	Gram	Lentil	Mustard	Groundnut	Sesamum	Mango	Banana	Guava	Aonla	Potato	Green Peas	Tomato	Carp
Share in All-India Production of the Crop (%)	5	0.69	1.24	0.14	0.60	3.20	1.06	0.00	1.03	2.42	1.01	3.52	3.77	3.37	5.00	0.31	0.66
Wastages along the value chain (%)	15	0.97	2.40	2.37	2.37	0.00	1.51	1.93	1.47	3.73	2.71	4.98	15.00	2.81	2.40	4.83	1.57
Area under Cultivation in Uttar Pradesh ('000 ha)	10	5.3	5.6	1.2	9.1	7.9	11.3	1.2	5.9	4.1	0.8	0.5	0.2	10.0	3.4	0.0	6.9
Share of Agri & Allied sector GVA (%)	10	1.04	1.06	0.00	1.78	1.44	2.83	0.10	0.21	10.00	4.85	0.99	0.29	8.15	3.44	1.09	3.69
Price Volatility (%)	20	2.93	5.95	1.71	0.66	3.28	0.00	3.85	5.28	7.08	6.03	9.16	12.40	12.47	20.00	15.89	10.78
Scope for Value Addition	40	16	16	16	24	16	32	28	20	32	26	32	32	38	24	24	3120

Source: Deloitte India data analysis 2020.

Appendix 2: Global Trade of Potatoes and Potato Products 2008–2019

Product	Potatoes, prepared or preserved otherwise than by vinegar or acetic acid, frozen				Potatoes, prepared or preserved otherwise than by vinegar or acetic acid (excluding frozen)				Potato starch				Flakes, granules, and pellets				Flour, meal, and powder				Potatoes, uncooked or cooked by steaming or by boiling in water, frozen			
	HS Code 200410	\$ billion	million	MT	HS Code 070190	\$ billion	million	MT	HS Code 200520	\$ billion	million	MT	HS Code 110813	\$ billion	million	MT	HS Code 110520	\$ billion	million	MT	HS Code 110510	\$ billion	million	MT
Year																								
2008	4.74	4.91	4.91	2.59	9.07	1.96	0.98	0.40	0.52	0.38	0.25	0.12	0.10	0.16	0.16	0.29								
2009	4.79	5.27	5.27	2.37	8.88	1.91	0.96	0.34	0.60	0.38	0.26	0.10	0.08	0.14	0.14	0.27								
2010	4.91	5.52	5.52	2.85	9.90	1.92	1.04	0.39	0.77	0.38	0.30	0.10	0.09	0.14	0.14	0.32								
2011	5.69	5.69	5.69	3.59	10.91	2.26	1.09	0.50	0.52	0.43	0.32	0.14	0.11	0.21	0.21	0.47								
2012	5.64	6.00	6.00	2.83	10.30	2.24	1.08	0.45	0.59	0.48	0.36	0.12	0.09	0.18	0.18	0.37								
2013	6.42	6.26	6.26	3.75	10.89	2.31	0.99	0.54	0.73	0.48	0.35	0.11	No data	0.16	0.16	0.26								
2014	6.39	6.35	6.35	3.25	10.60	2.30	1.01	0.55	0.66	0.55	0.39	0.13	0.10	0.14	0.14	0.24								
2015	5.81	6.71	6.71	2.84	No data	2.09	1.01	0.50	0.77	0.51	0.43	0.10	0.09	0.13	0.13	0.18								
2016	6.53	7.31	7.31	3.21	11.20	2.21	1.06	0.47	0.69	0.49	0.41	0.09	0.09	0.17	0.17	0.22								
2017	6.96	7.63	7.63	3.41	No data	2.44	1.10	0.52	0.76	0.53	0.44	0.09	0.11	0.19	0.19	0.28								
2018	7.47	8.08	8.08	3.35	No data	2.61	1.13	0.41	0.55	0.60	0.45	0.11	0.10	0.19	0.19	0.31								
2019	7.90	8.24	8.24	3.80	11.15	2.47	1.11	0.43	0.51	0.61	0.43	0.11	0.09	0.20	0.20	0.28								
CAGR %	4.8	4.8	4.8	3.5	1.9	2.1	1.2	0.7	-0.1	4.4	5.1	-0.9	-0.7	2.0	2.0	-0.2								

Note: The values in this section have been calculated as the sum of the value of world exports and imports of potatoes and potato products.
Source: UN Comtrade and ITC statistics. <http://www.intracen.org/itc/market-info-tools/trade-statistics/>.

Appendix 3: Farmer Producer Organizations in the Potato, Mango, and Gram Value Chains of Uttar Pradesh

Details of Farmer Producer Organizations in the Potato Value Chain of Uttar Pradesh

Parameter	Fatehabad FPC		Khet Kisan		Kanpur Mushroom		Rameshwar FPC		Kashi Vishwanath	
	Ltd., Agra	2016	Producer Company Ltd., Fatehpur	2016	Purvanchal FPC Limited, Jaunpur	2015	Producer Co. Ltd.	Ltd., Varanasi	FPC Ltd., Varanasi	2015
Year of establishment	2016	2016	2016	2016	2016	2015	2015	2015	2015	2015
Commencement of operations	2017	2017	2016	2016	2016	2015	2015	2015	2015	2015
Associated number of farmer members	1,000	1,000	551	551	300	250	1,000	1,000	1,000	1,000
Contributed share capital (₹)	1,000,000	1,000,000	500,000	500,000	500,000	775,000	1,000,000	1,000,000	502,000	502,000
Existing area under focus crop production under FPO (acres)	1,600	1,600	75	75	250	60	200	200	50	50
Existing production volumes of focus crop (MT)	12,000	12,000	750	750	1,500	600	2,000	2,000	700	700
Production- and marketing-related functions performed by FPO to facilitate backward and forward links	Sale of inputs (seeds, fertilizers and pesticides). Dealership of IFFCO and KRIBHCO for sale of their fertilizer. Potato seed production on 40 acres: 800 quintals of potato seed. Not involved in output marketing.	Sale of inputs (seeds, fertilizers, pesticides) to fellow farmers. Farming for quinoa and mustard. Potatoes cultivated by some member farmers but are not a focus crop for the FPO presently.	Sale of inputs (fertilizers, pesticides) to fellow farmers. Farming for quinoa and mustard. Potatoes cultivated by some member farmers but are not a focus crop for the FPO presently.	Sale of inputs to fellow farmers and sale of produce in local markets. Potatoes being cultivated by some member farmers but are not a focus crop for the FPO presently.	Sale of inputs to fellow farmers and sale of produce in local markets. Potatoes being cultivated by some member farmers but are not a focus crop for the FPO presently.	Sale of inputs to fellow farmers and sale of produce in local markets. Potatoes being cultivated by some member farmers but are not a focus crop for the FPO presently.	Involved in output marketing of potatoes and other vegetables (okra, capsicum). Had an outlet in a private market in Rajatalab but this is not providing any space to the FPO.	Sale of inputs (seeds, fertilizers, pesticides). Retail outlet in Panchkoshi Mandi for marketing vegetables. Has set up a farm machinery bank to lease agricultural equipment (e.g., tractor, thresher, rotavator).	Sale of inputs (seeds, fertilizers, pesticides). Retail outlet in Panchkoshi Mandi for marketing vegetables. Has set up a farm machinery bank to lease agricultural equipment (e.g., tractor, thresher, rotavator).	Sale of inputs (seeds, fertilizers, pesticides). Retail outlet in Panchkoshi Mandi for marketing vegetables. Has set up a farm machinery bank to lease agricultural equipment (e.g., tractor, thresher, rotavator).

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Continued

Parameter	Khet Kisan				Kanpur Mushroom		Kashi Vishwanath
	Fatehabad FPC Ltd., Agra	Producer Company Ltd., Fatehpur	Purvanchal FPC Limited, Jaunpur	and Vegetable Producer Co. Ltd.	Rameshwar FPC Ltd., Varanasi	FPC Ltd., Varanasi	
Current sales and annual turn-over (₹)	850,000	5 million. Turnover is mostly through input supply and farming of quinoa and mustard.	1 million	NA	2 million	NA	
Intent and ability to co-invest in market link development	Said it would be interested in contract farming for growing Chipsona varieties if there is a processing unit in the vicinity.	Said if it can get technical guidance on production planning, governance, and marketing, this would help it scale up its business activities.	Planning to supply fresh vegetables directly to households in Kanpur City.	Has applied for a fertilizer dealership from IFFCO. Is trying to get an outlet at the private market in Rajatalab to sell aggregated produce from its farmer members.	Makes potato chips and potato papad (cottage-level processing) through women's self-help groups and markets these under its FPO brand.		

Source: Deloitte India field data as of 2020.

Details of Farmer Producer Organizations in the Mango Value Chain in Uttar Pradesh

Parameter	Maihabad Mango FPC Ltd., Lucknow	Irada FPC Ltd., Lucknow	Avadh Aam Utpadak evam Baghwani Samiti, Lucknow	Vindhyaasini FPC Ltd., Sonbhadra
Year of establishment	April 2016	June 2016	2016	August 2016
Commencement of operations	2017	2016	2016	2017
Associated number of farmer members	180	400	200	500
Contributed share capital (₹)	180,000	175,000	-	1 million
Existing area under focus crop production under FPO (acres)	360	600	800	100
Existing production volumes of focus crop (MT)	2,500	3,600	5,000	420
Production- and marketing-related functions performed by FPO to facilitate backward and forward links	Input (fertilizer) trading and marketing of produce. Last year marketed 16 MT of mangoes in Vashi market, Mumbai.	190 MT of mangoes traded in past two seasons. FPO is also involved in input trading (fertilizers and seeds).	Focused on promotion of GAP in mango cultivation and is working closely with CISH, Lucknow, through its Farmers FIRS.	Input supply, composting, indirect marketing of mango at mandi.
Current sales annual turnover (₹)	800,000	NA	NA	NA
Intent and ability to co-invest in market link development	This season planning to do direct marketing in Lucknow, Bengaluru, Hyderabad, and Mumbai. Has also secured marketing link with Metro Cash and Carry to supply 1 ton of Dussheri mangoes daily during the current season.	Has registered on eNAM and will be getting an auction platform at the fruits and vegetables produce market in Lucknow.	Is interested in developing direct marketing links with buyers in distant markets and setting a mini-pulping unit.	Is looking forward for direct marketing of mangoes.

Source: Deloitte India field data as of 2020.

Details of Farmer Producer Organizations in the Gram Value Chain in Uttar Pradesh

Parameter	Vikas Path FPC, Lalitpur	Bamaur FPC, Jhansi	Prayag Raj FPC, Allahabad
Year of establishment	2016	2013	2015
Commencement of operations	2017	2014	2015
Associated number of farmer members	910	930	800
Contributed share capital (₹)	1 million	1 million	NA
Existing area under focus crop production under FPO (acres)	300+	2,400	400+
Existing production volumes of focus crop (MT)	180+	1,680	500+
Production- and marketing-related functions performed by FPO to facilitate backward and forward links	Involved in certified seed production. Expanded activities to contract farming and vegetable production. Presently generating revenue.	Sale of inputs (fertilizers, pesticides, seed) to fellow farmers and selling agricultural produce in distant markets and on eNAM.	Not engaged in direct marketing but facilitates sale of inputs, fertilizers, and seed to farmer members.
Current sales annual turnover (₹)	5.6 million	4 million	1.5–2 million
Intent and ability to co-invest in market link development.	FPO would like to expand its activities to production of biofertilizers and associated products; however, it needs government support in building and upgrading storage facilities and agriculture marketing infrastructure.	Very proactive, has taken a shop on rent in sub-market Bamaur and sold produce to distant markets like Mirzapur and Lucknow. Connected with traders and sold produce through eNAM. Requires support in creating infrastructure and sales. Needs help in ensuring timely availability of fertilizer and seeds.	FPO requires support but it has great potential and farmers are willing.

Source: Deloitte India field data as of 2020.

Appendix 4: Financial Analysis of Guava Orchard in Uttar Pradesh

Item	Year 1	2	3	4	5	6	7	8	9	10	15
I Expenditures (₹)											
1 Planting materials, land preparation, and transportation (assuming replacement of 2% from 2nd year)	38,200	764	764	764	764	764	764	764	764	764	764
2 Urea	2,033	2,033	2,033	2,033	2,033	2,033	2,033	2,033	2,033	2,033	2,033
3 DAP	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100
4 Farmyard manure and micronutrients	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
5 Labor	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
6 Irrigation charges including rent, labor, tanker fuel, etc.	31,200	31,200	31,200	31,200	24,960	24,960	24,960	24,960	24,960	24,960	24,960
7 Cost of weeding	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
8 Cost of plant protection	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500
9 Harvesting @ ₹1.2/kg	0	0	2,400	9,600	12,000	19,200	19,200	20,400	20,400	20,400	20,400
10 Additional cost of intercrops (seeds and planting material, labor, etc.)	12,000	12,000	8,000	6,000	0	0	0	0	0	0	0
A Total expenditure (₹)	137,783	100,347	98,747	103,947	94,107	101,307	101,307	102,507	102,507	102,507	102,507
II Income (₹)											
1 Production in kg (₹)	0	0	2,000	8,000	10,000	16,000	16,000	17,000	17,000	17,000	17,000
B Income from sale of guava @ ₹12/kg	0	0	24,000	96,000	120,000	192,000	192,000	204,000	204,000	204,000	204,000
C Income from intercrops (mustard, mentha/watermelon) (INR)	35,000	30,000	20,000	20,000	0	0	0	0	0	0	0
III Net Income (B+C-A) (INR)	(102,783)	(70,347)	(54,747)	12,053	25,893	90,693	90,693	101,493	101,493	101,493	101,493

Source: Deloitte India data analysis. 2020.

Other aspects	Details
Per kg price of guava realized by farmer (INR)	12
Replacement rate 2–15 years	2%
Internal rate of return at 10 years	15.18%
Internal rate of return at 15 years	21.42%
Payback period	8 years

Appendix 5: Synopsis of Recommendations on the Promotion of Farmer Producer Organizations

It is recognized that the collectivization of small and marginal farmers into producer organizations is an effective pathway to address many challenges faced by farmers.¹ In India, most farmers have an average landholding of 1 ha. Individual farmers cannot achieve economies of scale or afford to invest in technology and mechanization or postharvest facilities. They find it difficult to procure inputs; along with the lack of mechanization, this leads to low productivity. Individual farmers find it difficult to directly access buyers, especially for emerging high-paying markets. Development of FPOs is a feasible option for farmers to enhance their bargaining power and farm-related value creation, which has been established through various programs.²

A pilot program was launched in 2011–2012 by DAC&FW to promote FPOs. This was done in partnership with state governments and implemented through SFAC under two sub-schemes of the Rashtriya Krishi Vikas Yojana (RKVY)—namely the National Vegetable Initiative for Urban Clusters and the Program for Pulses Development for 60,000 villages in rainfed farming areas.

According to SFAC reports, the pilot program has shown encouraging results and has been able to mobilize 828,000 small and marginal farmers (toward a target of 885,000) into 822 registered FPOs; another 80 were in the process of registration as of October 2019 (footnote 2). In the meantime, DAC&FW issued policy and process guidelines for FPOs to help the states support FPO promotion as an activity under the RKVY.

Estimates vary regarding the total number of FPOs in the country. SFAC's strategy paper indicates that 5,000 FPOs have been formed over the past 10 years under various initiatives of the Government of India (including SFAC and NABARD), state governments, and other organizations. Of these, 3,200 FPOs (64%) are registered as producer companies and the others as cooperatives or societies.³ Another study estimates the present number of FPOs and FPCs in India at 7,374.⁴ These are spread across different states, with Maharashtra having the highest number (1,940) followed by Uttar Pradesh (750), which is 10% of the total FPOs in the country. In Uttar Pradesh, 25% of FPCs and FPOs are less than 2 years old and 80% less than 5 years old.

Most FPOs are in the early stage of development with wide-ranging memberships (having 100 to more than 1,000 members). It has been estimated by SFAC that 30% of FPCs and FPOs are operating viably, while 20% are struggling to survive. The remaining 50% are still in the mobilization, equity collection, and business planning phases (footnote 2).

Some studies have indicated the positive role of FPOs in increasing the net income of farmers, improving access to inputs and agro-services, institutional credit, market links, and higher efficiency in farming. Features of successful FPOs include strong board leadership, recruitment of experienced managers, robust charters, adherence to democratic processes, targeting niche domestic and export markets, thereby reducing competition and conflict with local trader networks, income diversification, and significant paid-up capital and scale of operation.

¹ Department of Agriculture and Cooperation. 2013. *Policy and Process Guidelines for Farmer Producer Organizations*. https://mofpi.nic.in/sites/default/files/fpo_policy_process_guidelines_1_april_2013.pdf.

² SFAC. 2019. *Strategy Paper for Promotion of 10,000 Farmer Producer Organisations (FPOs)*. <http://sfacindia.com/UploadFile/Statistics/StrategyPaperonPromotion10KFPOs.pdf>.

³ NABARD. 2019. *Farmer Producers' Organizations (FPOs): Status, Issues & Suggested Policy Reforms*. National Paper PLP. 2019–2020.

⁴ Annapurna. Neti, Richa. Govil, and Madhushree. Rao. 2019. Farmer Producer Companies in India: Demystifying the Numbers. *Review of Agrarian Studies*. 9 (2).

However, other studies have highlighted challenges such as a low capital base, insufficient external finance, talent gaps, operational issues, weak governance, and inadequate storage and processing facilities. Most FPCs and FPOs are undercapitalized. One estimate indicates that the median paid-up capital of all the FPOs and FPCs in India is only ₹106,000, although there are a few FPCs with paid-up capital (footnote 3).

Most producer companies do not have enough equity or fixed assets to raise loans. Banks are hesitant to offer loans to producer companies against inventory as collateral. Despite initiatives such as credit guarantee schemes and inclusion of loans of up to ₹20 million for FPCs and FPOs under priority sector lending, formal financial support remains weak.

Several reports on FPO performance document the historic collapse of cooperatives in India, owing in considerable part to elite capture and corruption. To date, there appears to be limited analysis of elite capture within FPOs; however, without strong producer organization-promoting institution support, FPOs are vulnerable to this outcome.

Earlier, the technical and management support provided to embryonic FPOs by producer organization-promoting institutions was limited to the first couple of years, which was insufficient for their sustainable operation. Support needs to be extended to 4–5 years. This has been proposed by several studies and papers on FPO development.

Suggestions for improving FPC and FPO establishment and performance are listed here⁵:

- Develop a methodology to score FPO performance, addressing financial, management, social, and environmental performance.
- Hold regular capacity-building on best management practices for FPO board members and other key appointees.
- Improve FPO risk management systems.
- Strengthen FPOs' capital base. The benefits of equity grant and CGF schemes of SFAC can be extended to all forms of FPOs, including smaller FPOs with membership of less than 500 farmers.
- Develop rural entrepreneurial ecosystems to nurture new rural entrepreneurs.
- Establish local FPO learning and development platforms.
- Link FPOs with nearby agriculture universities and management institutions.
- Mandate ministries and departments to implement all farmer-centric schemes through FPOs for efficient delivery of services and improved outcomes.
- Enable the convergence of resources for creation of farm infrastructure at FPO level for cleaning, grading, sorting, assaying, processing, branding, and transportation of agricultural commodities to delivery and market centers and establishment of CHCs for the benefit of shareholder members.
- State governments introduce appropriate flexible policy to scale up FPO promotion and to strengthen them to become self-sustaining commercially viable business enterprises, particularly for small produce.

To address the challenges and to encourage further development and sustainable operation of FPOs, DAC&FW launched a new scheme, the Formation and Promotion of 10,000 FPOs, in July 2020.⁶ The scheme aims to create a broad supportive ecosystem to form 10,000 new FPOs and provides support to new FPOs for up to 5 years from the year of creation in all aspects of management, inputs, production, processing and value addition, market links, credit links, and use of technology. There are also provisions in the scheme for matching equity grants from the government, which is required to strengthen the financial base of FPOs. The equity grant would be in the form of a matching grant of up to ₹2,000 per farmer member of the FPO subject to a limit of ₹1.5 million per FPO. The

⁵ Various sources including SFAC. 2019. *Strategy Paper for Promotion of 10,000 Farmer Producer Organisations (FPOs)* and NABARD. 2019. *Farmer Producers' Organizations (FPOs): Status, Issues & Suggested Policy Reforms*.

⁶ Ministry of Finance. Establishment of Farmer Producer Organisations (FPO). <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1605030#:~:text=Shri%20Thakur%20stated%20that%20pursuant,new%20FPOs%20with%20a%20total>; DAC&FW. 2020. *Formation and Promotion of 10,000 Farmer Producer Organizations (FPOs). Operational Guidelines*.

scheme also has a dedicated CGF, which will provide credit guarantees to ensure access of FPOs to credit from commercial banks and financial institutions.

The scheme proposes the creation of Produce Cluster Areas for FPO formation and management. A Produce Cluster Area is defined as an area wherein agricultural and allied produce of a similar nature is grown and an FPO can be formed for leveraging economies of scale in production and marketing.

Some state governments have launched their own programs for FPO development. The Government of Haryana recently launched its Crop Cluster Development Program to boost primary processing facilities in horticulture crop clusters through FPOs. These clusters were identified by surveying and mapping villages across the state for fruit and vegetable crops. Within these clusters, integrated packing houses for sorting and grading will be managed and run by FPOs. These will be bank-appraised projects with credit-linked subsidies. The scheme's strong points are in-house information technology links through e-services and deployment of outsourced cluster and district-based project extension managers.

The present study in Uttar Pradesh identified 10 financially viable FPOs (three for potatoes, four for mangoes, three for gram). No viable FPOs were found for guava and mustard. This is a low number in a state reported to have the second-largest number of FPCs and FPOs in India after Maharashtra.

Considering the present status of low penetration of viable FPOs in the selected commodities, long-term support for capacity-building is proposed, along with technology and postharvest infrastructure, access to finance, and establishment of market links. These interventions are in line with the recently launched government schemes and programs and would help the state government complement the implementation of schemes and programs.

The recommendations also propose that agro-enterprises develop village-level facilities and infrastructure. FPOs are not expected to replace the existing network of traders or commission agents. However, they can help farmers get better deals in Maharashtra, Madhya Pradesh, and Andhra Pradesh. The relationship between traders and FPOs is mutually beneficial as it gives traders access to a large number of farmers. While it is not expected that most farmers of Uttar Pradesh will be part of an FPO and will develop their own village-level infrastructure, this could be an important step toward transforming traditional value chains, given that there is strong government support for these initiatives.

Economies of scale are critical for the viability of investments, particularly for many of the proposed infrastructure developments that will be viable only if farmers are able to associate in larger groups (e.g., 500–1,000) to achieve the minimum viable scale. Hence, an overarching principle should be to first assess what processing, storage, handling, and agricultural services are already operating in specific clusters, what the threshold investments are for rural entrepreneurs, FPOs, and farmers to enter into them, and what sort of scale and technology is needed to compete. These detailed assessments should be a priority during project design.

One solution would be for FPOs to have equity participation in town-based marketing and processing enterprises delivering processes needing scale, while focusing locally on delivering services in short supply, including input supply, seed multiplication, equipment rental and operation services, groundwater tube well drilling and maintenance services, land preparation and chemical application, drying/sorting/cleaning services for some grain commodities, sorting and handling vegetables, milk and fish collection, and transport services. The private sector is generally reluctant to dilute its stake in FPOs. This model can be promoted through the proposed agribusiness venture funds and the private sector with the FPOs, which should be sensitized to the benefits of such collaborations. Gradually, FPOs can be co-owned with town-based FPCs, or a federation of FPOs could be promoted that can invest more in marketing and processing.

For any Uttar Pradesh investment program, FPO development and sustainability would take at least 3–4 years of sustained support, even if the program starts by cultivating the few existing FPOs, many of which have neither a large membership nor substantial paid-up capital. This is in line with the new scheme on Formation and Promotion of 10,000 FPOs and provides support to new FPOs for up to 5 years from the year of creation in all aspects of management, inputs, production, processing, value addition, market links, credit links, and use of technology to make them sustainable. There are examples from other states in India where FPOs have shown significant progress in 3–4 years based on continuous project support. Case studies are included in this report.

For a large and complex state like Uttar Pradesh, it will take time to bring about transformational change in the FPO ecosystem. This program can provide a good foundation for such a change. The state government should take the opportunity of convergence with the new Government of India scheme for FPO promotion and provide additional support.

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Appendix 6: Details of Relevant Government Policies and Initiatives

A. National Policies

Mega Food Parks Scheme, Ministry of Food Processing Industries, Government of India

MoFPI launched the Mega Food Parks Scheme in 2008–2009 to provide a mechanism to link agricultural production to the market by bringing together farmers, processors, and retailers. The scheme is based on a cluster approach and envisages state-of-the-art infrastructure in a well-defined agro-horticultural zone, with modern food processing units in the industrial plots provided in the park and well-established supply chains. A mega food park typically consists of supply chain infrastructure with collection centers, primary processing centers, central processing centers, a cold chain, and 30–35 fully developed plots for entrepreneurs to set up food processing units.

The Mega Food Parks Scheme is implemented by Special Purpose Vehicles (SPVs) created for this purpose. State government entities and cooperatives setting up the parks are not required to form a separate SPV. The Ministry provides a grant as a capital subsidy of up to ₹500 million to build a park with a minimum land area of 50 acres.

To date, the Ministry has approved 42 mega food parks under the scheme, of which only 12 are functional. Many functional parks are yet to attract a sufficient number of private sector actors to set up food processing units. For the parks under implementation, some are yet to complete construction 6–7 years since their approval. The Ministry cancelled 17 allotments as implementation could not start for various reasons; these were given to new bidders.¹

Lessons learned²:

- The scheme guidelines have certain rigidities in terms of SPV composition, land requirements, components, and government controls, which the private sector has found too restrictive.
- The scheme has certain basic requirements, 50 acres of contiguous land in possession of the developer being one. Obtaining this at a reasonable price has been a challenge, and this has led to approval of projects in remote locations or inappropriate locations.
- Initially, no SPV member was allowed to own a majority stake in the SPV, which became a disincentive for large private sector actors. This and the issues of government control resulted in low interest among large private sector actors.
- Along with the processing and common infrastructure, the SPVs were to make primary processing centers and collection centers compulsorily. These were designed to facilitate establishing backward links. However, the actual requirements of the private sector were not taken into consideration and did not receive positive responses from the SPVs.
- Scheme design envisaged premarketing the projects by including at least five food processors as part of the SPV. For interpersonal, political, bureaucratic, and financial reasons, this has not happened, which has led to ineffective composition of SPVs.

¹ S. Mukherjee. 2015. *Mega Food Park Plan Needs to Be Redesigned*. ICRIER. https://www.business-standard.com/article/economy-policy/mega-food-park-plan-needs-to-be-redesigned-icrier-115101300080_1.html.

² Deloitte India's own assessment and other sources such as ICRIER. 2015. *Report on Evaluation of the Impact of the Scheme for Mega Food Park of the Ministry of Food Processing Industries*.

- According to the present model, the plots inside the mega food parks cannot be sold by SPVs to the units set up in the park. Leasing is the preferred mode of land transfer. This has led to challenges for the SPVs in getting bank loans, because of nonacceptance of leased land as collateral by the banks.
- The business model has been found to be restrictive as the SPVs can only charge rent from the units but cannot undertake processing and marketing on their own.
- Flexible scheme guidelines are important, as is an understanding of the business interests, capacities, existing infrastructure, and focus of private sector actors. The private sector, especially large companies, may not be interested in highly regulated end-to-end value chain development projects. Hence, stakeholder consultations should be held with the private sector during the design stage of such interventions.
- This being a central scheme, collaboration with state governments has not been carried out effectively, resulting in limited participation and delays in statutory approvals and other support.
- The food parks are mainly an infrastructure scheme, with no emphasis or allowance for expenditure on forging backward links with farmers or extension workers. Although the primary processing centers and collection centers are supported under the scheme, there is no focus on engaging farmers or FPOs directly. Understanding the private sector business interests in terms of procurement from farmers and FPOs directly has been lacking, which has led to less interest from the private sector.
- Links with farmers groups and FPOs are important in creating an integrated value chain and a win-win situation for private investors, farmers, and FPOs. Hence, the geographical spread of farmers' organizations and the crops grown should be studied and then matched with the interests of the private sector in procuring such crops during the design stage.

Scheme for Creation of Backward and Forward Links, Ministry of Food Processing Industries, Government of India

MoFPI launched the Scheme for Creation of Backward and Forward Links in 2017–2018, with the aim of providing effective and seamless backward and forward integration for the processed food industry by plugging the gaps in supply chains in terms of availability of raw material and market links. The scheme is applicable to perishable horticulture and non-horticulture produce such as fruits, vegetables, dairy products, meat, poultry, fish, honey, and spices. The scheme envisages components of backward links that would include integrated packing houses, milk chilling units, precooling units, minimal processing (cutting, dicing, pulping, canning, waxing) units, and cold storage. Forward links would include retail chain of outlets with facilities for frozen stores, deep freezers, chillers, a distribution center associated with retail chains, and transport vehicles associated with backward and forward links.

The scheme allows FPOs, FPCs, self-help groups, individual entrepreneurs, public sector undertakings, promoters of food processing units, and corporate entities to be eligible for financial assistance. The Ministry approves plans for each project at 35% of the eligible project costs for general areas and at 50% for difficult areas, subject to a maximum of ₹50 million per project.

To date, the Ministry has approved 64 projects, with 12 in Maharashtra and two projects for FPOs.³ The scheme invited Expressions of Interest from FY 2017 and since then has extended the deadline for application multiple times as few applications have been received.

Lessons learned:

- The scheme provides grants up to a maximum of 35% only on eligible components in general areas. There are many infrastructure support schemes run by different state governments that provide grants up to 75%, hence the limited participation of entrepreneurs in the Ministry's scheme.

³ MoFPI. www.mofpi.nic.in;http://mofpi.nic.in/sites/default/files/website_notice_0.pdf.

- The scheme has a mandatory component of 20% of project cost to be taken as a term loan from a bank but there is no component for facilitation of access to financing. This is a major hurdle for the participants, especially for FPOs.
- The scheme requires industrial land and industrial converted land for setting up infrastructure. Many FPOs and farmer groups have agricultural land that they find difficult to convert to industrial land so they cannot participate.
- The scheme allows participants to choose land with no restrictions on location or type, which enables flexibility.
- The scheme focuses on hard interventions such as developing infrastructure for value addition and processing. The need for capacity-building and soft skills is not addressed.
- There is no scheme component for supporting marketing, e-marketing, or advertising to be carried out by private entrepreneurs and FPOs selling processed goods. Developing market links is the sole responsibility of the FPO making the application.
- The scheme covers most perishable crops, thus providing flexibility to entrepreneurs and FPOs.

Cold Chain Scheme, Ministry of Food Processing Industries, Government of India

MoFPI launched the Cold Chain Scheme in 2008 to provide integrated cold chain and preservation infrastructure facilities, without any interruption, from farm gate to consumer. The scheme covers the creation of infrastructure along the entire supply chain, which can include multiproduct and multilevel cold storage, controlled atmosphere storage, IQF, and blast freezing in distribution hubs, reefer vans, and mobile cooling units with an emphasis on cold chain infrastructure at farm level.

The applicant can be a partnership firm, corporation, cooperative, self-help group, FPO, NGO, or public sector undertaking. The Ministry approves grants for each project for storage infrastructure, including packing houses at 35% of the eligible project cost for general areas and 50% for difficult areas, for value addition and processing infrastructure, including frozen storage, and irradiation facilities at 50% for general areas and 75% for difficult areas.

To date, MoFPI has approved 274 projects under the scheme. Maharashtra has the highest number of projects approved in the scheme with 59 projects, 29 of which have stated commercial operations. Uttar Pradesh has 23 projects, of which 16 have been completed.⁴

⁴ MoFPI. www.mofpi.nic.in.

Lessons learned:

- The scheme has a mandatory component of 20% of project cost to be taken as a term loan from a bank or financial institute but there is no component for facilitating access to financing. This is a major hurdle for the participants, especially FPOs.
- The scheme requires the applicant to have a net worth of more than 1.5 times the grant applied for, thus limiting the participation of FPOs, farmer groups, and entrepreneurs.
- The scheme allows submission of in-principle term loan sanction letters instead of final sanction letters from a bank of financial institution to apply under the scheme, thus allowing some flexibility to the applicants.
- The scheme focuses on hard interventions such as developing infrastructure for value addition, processing, and cold storage. The need for capacity-building and developing soft skills is not addressed.
- The scheme mandates the applicant to establish farm-level infrastructure along with a distribution hub and refrigerated vans. There is no scope for establishing a stand-alone minimal processing unit or value addition center, thus limiting participation from FPOs and farmer groups.

Scheme for Creation and Expansion of Food Processing and Preservation Capacities Scheme, Ministry of Food Processing Industries, Government of India

MoFPI launched the Creation and Expansion of Food Processing and Preservation Capacities Scheme in 2017 with an objective to modernize and expand food processing units to increase the level of processing, and value addition and thereby a reduction of waste and an increase in farmer incomes. The scheme covers creation of infrastructure facilities along the entire supply chain, including packing houses, preservation units, packing facilities, cold storage, IQF freezing, blast freezing, reefer vans, and mobile cooling units with an emphasis on processing capacities at farm level.

The applicant can be a partnership firm, corporation, cooperative, self-help group, FPO, NGO, or public sector undertaking. The Ministry approves grants for each project at 35% of the eligible project cost for general areas and 50% for difficult areas. The scheme gives preference to processing units set up in mega food parks, and agro-processing clusters assisted by the Ministry or designated food parks in the state.

To date, the Ministry has approved 134 projects under the scheme. There are 15 projects in Maharashtra, all in the implementation stage.⁵ The scheme started inviting expressions of interest from December 2017 and since then has extended the deadline many times as few applications have been received.

Lessons learned:

- The scheme gives preference to processing units that propose setting up in mega food parks, agro-processing clusters, or designated food parks, thus limiting the flexibility of entrepreneurs and FPOs to choose the location of their processing units. Entrepreneurs and FPOs should be given the freedom to set up processing units on their own land near production clusters.
- The scheme requires the applicant to have a net worth of more than 1.5 times the grant applied for, thus limiting the participation of FPOs, farmer groups, and entrepreneurs.
- The scheme requires the proposed project to have a project cost of more than ₹30 million in general areas and more than ₹10 million in difficult areas, thus limiting the participation of FPOs, farmer groups, and entrepreneurs in the scheme.

⁵ MoFPI. www.mofpi.nic.in.

- The scheme provides a grant with a maximum of 35% only for eligible components in general areas. There are many infrastructure support schemes run by different state governments that provide grants up to 75%, hence limited participation of entrepreneurs here.
- The scheme focuses only on hard interventions such as developing infrastructure for value addition, processing, and cold storage. The need for capacity-building and developing soft skills is not addressed.
- There is no scheme component for supporting marketing, e-marketing, or advertising that should be carried out by private entrepreneurs and FPOs selling processed goods. Developing market links is the sole responsibility of the FPO applicant.

Operation Greens Scheme, Ministry of Food Processing Industries, Government of India

MoFPI launched the Operation Greens Scheme for the integrated development of the tomatoes, onions, and potatoes value chains in November 2018, with an objective of enhancing value realization for farmers, price stabilization for consumers and producers, reduction of postharvest losses, an increase in processing capacities, and setting-up of market intelligence networks. The scheme proposes a two-pronged strategy of price stabilization measures and integrated value chain development. The main components of the scheme are as follows:

- short-term price stabilization measures
 - » support for transportation of crops from production to storage;
 - » support for arranging storage facilities for crops.
- long-term integrated value chain development projects
 - » support for capacity-building of FPOs and their consortia;
 - » support for improving quality of production through providing quality seeds, setting up nurseries, mechanization of farm practices, promoting contract farming, and varietal change based on market demand;
 - » postharvest management through support for development of processing infrastructure at farm level, secondary processing facilities, and transportation facilities.
- agro-logistics support for development of integrated multimode transportation facilities
 - » support for creation of marketing yards, retail outlets, storage facilities at market level, and creation of e-markets.

NAFED is the lead agency in implementing short-term price stabilization measures. For long-term integrated value chain development projects, the applicant can be a state agricultural or marketing federation, FPO, farmer group, cooperative, self-help group, food processor, logistics operator, or state/central government entity.

The Ministry will approve a subsidy at 50% for price stabilization measures for each project and 50% of the eligible project cost for integrated value chain development projects. If the applicant is an FPO, the grant will be 70% for integrated value chain development projects.

Public–Private Partnership for Integrated Agriculture Development Program under Rashtriya Krishi Vikas Yojana, Ministry of Agriculture and Farmers Welfare, Government of India

MoAFW launched Public–Private Partnership for Integrated Agriculture Development Program in 2012–2013 to facilitate large-scale integrated projects led by the private sector in the agriculture and allied sectors with a view to aggregating farmers and integrating the agricultural supply chain with financial assistance from RKVY. The objective is to address all concerns relating to production and postharvest management in agriculture and allied sectors, enhance production and productivity through technology, create employment, improve value chains, and ensure farmer profitability.

The Ministry designated SFAC as the national lead agency to examine proposals from a technical viewpoint and thereafter propose it for funding to the state government. Applications under the scheme are allowed from technology providing companies, end user companies (processors, exporters, retailers), FPOs, business entities, and corporations.

The scheme mandates that applicants must ensure development of an integrated value chain approach, covering all aspects from production to marketing, and include mobilizing farmers into producer groups, technology infusion, value addition, and marketing solutions.

Lessons learned:

- The scheme proposes to develop integrated agricultural development projects with a mandate to cover at least 5,000 farmers in each project. This has deterred participation from small private sector companies and entrepreneurs and to some extent from the corporates, as covering such a large number of farmers in each project is difficult.
- Applicants have to develop a complete integrated value chain solution covering the formation of FPOs, technology infusion, marketing, and value addition. This eliminates participation for the development of individual components of the value chain.
- Invited applicants are technology providers, processors, and input supplier companies, but they have to partner with other organizations to cover aspects of the scheme not related to their expertise. This is an obstacle to participation as partnering with multiple organizations on such a large project is complex.
- The amount of investment required from the applicants is pegged at a minimum of ₹100,000 per farmer in each project. Such a high investment cost makes it difficult for FPOs and farmer groups and even corporates to participate.
- The scheme caps government support at 50% or ₹50,000 (whichever is lower) per farmer investment cost by the applicant. Any additional investment cost has to borne by the applicant.
- The scheme provides applicants with the flexibility to select project land according to their needs and availability. This vies some freedom to applicants.
- Most projects under the scheme have a maximum expenditure on providing subsidized agro-inputs followed by agro-extension activities, thus limiting the scope for value addition through processing and postharvest management activities.

Mission for Integrated Development of Horticulture, Ministry of Agriculture and Farmers Welfare, Government of India

MoAFW launched MIDH in 2014, subsuming individual schemes for the development of horticulture and integrating various schemes to harness the potential of horticulture in the country. The objectives of the mission are holistic growth of the horticulture sector through improved productivity, enhanced horticulture production, augmenting farmer incomes, aggregation of farmers into farmer groups, skills development, and employment creation.

Major components covered under the scheme are establishment of nurseries, area expansion, development of water harvesting structures, mechanization of horticulture, development of postharvest infrastructure, capacity building of farmers, and establishment of centers of excellence. The scheme contributes 35%–50% of the eligible project costs in most of the components with corporates, entrepreneurs, FPOs, cooperatives, self-help groups, and private sector actors eligible to apply. Centers of excellence can be established only by public sector entities, with a maximum grant of ₹100 million per center.

To date, 4,650 cold storage facilities with 20.65 million MT capacity, 478 ripening chambers, 411 reefer trucks, and 28 centers of excellence have been established with training and capacity-building for 2.3 million farmers.⁶

Lessons learned:

- The scheme focuses on hard interventions such as developing infrastructure for value addition, processing, and cold storage, as well as soft interventions such as training and study tours for farmers. This has led to the overall capacity-building of farmers along with the development of supporting infrastructure.
- The scheme provides only credit-linked, back-ended subsidies for development of post-harvest infrastructure such as packing houses, cold stores, and cooling units. Thus, the entrepreneur or FPO must invest the total project amount upfront and get the grant after completion. This results in low participation by FPOs and farmer groups.
- The scheme has a component on developing centers of excellence with international collaboration that will act as demonstration and training centers for the latest technologies and a source of planting material.

Agriculture Price Policy and Minimum Support Price, Government of India

The Agriculture Price Policy has been the cornerstone of agro-marketing policies of the Government of India since the 1970s. It aims to incentivize the production of major crops undertaken by farmers and to ensure remunerative prices for agricultural commodities based on the cost of production. At the same time, the policy aims to safeguard consumer interests by ensuring that basic food commodities are available to the public at reasonable prices.

The MSP is the most important policy instrument under the Agriculture Price Policy. The Government of India fixes the MSP for major crops at the beginning of the cropping season based on recommendations from the Commission for Agricultural Costs and Prices for 22 major agricultural commodities; in the case of sugarcane, the Fair and Remunerative Price is declared.

The MSP acts as a protection for farmers who might suffer from sharp falls in the market prices of agricultural commodities, especially during years of surplus production. Some of the important factors taken into consideration while fixing the MSP are as follows:

- cost of production;
- increase or decrease in the cost of major inputs (seeds, fertilizers, pesticides);
- demand and supply dynamics;
- market trends;
- effect on general price level and cost of living (from point of view of consumers).

The MSP influences production trends in a major way since farmers prefer to cultivate those crops that have a higher MSP. Although the MSP is declared for 22 commodities, it is not possible for the government to undertake procurement of all commodities; it must, therefore, select major commodities like rice, wheat, gram, mustard, and jute.

⁶ MIDH. <http://midh.gov.in/PDF/Presentation%20on%20MIDH,%20October-2018.pdf>.

B. State Policies

Uttar Pradesh Food Processing Industry Policy 2017

This policy aims to develop the food processing industry in the state by augmenting current capacity and to achieve a level of value addition and processing up to 20% in the next 5 years from the current processing capacity of 6%. The major objectives outlined are:

- fair and remunerative prices to growers;
- value addition to the price of raw produce;
- promotion of food processing industry startups;
- easy availability of processed food products to consumers at competitive prices;
- generation of new employment opportunities to build capacities; and
- increased skill level of people working in this sector.

The policy has identified priority sectors and activities to ensure the private sector is encouraged to make investments in the state:

- development of infrastructure facilities;
- identification of food processing zones;
- development of food processing parks, mega food parks, and cold chain facilities;
- providing a conducive atmosphere for setting up food processing industries; and
- simplification of procedures.

Table A6.1: Food Processing Industry Policy, 2017

Particulars	Type of Subsidy	Subsidy Details	Eligible Works, Industry
Setting up food processing units	Capital investment subsidy	25% of incurred expenditure on plant and machinery and technical civil work subject to a maximum of ₹5 million Under the Pradhan Mantri Kisan SAM-PADA Yojana scheme, an additional 10% capital investment subsidy on cost of plant and machinery and technical civil works An additional subsidy at the rate of 10%, for mega food parks sanctioned under Pradhan Mantri Kisan SAMPADA Yojana scheme	Setting-up, expansion, modernization of food processing units in the state Only for fruit and vegetable processing units; setting-up of new units and modernization of existing units Minimum capital investment of ₹5 million
	Interest Subsidy	100% of the interest accrued on loans taken from banks or financial institutions toward the cost of plant and machinery, technical civil works, and spare parts; reimbursed for a maximum period of 5 years Interest subsidy at the rate of 7% on loans taken from banks or financial institutions toward the cost of plant and machinery, technical civil works and spare parts; reimbursed for a maximum period of 5 years	Micro and small food processing industries All other food processing units established in the state
	Interest subsidy	Interest subsidy at the rate of 7% or actual interest rate (whichever is less) for loans taken from banks or financial institutions. The maximum is ₹5 million	NA

Source: Department of Horticulture and Food Processing, Government of Uttar Pradesh. 2017. The Uttar Pradesh Food Processing Industry Policy-2017. <https://uphorticulture.in/pdf/GOenglish.pdf>.

Financial concessions and grants would also be provided for the following:

- creating infrastructure for degree, diploma, and certificate courses in food processing;
- skill development for food processing;
- food processing promotional facilities;
- promotion of standardization;
- provisions for patent and design registration;
- provisions for marketing development and brand promotion; and
- assistance for preparation of bankable projects for food processing units.

New Agricultural Policy Uttar Pradesh 2013

This policy was developed after acknowledging the multiple challenges the state was facing:

- increasing population;
- depletion of natural resources;
- unplanned urbanization and industrialization;
- unplanned use of chemical fertilizers;
- increasing air, water, soil, and noise pollution, as well as consumerism.

Multiple factors, such as the increasing cost of cultivation and a lack of postharvest management and processing infrastructure, are affecting the profitability of agriculture. Declining profitability is further compounded by reduced operational land holdings in the state and the threats posed by climate change.

The policy outlines a strategy to make agriculture more profitable and sustainable. Its mission and area of intervention are outlined below.

Mission:

- Achieve 5.1% agricultural growth.
- Encourage sustainable management and conservation of natural resources.
- Develop agricultural research, extension, input management, and agricultural marketing.

Objectives:

- Achieve a growth rate of 5.1% in agriculture and allied sectors.
- Develop and promote eco-friendly agricultural practices to sustain soil health and increase farmer incomes.
- Ensure ecological balance by promoting conservation and development of natural resources.
- Promote agricultural diversification to ensure food security and value addition for increasing the incomes of agro-dependent households.
- Develop basic facilities for seeds, fertilizers, pesticides, marketing, agricultural machinery, and food processing and promote the private sector by encouraging contract farming.

Areas of interventions are outlined as follows.

- Ensuring Food Security and Nutrition for the State Population
 - » Improve input management by encouraging quality seed production and distribution; ensure availability of organic and chemical fertilizers, micronutrients, and agricultural machinery.
 - » Promote GAP to reduce production costs and improve yields and quality of outputs.
 - » Diversify by promoting allied activities, including animal husbandry, dairy farming, fisheries, and poultry.
 - » Increase cropping intensity by promoting short-cycle summer crops.
 - » Promote nonconventional energy resources.
 - » Encourage private participation for extension, particularly for production and distribution of agricultural inputs.
 - » Promote soil health management and water conservation measures.
 - » Prevent crop losses from wild animals.
- Environment Management and Efficient Use of Natural Resources
 - » Improve soil management through effective crop residue management and promotion of balanced fertilizer use, vermicompost, organic fertilizers, and soil testing labs.
 - » Water management: promote micro-irrigation; revisit cultivation of water-intensive crops in unsuitable areas; develop strategies for conserving water and preventing losses in groundwater; develop drought mitigation strategies; promote flood-tolerant crops; and develop interventions for using excess flood water from canals.
 - » Climate change: promote biodiesel; integrated management of groundwater, rainwater, and surface irrigation; awareness-raising on climate change; and encourage water recycling.
- Agricultural Input and Credit Management
 - » Focus on timely availability of key inputs, fertilizers, irrigation, farm mechanization, and production and availability of quality seeds and planting material, and promote investment for agricultural activities.
 - » Work toward self-sufficiency in production of key agricultural inputs at district level; promote hiring centers for farm mechanization and make better use of canal systems.
 - » Promote integrated pest management and biofertilizers; strengthen development and production of biofertilizers, promote soil moisture management, and micro-irrigation.
- Strengthening Agricultural Extension
 - » Encourage coordination and cooperation among departments, institutions, and universities providing extension and training on fertilizers, seeds, dairy, fisheries, agricultural machinery, pesticides, agro-clinics, and animal husbandry. This includes development of district agricultural technology management centers for extension and developing integrated farming.
 - » Encourage convergence with private stakeholders for training and extension; get full support from KVKs at block level for training and capacity-strengthening of staff at district level by coordinating with universities; and encourage the active participation of women.
 - » Disseminate information about new developments and GAP to farmers; ensure all information on schemes, prices, and incentives is easily available on the websites of departments.
- Agricultural Diversification
 - » Diversify high-value crops; promote crop diversification and crop rotation; promote integrated farming by encouraging allied activities including dairy and poultry farming, fisheries, horticulture, and spice and mushroom cultivation.
 - » Develop clusters for fruit and vegetable production; promote the balanced use of fertilizers and pesticides in the production of horticulture crops, ensuring availability of quality planting material; promote medicinal plants and spices; develop wholesale markets for fruits, flowers, and vegetables; strengthen cooperatives and farmers' groups; and develop storage infrastructure to reduce losses and increase shelf life.

- » Rejuvenate old orchards; promote private investment and processing for better price realization for farmers.
- » Strengthen dairy activities and milk production; strengthen cooperatives for milk procurement, quality testing, and marketing; ensure availability of paravets at village level; breed improved indigenous animals; improve the productivity of indigenous species; and strengthen livestock health interventions and fodder development.
- » Promote backyard poultry; promote value addition and processing of dairy products and fisheries; encourage private investment for development of fish nurseries and hatcheries; integrate development of ponds and lakes; promote conservation of fisheries and related resources; promote private investment for fish fodder development; and establish fish markets.
- » Improve productivity and value addition of sugar cane and its processing infrastructure; encourage sericulture activities through self-help groups and cooperative societies; use wasteland and unused village council land for silk production.
- Postharvest Management and Development of Processing Infrastructure in State
 - » Promote scientific, right-time storage and produce marketing; train farmers in packing, sorting, and grading produce.
 - » Provide incentives for purchasing equipment and crates; promote value addition and processing at village level, along with branding and marketing produce.
 - » Promote private sector food processing; establish quality testing labs; connect horticulture production sectors with food parks.
 - » Disseminate information on quality parameters, rules, and regulations on processing; encourage convergence between farmers, traders, processors, and exporters.
- Development of Farmer-Friendly Marketing Infrastructure in State
 - » Develop marketing infrastructure and promote transparency in grading and sorting at market level.
 - » Develop markets and e-pashu Haats web portals at village council level; develop major markets at township level; promote e-trading and single unified licenses.
 - » Make efforts to prevent price distortion in the market and promote stability through contract farming; develop infrastructure for packaging, grading, and quality certification at market level; develop quality parameters and awareness-raising activities.
- Ensuring Economic Well-Being of Farmers Through Agriculture
 - » Promote large-scale processing and cold storage infrastructure at district level by providing subsidies to the private sector; ensure continuous availability of electricity to all stakeholders.
 - » Promote alternative and renewable sources of energy; encourage biodiesel production and farming of energy crops on wasteland.
 - » Promote organic cultivation; promote exports and develop enabling infrastructure for facilitating exports; provide technical support for granting patents; develop Geographic Identification tags for crops and products.
- Risk Management
 - » Promote disaster management and provide crop insurance; ensure availability of seeds during unfavorable climate conditions.
 - » Develop Geographical Information System-enabled crop management services; develop modules on risk management in agriculture and awareness-raising about diseases; improve weather prediction.
- Encourage Women's Participation in Agriculture
 - » Encourage gender mainstreaming in training and capacity-building programs; encourage easier access to credit for women; promote women's self-help groups.

- » Promote the sale of agricultural produce by women farmers through cooperative societies; develop agricultural equipment and techniques to reduce drudgery; develop gender-sensitive training modules.
- Development of rural infrastructure
 - » Ensure the availability of basic infrastructure and facilities such as roads, electricity, credit facilities, and processing and storage facilities at the village level.
 - » Encourage investment in irrigation and promote micro-irrigation and village-level water harvesting projects.
 - » Encourage village councils and associated institutions to take a more active role in planning and development of rural infrastructure.
- Promotion of Agricultural Research, Education, and Human Resource Development
 - » Strengthen state agricultural universities; promote investment in training young scientists and experts; explore employment opportunities for youth in the agriculture sector.

Uttar Pradesh Krishi Utpadan Mandi Adhiniyam 1964 (Amended in 2018)⁷

Uttar Pradesh Krishi Utpadan Mandi Adhiniyam governs the wholesale, storage, and processing of agricultural, horticultural, and animal husbandry produce in the state. Under the act, state government can notify and de-notify commodities (put them on and them off the list), and designate markets and regulated trading areas.

The act gives market committees the power to collect taxes and development cesses (taxes). Traders, processors, or wholesalers need a license to operate in the market yards, but primary producers can sell their produce anywhere without paying any taxes or cesses.

The present act regulates the trade of more than 150 commodities:

- 14 cereals, coarse cereals, and millets;
- 14 pulses, including soybean;
- 12 oilseeds;
- 6 minor forest products;
- 7 fiber crops;
- 2 fodder crops;
- 15 animal and dairy products;
- 23 miscellaneous crops;
- 8 spices;
- 80 fruits and vegetables, including grapes⁸;
- Apiculture, pisciculture, and sericulture produce.

The act has been amended over the years to provide more flexibility with some of the recent amendments listed next.

⁷ Government of Uttar Pradesh. Uttar Pradesh Mandi Council. http://upmandiparishad.upsdc.gov.in/images/pdf_files/mandi_act2018.pdf.

⁸ Uttar Pradesh has given cabinet approval for an ordinance to de-list 46 fruits and vegetables from the purview of the act. http://www.upkrishivipran.in/pdf/1_Go.pdf.

Amendment	Provision
6.7.1.1	The state can notify any warehouse, cold store, silo, packing house, or processing unit as a submarket yard to facilitate trade of agricultural commodities.
6.7.1.2	The limit for a market tax or development cess is set at 2% and 0.5%, respectively.
6.7.1.3	Provisions for direct marketing and private market yards.
6.7.1.4	Provisions for electronic trading.
6.7.2	Provision for single unified license for trading across Uttar Pradesh.
6.7.3	Amendments to encourage private sector participation and flexibility for commodities trade.

A total of 125 five markets have been integrated into the Government of India's eNAM. In addition, the State Agricultural Marketing Board provides financial support to registered farmers within the market committee

- up to ₹300,000 in case of accident or death;
- up to ₹5,000 for crop damages due to accidental fire;
- periodic performance rewards for selling produce in mandi yards;
- student scholarship for higher degree in agriculture and related subject;
- financial support to commission agents and traders in case of accident; or
- financial support for damages due to fire on mandi premises.

Uttar Pradesh Potato Development Policy 2014

This policy aims to facilitate better rate realization for potato farmers and to promote quality seed production for cultivating processing potatoes. It aims to achieve the following objectives:

- Produce quality seed for potato cultivation.
- Promote advanced practices for potato cultivation.
- Ensure sufficient cold storage capacity for seed grade and table grade potatoes.
- Promote potato marketing outside the state and export to international markets.
- Promote potato processing industries in the state.
- Promote skill development and technical transfer of scientific methods to farmers for potato production.

Seed production program: Under the policy, there is provision to subsidize farmers to take up production of certified seed potatoes. Some of the salient features of this scheme are as follows:

- Interested farmers should have land with sufficient irrigation facilities and should be interested in taking up seed production and have the capacity to manage the due diligence required for seed production and certification processes.
- Farmers need to register with the state Seed Certification Institute.
- Seed production must be taken up on a minimum of 5 ha (separate plots must be within a 1 km² area). Several farmers can farm these plots as a seed production group.
- Each member of a group must produce seed on an area of at least 0.50 ha.
- Each farmer in a seed production group is eligible for a subsidy for 0.5 ha of the production area (₹10,000/ha). The subsidy is transferred directly to the account of the beneficiary farmer.
- To apply for this program, farmers need to register online at upagriculture.com.

The policy has provisions to facilitate buyer–seller meetings to promote marketing in other states. There is also a provision to distribute certified potato seeds to farmers on a first-come, first-served basis through the District Horticulture Office.

Uttar Pradesh Cold Storage Regulation Act 1976

The Central Cold Order of 1980 regulates the cold storage industry. However, Uttar Pradesh has its own cold storage act: the Uttar Pradesh Cold Storage Regulation Act of 1976. This has provisions for fixing the maximum rental charge for storage of produce; for compensation to farmers in the event of spoilage of produce stored in cold stores; for grievance redressal; and for using the stored produce as collateral for loans.

In Uttar Pradesh, potatoes are the main commodity in cold stores. Some of the enabling provisions are listed as follows.

- There is a provision to enable early booking of cold storage space by paying a reservation fee. The reservation fee must be returned to the farmer when he or she pays the storage rental at the time of clearing his or her produce storage.
- After unloading produce, the farmer need not pay any other charges to the cold store owner other than the rental fee.
- The farmer can inspect the stored produce at any time and can weigh 10% of the produce when collecting the produce.
- There is a provision for loans to farmers using the stored produce as collateral. The interest rate is 0.5% more than the bank rate or 15% per annum, whichever is less.
- The farmer may take produce back by paying the storage rental. There is provision to take part of the produce according to the farmer's requirement by paying the rental fee for the amount withdrawn.

Export Promotion Schemes by Uttar Pradesh Mandi Parishad

The Uttar Pradesh Mandi Council has schemes to promote exports of rice, potatoes, and mangoes. These policies are outlined next.

Taj Brand Potato Promotion Scheme

- Export quality potatoes produced in the state can be exported under the Taj brand.
- Under this scheme, a brand promotion grant of ₹0.50/kg and a transport grant of ₹2.0/kg is provided to exporters who export under the Taj brand.
- This scheme is available to exporters and individual farmers.

Nawab Brand Mango Promotion Scheme

- Export quality mangoes produced in the state can be exported under the Nawab brand.
- Under this scheme, there is grant assistance for mangoes exported by air, sea, and road.
- If the produce is exported by air or sea, ₹13/kg is provided as a grant and ₹13/kg is provided toward freight, or 25% of the cartage, whichever is less.
- If the produce is exported by road, the total export promotion grant, including the freight grant, is ₹6.5/kg.
- The exporter must meet the export quality criteria.
- To encourage farmers to take up production of export quality mangoes, a promotion grant of ₹6/kg is provided to the farmers the exporters buy from.

Export Promotion Schemes by Export Promotion Bureau, Government of Uttar Pradesh

The Government of Uttar Pradesh established the Export Promotion Bureau (EPB) in 1999. It provides fiscal incentives to exporters, offers capacity building programs, and conducts research to identify export markets.

Manufacturers and exporters must register with the EPB to qualify for fiscal incentives under its export promotion schemes, as outlined in Table A6.2.

Table A6.2: Fiscal Incentives under Export Promotion Schemes of State Government

Scheme	Eligibility	Details
Marketing support		
Foreign fairs and exhibitions	Micro-, small- and medium-sized enterprise exporter registered with EPB and concerned District Industries Center	60% of stall charges (maximum of ₹10,000) for one fair/exhibition Airfare 50% by economy class maximum ₹50,000 per fair for 1 person
Publicity, advertising, catalog printing, and website development	Same as above	60% of total cost of expenditure maximum up to ₹60,000 annually.
Samples to foreign buyers	Same as above	75% of total expenses on airfreight courier for sending samples; maximum assistance ₹50,000 per year
Facility for obtaining certifications like ISO 9001-2000/Bureau of Indian Standards 14000, wool mark, hall mark, HACCP, and C-mark	Same as above	50% of total expenses; maximum ₹75,000 per year
Subsidy on freight charges from Uttar Pradesh to gateway port		
Export cargo sent by internal container depot or container freight station	SSI Exporter registered with EPB and concerned District Industries Center	25% of freight charges maximum ₹5,000 per container (20 foot) admissible to exporting units to send their goods by State inland container depots (ICD)/ container freight stations (CFS) to the gateway port
Subsidy on export cargo sent by air		
Export cargo sent by air cargo complex in Uttar Pradesh (Amausi, Lucknow and Babatpur, Varanasi)	SSI Exporter and Merchant Exporter registered with EPB and concerned District Industries Center	20% of freight charges or ₹50/kg, whichever is less; maximum of ₹200,000 per unit per year

SSI = Small-Scale Industries.

Source: Export Promotion Bureau, Uttar Pradesh.

Appendix 7: Focus Crop Market Regulatory and Control Mechanisms

Agriculture is a critical sector of the Indian economy. Overall, the growth and development of agriculture and allied sectors directly affect the socioeconomic well-being of the majority of the workforce. The sector is an important resource base for agro-industries and agro-services. Thus, the overall performance of the Indian economy and the quality of life of large portion of the population are dependent on its performance.

Over the past few years, the agriculture sector in India has experienced several transformations as a result of policy changes at the national and international level. Instrumental in bringing about positive changes in the sector has been the adoption of high-yielding varieties and advanced production technologies, supported by land reforms, price support policies, investments in market infrastructure development, and rural development. The sector has also experienced trade policy reforms to facilitate greater integration with the global market. Most agriculture commodities have been brought under Open General Licensing. Average tariffs on agricultural imports have been reduced and export policies have been liberalized. India has also signed trade agreements to facilitate the overall trade of agricultural commodities. From time to time, market regulatory and control mechanisms have been introduced with the aim of increasing farmer incomes, improving supply chain efficiency, and addressing concerns related to food security and self-sufficiency. This section reviews some of key mechanisms that have been put in place and analyzes their impact on marketability and trade performance on selected commodities.

A. Taxes

Goods & Services Tax

Introduced in 2017, the GST is a comprehensive, multistage, destination-based tax levied at each level of value addition. GST is classified into three types: central GST (CGST), state GST (SGST), and integrated GST (IGST). The GST replaces all earlier central taxes, such as excise tax, service tax, and custom duty, as well as state-level taxes such as value-added tax (VAT), central sales tax, and entertainment tax (Table A7.1).

Table A7.1: New Goods and Services Tax Rates

Sale Transaction	Old Tax Regime	New Tax Regime	Remarks
Within state	VAT+ central excise/ service tax	CGST + SGST	Revenue shared equally between center and state
To another state	Central sales tax + excise/ service tax	IGST	Only a central-level tax; the center then shares revenue based on destination of goods

Source : Deloitte India study team analysis based on information from GST Council, Government of India.

Under the GST, there is a four-tier tax structure for all goods and service under 5%, 12%, 18%, and 28%, along with some goods and services that are not taxed. Data on tax rates on different agricultural inputs and services and outputs in different tax regimes (i.e., VAT, central excise, and GST) have been compiled using the Uttar Pradesh

VAT schedule (as amended by Notification 292 dated 12 March 2015),¹ the Central Excise Tariff (of 30 June 2016),² and the Rate of GST on Goods from the Goods and Service Tax Council.

General Scenario of Tax Rate on Important Agricultural Commodities and Inputs

Table A7.2: Tax Rates per Tariff Item

Tariff Item	Input Item	Pre-GST rate (%)		
		Uttar Pradesh	Centre	GST Rates
12	All goods of seed quality	Exempted	NIL	NIL
28	Micronutrients	4%	12.5%	12%
3101	All goods and organic manure (other than put up in unit containers and bearing a registered brand name)	Exempted	NIL	NIL
3101	All goods i.e. animal or vegetable fertilizers or organic fertilizers put up in unit containers and bearing a brand name	Not defined	NIL	5%
3102	Mineral or chemical fertilizers (NPK)	Exempted	12.5%	5%
3103				
3104				
3808	Insecticides, rodenticides, fungicides, herbicides, anti-sprouting products and plant growth regulators, disinfectants, and similar products	4%	12.5%	18%
8201	Agricultural implements manually operated or animal-driven	Exempted	12.5%	NIL
8413	Power-driven water pump	4%	12.5%	12%
8432	Agricultural, horticultural, or forestry Machinery for soil preparation or cultivation	Exempted	NIL	12%
8701	Tractors	4%	12.5%	12%
4011	Rear tractor tires and rear tractor tire inner tubes	4%	12.5%	18%
4013				
8708	Following parts of tractors—namely, rear tractor wheel rim, tractor center housing, tractor housing transmission, tractor support front axle	4%	12.5%	18%
8708	Parts and accessories of motor vehicles of headings 8701 to 8705 other than specified parts of tractors	4%	12.5%	28%
8433	Harvesting or threshing machinery including straw or fodder balers; grass or hay mowers; machines for cleaning, sorting, or grading fruit or other agricultural produce (other than tariff item 8437)	Exempted	NIL	12%

Sources: Deloitte India study team analysis based on information from GST Council, Government of India; Uttar Pradesh Commercial Taxes Department; and Ministry of Finance, Department of Revenue, CBIC.

¹ Uttar Pradesh Commercial Taxes Department. *Uttar Pradesh Value Added Tax Act 2008*. As amended by Notification 292 dated 12 March 2015. <http://comtax.up.nic.in/GST/GSTAct2017English.pdf>.

² Ministry of Finance, Department of Revenue, CBIC. *Central Excise Tariff 2016–2017*. <http://www.cbic.gov.in/htdocs-cbec/excise/cxt-2016-17-revised/cxt-1617-june16-idx-bkp>.

Tariff Item	Input Item	Pre-GST rate (%)		GST Rates
		Uttar Pradesh	Centre	
8437	Machines for cleaning, sorting, or grading seed, grain, or dried leguminous vegetables	Exempted	NIL	5%
8437	Machinery used in the milling industry or for the working of cereals or dried leguminous vegetables other than farm type machinery and parts thereof	Not defined	NIL	5%
84 or 85	Solar-powered devices and parts for their manufacturing	Exempted	12.5%	5%
84222000	Machinery for cleaning or drying bottles or other containers;	Not defined	12.5%	18%
842230008422400	machinery for filling, closing, sealing, or labeling bottles, cans, boxes, bags, or other containers; machinery for capsuling			
852290	bottles, jars, tubes and similar containers; other packing or wrapping machinery (including heat-shrink wrapping machinery); machinery for aerating beverages			
Other than 84221100 and				
84221900				
8438	Machinery, not specified or included elsewhere in this chapter, for the industrial preparation or manufacture of food or drink, other than machinery for the extraction or preparation of animal or fixed vegetable fats or oils	Not defined	12.5%	18%
07, 08	Fresh fruits and vegetables	Exempted	NIL	NIL
	Oilseeds, of seed quality	Exempted	-	NIL
	Oilseeds, other than seed quality	4%	-	5%
	Pulses (both whole or split)	1%	NIL	NIL
	Processed vegetable and fruits	4%	NIL	12%
	Frozen or preserved vegetable and fruits	4%	NIL	5%
	Spices and condiments	4%	NIL	5%
	Edible oils	4%	6%	5%
	Oilcakes	4%	NIL	5%

Source: Uttar Pradesh Commercial Taxes Department. Uttar Pradesh Value Added Tax Act 2008. As amended by Notification 292 dated 12 March 2015; CBIC. Central Excise Tariff 2016–2017; MoFPI, GST Facilitation Cell. GST Council Rate of GST on Goods. As Revised on 18 January 2018.

Analytical reports on the GST effects on the agriculture sector specific to Uttar Pradesh are unavailable. However, based on similar studies and reviews of published research, the impact appears to be positive. As the GST was introduced with the aim of unifying the tax structure for goods and services, it is expected to offer the following benefits for the agriculture sector (Table A7.2).

- Uniformity in tax rates and procedures across the country will simplify procedures and contribute to an overall improvement in marketing agricultural commodities.
- Amalgamation of taxes could break down interstate barriers on the movement of commodities, which would improve transparency, reliability, and timely supply chain mechanisms. A better supply chain mechanism would help reduce waste and costs for farmers and retailers. Interstate trade will help farmers get better market access, connect with more buyers and traders, and realize better prices for their produce.

- A simplified and uniform tax regime is expected to reduce transit times and reduce perishables waste. This will also help reduce marketing costs and facilitate direct links between farmers and processors.³
- Reduction in the cascading effect of taxes. GST is expected to make production of agricultural products more cost effective, which will benefit consumers and make exports more competitive.
- A single rate is expected to simplify procedures and facilitate development of a unified National Agricultural Market Platform,⁴ which was challenging to implement earlier because of nonuniform and variable state VAT and APMC laws. Greater market integration will help farmers get higher farm gate prices and build a more transparent and impartial trade of commodities (Box A7.1).

Box A7.1: Interstate Trade from Uttar Pradesh to Other States on the eNAM Platform

So far, eight states (Uttar Pradesh, Uttarakhand, Andhra Pradesh, Telangana, Rajasthan, Gujarat, Maharashtra, and Madhya Pradesh) have initiated interstate trade on the eNAM platform⁵ Analysis of interstate trade on the platform from April 2018 to March 2019 shows an increased momentum of trade transactions between Uttar Pradesh and other states. During FY2018–2019, 234 interstate sales transactions worth ₹1.84 million were transacted through eNAM. The major commodities traded from Uttar Pradesh were paddy, wheat, mustard, and vegetables. Trade links have been established with Haryana, Madhya Pradesh, Chhattisgarh, and Rajasthan.

Source: Inter-State Trade Data Analysis, e-NAM Platform.

Applicable updated GST rates (as at 21 July 2018), for focus crops and value-added products prepared, are shown in Table A7.3.⁶

³ A. Khan, A. Hasan, and Md. A. Anwar. 2018. GST and India Agriculture: An Overview. *International Journal of Academic Research and Development*. 3 (4). pp. 94–100.

⁴ MoAFW, CCS National Institute of Agricultural Marketing. *GST: Its Implication on National Agricultural Markets*. NAM Paper Series 2. https://ccsniam.gov.in/images/pdfs/nam/Paper_Series-2.pdf.

⁵ MoAFW. 2019. Inter-State Trade on e-NAM Platform. Press Release, 7 February.

⁶ MoFPI. http://mofpi.nic.in/sites/default/files/gst_rate.pdf.

Goods & Service Tax Rates Applicable for Focus Crops and Related Value-Added Preparations

Table A7.3: Goods and Service Tax Rates on Focus Crops

Description of Goods	GST Rate
1. FOCUS CROP: POTATO	
Potatoes, fresh or chilled (seed quality)	NIL
Potatoes, fresh or chilled (except in frozen state or preserved)	NIL
Potato vegetable frozen/preserved (but unsuitable in that state for immediate consumption)	5%
Flour, meal, powder, flakes, granules, and pellets of potatoes other than those put up in unit container and bearing a registered brand name	NIL
Flour, meal, powder, flakes, granules, and pellets of potatoes put up in unit container and bearing a registered brand name	5%
Potato starch	12%
Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of tariff item 2006	12%
Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of tariff item 2006	12%
2. and 3. FOCUS CROP: MANGO and GUAVA	
Fresh fruit (except in frozen or preserved state)	NIL
Dried fruit	NIL
Edible fruits in frozen or preserved state	5%
Mangoes sliced dried	5%
Preparation of fruit or other parts of plants including pickle, murraba, chutney, jam, jelly	12%
Mango fruit juices	12%
Description of Goods	GST Rate
Fruit pulp or fruit juice-based drinks	12%
4. FOCUS CROP: MUSTARD	
Mustard seeds (of seed quality)	NIL
Mustard seed (other than of seed quality)	5%
Mustard oil, whether or not refined, but not chemically modified	5%
Flour and meal of mustard oilseeds	5%
Oilcake (irrespective of the end use)	5%
Sauces and preparations thereof	12%
5. FOCUS CROP: GRAM	
Leguminous vegetables, shelled or unshelled	NIL
Dried leguminous vegetables, shelled, whether or not skinned or split (pulses)	NIL
Dried leguminous vegetables (no container-no brand)	NIL
Dried leguminous vegetables, shelled, whether or not skinned or split [put up in unit container and bearing a registered brand name]	5%
Meal and powder of the dried leguminous vegetables (pulses)	5%

Continued on next page

Table A7.3: *continued*

Description of Goods	GST Rate
Roasted gram	5%

Source: MoFPI, GST Facilitation Cell. GST Council Rate of GST on Goods Book and Product-Wise GST Rate (latest revisions dated 18 January 2018).

Mandi Fee and Development Cess

The mandi tax is a fee levied by the state on the sale and purchase of agricultural produce to defray the cost of running agricultural wholesale markets. Presently, the GST does not subsume the mandi tax, unlike the other state cesses (taxed) under the SGST. The mandi tax varies by state and by commodity. The mandi tax and development cess in Uttar Pradesh are shown in Table A7.4.

Table A7.4: Mandi Tax and Development Cess in Uttar Pradesh

Focal Crop	Mandi Tax (%)	Development Cess (%)
Potato	2	0.5
Mango	2	0.5
Guava	2	0.5
Mustard	2	0.5
Gram	2	0.5

Source: Uttar Pradesh State Agricultural Produce Markets Board.

B. Tariffs and Nontariff Barriers

Import Regulations

Import duties on agricultural products generally comprise the following:

- basic customs duty;
- social welfare charges;
- IGST;
- custom handling duties.

The following section describes the import regulations applicable to the selected focus crops and their impact on sector performance.

Basic Custom Duty

The basic custom duty is applicable at a standard rate or a preferential rate when produce is imported into India from beneficiary countries. These rates may vary from one commodity to another and are amended from time to time. The basic custom duty rates applicable on the focus crop and related products is provided in Table A7.5 (effective as of 1 January 2019).⁷

⁷ Ministry of Finance, Department of Revenue, CBC. *Import Tariff*. As of 1 February 2019.

Table A7.5: Rate of Duty on Potatoes and Potato Products

HS Code	Description of Goods	Rate of Duty	
		Standard (%)	Preferential Area (%)
07011000	Potatoes, fresh or chilled (seed quality)	30	20
07019000	Potatoes, fresh or chilled (other)	30	20
07101000	Potato (uncooked or cooked by steaming or boiling in water), frozen	30	20
07129060	Dried potato, whole, cut, sliced, broken, or in powder, but not further prepared	30	20
11051000	Flour, meal, and powder of potato	30	-
11052000	Flakes, granules, and pellets of potato	30	-
11081300	Potato starch	30	-
20041000	Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of tariff item 2006	35	-
20052000	Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of tariff item 2006	30	-

Source: Ministry of Finance, Department of Revenue, CBC. *Import Tariff*. As of 1 February 2019.

India is the third-largest potato-producing country in the world. India's imports of potatoes and potato products are limited (70% is potato starch). Currently, there are few potato starch manufacturers in India, the preference being for maize starch, owing to its higher yield. While maize contains 12% water, potatoes have 78%, rendering the extraction of starch from potatoes less viable. However, potato starch has wide applications in the processed and snack food industries and for culinary purposes. It is used as a thickener or base in the preparation of ready-to-eat vegetable gravies and soups, potato chips, texturized potato products, and snack pellets. India mostly imports coarse potato starch from Europe and the PRC, which is then refined and used or re-exported to other countries. Processing potato starch into refined products can add significant value and returns. Regulation of import tariffs may thus play a critical role in the development of a domestic market for manufacturing and processing potato starch and related products (Table A7.6).

Table A7.6: Rate of Duty on Mangoes and Mango Products

HS Code	Description of Goods	Rate of Duty	
		Standard (%)	Preferential Area (%)
08045020	Mangoes fresh/dried	30	20
08045030	Mangoes sliced dried	30	20
08045040	Mango pulp	30	20
08129010	Mango slices in brine	30	20
11063030	Flour of mango	30	-
20079910	Jams, jellies marmalades, puree of mangoes	30	-
20089911	Mango squash	30	-
20098910	Mango juice	50	-

Source: Deloitte India study team analysis based on data from Central Board of Indirect Taxes and Customs and Department of Revenue, Ministry of Finance, Government of India, as of 1 February 2019. <https://www.cbic.gov.in/htdocs-cbec/customs/cst2021-280621/cst-idx>.

India is the largest producer of mangoes in the world. Its imports are small and mostly in the form of juice, given large domestic production. To incentivize domestic value addition and boost the Made in India Program, the government has increased the import tariff on fruit juice from 30% to 50% (Table A7.7).

Table A7.7: Rate of Duty on Guava and Guava Products

HS Code	Description of Goods	Rate of Duty	
		Standard (%)	Preferential Area (%)
08045010	Guavas fresh/dried	30	20
20079920	Jams, jellies marmalades, puree of guava	30	-
20089994	Guava prepared/preserved	30	-

Source: Deloitte India study team analysis based on data from Central Board of Indirect Taxes and Customs and Department of Revenue, Ministry of Finance, Government of India, as of 1 February 2019. <https://www.cbic.gov.in/htdocs-cbec/customs/cst2021-280621/cst-idx>.

India's imports of guava and guava products are small (Table A7.8).

Table A7.8: Rate of Duty on Mustard and Mustard Products

HS Code	Description of Goods	Rate of Duty	
		Standard (%)	Preferential Area (%)
12075010	Mustard seeds (of seed quality)	30	20
12075090	Mustard seed (other)	30	20
15149120	Crude mustard oil	75	65
15149920	Refined mustard oil of edible grade	75	65
09109927	Mustard powder (as spice)	30	-
21033000	Mustard flour and meal and prepared mustard	30	-
23069012	Oilcake and oilcake meal of mustard seeds (expeller variety)	30	-
23069021	Oilcake and oilcake meal of mustard seeds solvent extracted (defatted variety)	30	-
33019032	Mustard oil, aroma	30	-

Source: Deloitte India study team analysis based on data from Central Board of Indirect Taxes and Customs and Department of Revenue, Ministry of Finance, Government of India, as of 1 February 2019. <https://www.cbic.gov.in/htdocs-cbec/customs/cst2021-280621/cst-idx>.

India's imports of mustard and mustard products are mainly as prepared mustard products, oilcake, and oil meals (expeller and defatted variety). Limited quantities of mustard of seed quality are imported. India's trade policy effectively prohibits import of genetically modified mustard seed. However, non-genetically modified mustard of seed quality is eligible for import with restrictions subject to the new Policy on Seed Development 1988 and in accordance with an import permit granted under plant quarantine regulations (Regulation of Imports into India) Order 2003). Mustard other than seed quality is freely importable.⁸

Imports of edible oil are under an Open General License. Since 60% of India's demand for edible oil is met through imports, primarily from Malaysia, Indonesia, and Argentina, the domestic price of mustard oil has remained higher than international prices. To harmonize the interests of farmers, processors, and consumers and at the same time

⁸ DGFT. 2017. Notification of ITC (HS), Schedule 1 (*Import Policy*). Dated 17 January 2017. Chapter 12, Section II. [http://dgftcom.nic.in/Exim/2000/NOT/itc\(hs\)/ch12.pdf](http://dgftcom.nic.in/Exim/2000/NOT/itc(hs)/ch12.pdf).

regulate imports of edible oils to the extent possible, the import duty structure on edible oils is reviewed from time to time. With effect from 14 July 2018, the applied import duty on crude and refined mustard oils was raised to 35% and 45%, respectively (Table A7.9).⁹

Figure A7: Movement of Mustard Oil Price, 2012–2019

Source: MoAFW. 2019. Commodity Profile of Edible Oil.

Box A7.2: India's Import Policy on Edible Oils

- 60% of India's demand for edible oil is met through imports, primarily from Malaysia, Indonesia, and Argentina. Palm oil constitutes 70% of India's edible oil imports, followed by soybean, sunflower, and other oils.
- With effect from 14 June 2018, the import duty on all crude edible oils has been raised from 30% to 35% and on refined oils from 35% to 45%. The import duty on crude palm oil has been revised from 20% to 44% and on refined palm oil from 40% to 54%. Effective from 1 January 2010, the Government of India reduced the import duty on crude palm oil from Malaysia, Indonesia, and other members of the Association of Southeast Asian Nations (ASEAN) from 44% to 40%, while the duty on refined palm oil has been cut from 54% to 45% on imports from Malaysia and to 50% on imports from Indonesia and other member nations of ASEAN.
- Reductions in duty are likely to increase imports of palm oil in India and may impact the trade and prices of domestically produced edible oils and oilseeds in the country, including mustard.

⁹ Government of India. *Export Import Policy on Edible Oils*. <https://dfpd.gov.in/export-import-policy-edible-oil.htm>.

Table A7.9: Rate of Duty on Gram and Gram Products

HS Code	Description of Goods	Rate of Duty	
		Standard (%)	Preferential Area (%)
07132020 ¹⁰	Bengal gram or desi chana	60	20
	Dried leguminous vegetables, shelled whether or not skinned or split		
11061090	Flour of the dried leguminous vegetables of heading 0713 (pulses)	30	-
20081940	Roasted gram (i.e., other roasted and fried vegetable products)	30	-

Source: Deloitte India study team analysis based on data from Central Board of Indirect Taxes and Customs and Department of Revenue, Ministry of Finance, Government of India, as of 1 February 2019. <https://www.cbic.gov.in/htdocs-cbec/customs/cst2021-280621/cst-idx>.

India imports 14% of the pulses required for consumption, including chickpeas. The government has enforced quantitative restrictions on imports of peas, toor, moong, and urad effective from 1 April 2019. The import of chickpeas remains free of quantitative restrictions. However, revisions have been introduced from time to time on the import tariffs on chickpeas to manage domestic oversupplies and boost domestic prices for the benefit of small and marginal farmers. In December 2017, the Ministry of Finance announced a 30% tariff on imports of desi chana, which was further raised to 40% in February 2018 and to 60% in March 2018.

Social Welfare Charge

In addition to the revision to import tariffs, the government introduced a Social Welfare Charge of 10% on the value of goods, which is levied in place of the earlier Education Cess of 3%. This has been in effect since the budget of 2018.

Integrated Goods and Service Tax

IGST is applicable on all imports into India. IGST is levied on the value of imported goods plus a customs duty on the goods.¹¹

- Value on which IGST is calculated: Value of Imported Goods + Basic Customs Duty + Social Welfare Surcharge
- IGST payable equal to Value × IGST Rate

Customs Handling Fee

A customs handling fee of 1% is levied on all imports in addition to the applied customs duty.

¹⁰ Notification 02/2015-2020 dated 16 April 2018, the central government incorporated new HS codes for the import policy for Kabuli chana, Bengal gram, and other pulses under ITC(HS). 2017. EXIM Code 0713, Chapter 7, Schedule I (Import Policy). http://apeda.gov.in/apedawebsite/DGFT_notificationfile/Notification_No_2_english.pdf.

¹¹ Before GST implementation, imports were subject to an additional duty, a special additional duty, an education cess, state-level value-added or sales taxes, the central sales tax, and various other local taxes and charges. The new GST system subsumed a number of these charges, including the additional duty and the special additional duty that were previously levied on imports. The tariff (or basic customs duty) continues to be assessed on imports separately and has not been incorporated into the GST.

C. Export Regulations

The APEDA, an autonomous organization under the administrative control of the Department of Commerce, has a mandate to promote exports and development of industries relating to the scheduled products for export.¹² APEDA provides assistance to exporters under various components of its Agriculture and Processed Food Export Promotion Scheme, such as the Infrastructure Development, Quality Development, and Market Development component. Export promotion of oilseed crops and oils (including mustard) has been mandated to the Indian Oilseeds and Produce Export Promotion Council under the Ministry of Commerce.

Incentives are available for exports of the focus crops in this study under the Merchandise Exports from India Scheme (MEIS). Other schemes, such as the Trade Infrastructure for Export Scheme and the Market Access Initiative Scheme, have been introduced to provide export promotion support to exporters and state governments.

Export Policy Conditions (Including Price and Quantitative Restrictions)¹³

Table A7.10: Export Policy Conditions for Potatoes and Potato Products

HS Code	Description of Goods	Export Policy	Policy Condition
07011000	Potatoes, fresh or chilled (seed quality)	Free	Permitted subject to compliance with phytosanitary requirement per Article-V of IPPC
07019000	Potatoes, fresh or chilled (other)	Free	-do-
07101000	Potato (uncooked or cooked by steaming or boiling in water), frozen	Free	-do-
07129060	Dried potato, whole, cut, sliced, broken, or in powder, but not further prepared	Free	-do-
11051000	Flour, meal, and powder	Free	-do-
11052000	Flakes, granules, and pellets	Free	-do-
11081300	Potato starch	Free	-do-
20041000	Other vegetables prepared or preserved other-wise than by vinegar or acetic acid, frozen, other than products of tariff item 2006	Free	
20052000	Other vegetables prepared or preserved other-wise than by vinegar or acetic acid, not frozen, other than products of tariff item 2006	Free	-do-

Note: Free = According to Notification 15/2015-2020 dated 26 July 2016 relating to the export of potatoes, fresh or chilled, these are subject to a Minimum Export Price (MEP) of \$360 per MT. With Notification 32/2015-2020 dated 27 December 2016, the earlier notification has been amended according to which Export of Potatoes, Fresh or Chilled No. 50 A of Chapter 7, Schedule 2 of the ITC (HS) Classification of Export and Import Items, shall be permitted without any MEP.

Source: Directorate General of Foreign Trade.

¹² Various Schedule Products mandated for promotion by APEDA through exports: fruits, vegetables and their products, meat and meat products, poultry and poultry products, dairy products, confectionery, biscuits and bakery products, honey, jiggery, and sugar products, cocoa and its products, chocolate, alcoholic and nonalcoholic beverages, cereal and cereal products, groundnuts, peanuts and walnuts, pickles, papads and chutneys, guar gum, floriculture and floriculture products, and herbal and medicinal plants.

¹³ DGFT. <https://www.dgft.gov.in/CP/?opt=itchs-import-export>.

With Vide Notification 4/2015–2020, exemption was granted from any existing or future restrictions or prohibitions during the period 2019–2020 (April–March) on export of 15,492.36 MT of potatoes to the Republic of Maldives under a bilateral trade agreement (Tables A7.11–A7.14).¹⁴

Table A7.11: Export Policy Conditions for Mangoes and Mango Products

HS Code	Description of Goods	Export Policy	Policy Condition
08045020	Mangoes, fresh/dried	Free	Export permitted subject to compliance with phytosanitary requirements per Article-V of IPPC
08045030	Mangoes, sliced dried	Free	-do-
08045040	Mango pulp	Free	-do-
08129010	Mango slices in brine	Free	-do-
11063030	Flour of mango	Free	-do-
20079910	Jams, jellies marmalades, puree of mangoes	Free	
20089911	Mango squash	Free	-do-
20098910	Mango juice	Free	-do-

Source: Directorate General of Foreign Trade.

Table A7.12: Export Policy Conditions for Guava and Guava Products

HS Code	Description of Goods	Export Policy	Policy Condition
08045010	Guavas fresh/dried	Free	Export permitted subject to compliance of phytosanitary requirements per Article-V of IPPC
20079920	Jams, jellies marmalades, puree of guava	Free	
20089994	Guava prepared/preserved	Free	-do-

Source: Directorate General of Foreign Trade.

¹⁴ DGFT, Notification 04/2015–2020.

Table A7.13: Export Policy Conditions for Mustard and Mustard Products

HS Code	Description of Goods	Export Policy	Policy Condition
12075010	Mustard seeds (of seed quality)	Free	
12075090	Mustard seeds (other)	Free	
15149120	Crude mustard oil	Free	
15149920	Refined mustard oil of edible grade	Quantitative and minimum export price restriction	<ol style="list-style-type: none"> 1. According to DGFT Notification /2015-2020 dated 6 April 2018, export of mustard oil is permitted in branded consumer packs of up to 5 kg with a MEP of \$900 per MT 2. According to Notification 03/2015-2020 dated 19 April 2017, export of organic processed edible oils, i.e. organic edible oils from customs Electronic Data Interchange (EDI) ports, have been exempted from all quantitative ceilings irrespective of any existing or future restriction or prohibition on export of their basic product (nonorganic), with due certification by APEDA, New Delhi, as "Organic" under the National Programme for Organic Production (NPOP).
09109927	Mustard powder (as spice)	Free	<p>Export permitted subject to following conditions:</p> <ul style="list-style-type: none"> • Certificate of Origin from International Coffee Organization (Mandatory Requirement). Agency: Coffee Board, MoCandI, Govt. of India, No. 1, Dr. B. R. Ambedkar Veedhi, Bengaluru • Compliance per to Article-V of IPPC
21033000	Mustard flour and meal and prepared mustard	Free	
23069012	Oilcake and oilcake meal of mustard seeds (expeller variety)	Free	
23069021	Oilcake and oilcake meal of mustard seeds solvent extracted (defatted variety)	Free	
33019032	Mustard oil aroma	Free	

Source: Directorate General of Foreign Trade.

Table A7.14: Export Policy Conditions for Gram and Gram Products

HS Code	Description of Goods	Export Policy	Policy Condition
07132020*	Bengal gram or desi chana Dried leguminous vegetables, shelled, whether or not skinned or split	Free	1. Export shall be through EDI custom ports. However, export through non-EDI Land Custom Stations on the Indo-Bangladesh and Indo-Nepal border shall be allowed subject to registration of quantity with DGFT. Regional Authorities in Kolkata and Patna and such others as notified by DGF from time to time will designated for the purpose of such registration of quantity (Notification 38/2015 -20 dated 22 November 2017) 2. Compliance with phytosanitary requirements per Article-V of IPPC
11061000	Flour of dried leguminous vegetables of heading 0713 (pulses)	Free	3. Compliance with phytosanitary requirements per Article-V of IPPC
20081940	Roasted gram (i.e., Other roasted and fried vegetable products)	Free	

Note: * Vide Notification 02/2015-2020 dated 16 April 2018. The central government has incorporated new HS codes for the import policy for Kabuli chana and Bengal gram. ITC(HS). 2017. EXIM Code 0713, Chapter 7, Schedule I (Import Policy). http://apeda.gov.in/apedawebsite/DGFT_notificationfile/Notification_No_2_english.pdf.

Source: Agricultural and Processed Food Products Export Development Authority.

Incentives and Subsidies for Export Promotion

India provides a broad range of assistance to the agriculture sector through incentives and subsidies for enhancing crop production and marketing. Some of the market-related incentives and subsidies related to the focus crops are highlighted in the following pages.

MEIS: The Government of India introduced the MEIS through the Foreign Trade Policy 2015–2020 to promote exports of notified goods manufactured or produced in India.

Rewards under the MEIS are payable as a percentage of the realized free-on-board value of the covered exports by way of an MEIS duty credit scrip. The scrip can be transferred or used for payment of several duties and taxes including the customs, excise duty, and service taxes. The rewards and incentives provided by the government make exporters more competitive in the international market. For grant rates under the MEIS, countries have been pre-grouped into three market categories.¹⁵

Category A: Traditional markets (34) including the EU (28), the European Free Trade Association (Switzerland, Norway, Iceland, Lichtenstein) (4), and the US and Canada (2)

Category B: Emerging and focus markets (140) including Africa (55), Latin America and Mexico (45), Commonwealth of Independent States countries (12), Turkey and West Asian countries (13), ASEAN countries (10), and Japan, the Republic of Korea, the PRC, Hong Kong, China, and Taipei, China (5)

Category C: Other markets (64)

¹⁵ Ministry of Commerce and Industries. 2016. Press Release, 5 May. <http://pib.nic.in/newsite/PrintRelease.aspx?relid=144890>.

The reward rates under the MEIS for focus crop products for the three country groups are as follows (footnote 21) (Tables A7.15–A7.19).

Table A7.15: Reward Rates for Potatoes and Potato Products

HS Code	Description of Goods	Country Group A	Country Group B	Country Group C
07011000	Potatoes, fresh or chilled (seed quality)	3	3	3
07019000	Potatoes fresh or chilled other than seeds	3	3	3
07101000	Potatoes cooked or uncooked, frozen	3	3	3
07129060	Dried potato, whole, cut, sliced, broken or in powder, but not further prepared	3	3	3
11051000	Flour and meal of potatoes	5	5	5
11052000	Flakes of potatoes	5	5	5
11081300	Starch of potato	5	5	5
20041000	Potatoes prepared/preserved frozen	5	5	5
20052000	Potatoes prepared/preserved, not frozen	5	5	5

Source: Directorate General of Foreign Trade.

Table A7.16: Reward Rates for Mangoes and Mango Products

HS Code	Description of Goods	Country Group A	Country Group B	Country Group C
08045020	Mangoes, fresh/dried	5	5	5
08045030	Mangoes, sliced dried	5	5	5
08045040	Mango pulp	5	5	5
08129010	Mango slices in brine	5	5	5
11063030	Flour of mango	5	5	5
20079910	Jams, jellies marmalades, puree of mangoes	5	5	5
20089911	Mango squash	5	5	5
20098910	Mango juice	5	5	5

Source: Directorate General of Foreign Trade.

Table A7.17: Reward Rates for Guava and Guava Products

HS Code	Description of Goods	Country Group A	Country Group B	Country Group C
08045010	Guavas fresh/dried	5	5	5
20079920	Jams, jellies marmalades, puree of guava	5	5	5
20089994	Guava prepared/ preserved	5	5	5

Source: Directorate General of Foreign Trade.

Table A7.18: Reward Rates for Mustard and Mustard Products

HS Code	Description of Goods	Country Group A	Country Group B	Country Group C
09109927	Mustard powder (as spice)	3	3	3
21033000	Mustard flour and meal and prepared mustard	5	5	5
23069012	Oilcake and oilcake meal of mustard seeds (expeller variety)	5	5	5
23069021	Oilcake and oilcake meal of mustard seeds solvent extracted (defatted variety)	5	5	5
33019032	Mustard oil aroma	3	3	3

Source: Directorate General of Foreign Trade.

Table A7.19: Reward Rates for Gram and Gram Products

HS Code	Description of Goods	Country Group A	Country Group B	Country Group C
07132020 ¹⁶	Bengal gram or desi chana (dried leguminous vegetables, shelled, whether or not skinned or split)	-	-	-
11061000	Flour of dried leguminous vegetables of heading 0713 (pulses)	5	5	5
20081940	Roasted gram (i.e., Other roasted and fried vegetable products)	5	5	5

Source: Directorate General of Foreign Trade.

With Vide Public Notice dated 13 July 2018, the government extended MEIS benefits for Bengal gram at an MEIS rate on exports of 7% w.e.f. for 21 June 2018 to 20 September 2018.¹⁷

Duty Drawback Scheme

This scheme aims to provide a refund or recoupment of customs and excise duties paid on inputs or raw materials and service taxes paid on the input services used in the manufacture of export goods. The rates of drawback related to the focus crops as specified in Vide Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018 are presented in Table A7.20 (Tables A7.20–A7.24).¹⁸

¹⁶ Vide Notification 02/2015-2020 dated 16 April 2018. The central government has incorporated new HS codes for the import policy for Kabuli chana, Bengal gram, and other produce under ITC(HS). 2017. EXIM Code 0713, Chapter 7, Schedule I (Import Policy). http://apeda.gov.in/apedawebsite/DGFT_notificationfile/Notification_No_2_english.pdf.

¹⁷ DGFT. Public Notice dated 13 July 2018. <https://content.dgft.gov.in/Website/22-english.pdf>.

¹⁸ Government of India, Ministry of Finance. Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018.

Table A7.20: Drawback Rates for Potatoes and Potato Products

HS Code	Description of Goods	Unit	Drawback Rate (%)	Drawback Cap per Unit
07011000	Potatoes, fresh or chilled (seed quality)	-	0.15	-
07019000	Potatoes, fresh or chilled (other)	-	0.15	-
07101000	Potato (uncooked or cooked by steaming or boiling in water), frozen	-	0.15	-
07129060	Dried potato, whole, cut, sliced, broken, or in powder, but not further prepared	-	0.15	-
11051000	Flour, meal, and powder of potato	-	0.15	-
11052000	Flakes, granules, and pellets of potato	-	0.15	-
11081300	Potato starch	-	0.15	-
20041000	Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of tariff item 2006	-	0.15	-
20052000	Other vegetables prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of tariff item 2006	-	0.15	-

Source: Relevant data has been extracted from the Government of India, Ministry of Finance. Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018. <https://www.cbic.gov.in/resources/htdocs-cbec/customs/cs-act/notifications/notfns-2018/cs-nt2018/csnt95-2018.pdf>.

Table A7.21: Drawback Rates for Mangoes and Mango Products

HS Code	Description of Goods	Unit	Drawback Rate (%)	Drawback Cap per Unit
08045020	Mangoes, fresh/dried	-	0.15	-
08045030	Mangoes, sliced dried	-	0.15	-
08045040	Mango pulp	-	0.15	-
08129010	Mango slices in brine	-	0.15	-
11063030	Flour of mango	-	0.15	-
20079910	Jams, jellies marmalades, puree of mangoes	-	0.15	-
20089911	Mango squash	-	0.15	-
20098910	Mango juice	-	0.15	-

Source: Relevant data has been extracted from the Government of India, Ministry of Finance. Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018. <https://www.cbic.gov.in/resources/htdocs-cbec/customs/cs-act/notifications/notfns-2018/cs-nt2018/csnt95-2018.pdf>.

Table A7.22: Drawback Rates for Guava and Guava Products

HS Code	Description of Goods	Unit	Drawback Rate (%)	Drawback Cap per Unit
08045010	Guavas fresh/dried	-	0.15	-
20079920	Jams, jellies marmalades, puree of guava	-	0.15	-
20089994	Guava prepared/preserved	-	0.15	-

Source: Relevant data has been extracted from the Government of India, Ministry of Finance. Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018. <https://www.cbic.gov.in/resources/htdocs-cbec/customs/cs-act/notifications/notfns-2018/cs-nt2018/csnt95-2018.pdf>.

Table A7.23: Drawback Rates for Mustard and Mustard Products

HS Code	Description of Goods	Unit	Drawback Rate (%)	Drawback Cap per Unit
12075010	Mustard seeds (of seed quality)	-	0.15	-
12075090	Mustard seeds (other)	-	0.15	-
15149120	Crude mustard oil	-	0.15	-
15149920	Refined mustard oil of edible grade	-	0.15	-
09109927	Mustard powder (as spice)	-	0.15	-
21033000	Mustard flour and meal and prepared mustard	-	0.15	-
23069012	Oilcake and oilcake meal of mustard seeds (expeller variety)	-	0.15	-
23069021	Oilcake and oilcake meal of mustard seeds solvent extracted (defatted variety)	-	0.15	-
33019032	Mustard oil aroma	-	0.15	-

Source: Relevant data has been extracted from the Government of India, Ministry of Finance. Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018. <https://www.cbic.gov.in/resources/htdocs-cbec/customs/cs-act/notifications/notfns-2018/cs-nt2018/csnt95-2018.pdf>.

Table A7.24: Drawback Rates for Gram and Gram Products

HS Code	Description of Goods	Unit	Drawback Rate (%)	Drawback Cap per Unit
	Bengal gram or desi chana			
07132020 ^a	Dried leguminous vegetables, shelled, whether or not skinned or split	-	0.15	-
11061000	Flour of dried leguminous vegetables of heading 0713 (pulses)	-	0.15	-
20081940	Roasted gram (i.e., other roasted and fried vegetable products)	-	0.15	-

Source: Relevant data has been extracted from the Government of India, Ministry of Finance. Notification No. 95/2018-CUSTOMS (N.T.) dated 6 December 2018. <https://www.cbic.gov.in/resources/htdocs-cbec/customs/cs-act/notifications/notfns-2018/cs-nt2018/csnt95-2018.pdf>.

^a Vide Notification No. 02/2015-2020 dated 16 April 2018. The central government has incorporated new HS codes for the import policy for Kabuli chana, Bengal gram, and other produce under ITC(HS). 2017. EXIM Code 0713, Chapter 7, Schedule I (Import Policy). http://apeda.gov.in/apedawebsite/DGFT_notificationfile/Notification_No_2_english.pdf.

Trade Agreements

India has entered several bilateral and regional trade agreements over the years. These offer preferential tariff rates on the trade of goods among member countries. India and several Asian countries have signed a Comprehensive Economic Cooperation Agreement (CECA), which is an integrated package of agreements embracing trade in goods, services, investments, and economic cooperation across sectors. The agreements provide wide-ranging exemptions and reductions on basic customs duties on products. In a major policy shift, the government has decided to convert all Preferential and Free Trade Agreements into CECAs (Table A7.25).

Table A7.25: List of Free Trade Agreements and Comprehensive Economic Partnership Agreements

Trade Agreements Concluded	Trade Agreements Currently Under Negotiation
1. India–Korea CEPA	1. India–Thailand FTA
2. India–ASEAN CECA	2. India–Australia FTA
3. India–South Asia FTA	3. India–New Zealand FTA
4. India–Sri Lanka	4. India–EU Broad-Based Trade and Investment Agreement
5. India–Japan CEPA	5. India–European Free Trade Association
6. India–Malaysia CEPA	6. India–Chile PTA (expansion)
7. India–Singapore CECA	7. India–Mercosur PTA (expansion)
	8. India–Israel PTA
	9. India–Canada CECA
	10. India–Southern African Customs Union PTA
	11. Regional Comprehensive Partnership Agreement

CECA = Comprehensive Economic Cooperation Agreement; CEPA = Comprehensive Economic Partnership Agreement; FTA = Free Trade Agreement; PTA = Preferential Trade Agreement.

Source: MoAFW. India's Agriculture Trade Policy and Status Under Trade Agreements.

Nontariff Requirements

Nontariff requirements generally include the following:

- phytosanitary certificate;
- marking and labeling requirements;
- packaging requirements;
- import permits;
- food regulations.

These requirements vary by country and product. Some nontariff barriers faced by Indian exporters affect international trade of fruit and vegetable crop as follows.¹⁹

¹⁹ Trade Promotion Council of India. https://www.tpci.in/research_report/non-tariff-measures/.

Exports to the US: Mangoes exported to the US must be irradiated in India with a minimum absorbed dosage of 400 gamma rays. Importers must secure a US\$ import permit 30 days in advance of arrival of any irradiated commodities at a scheduled port for further facilitation. Mangoes must also be given postharvest hot water fungicidal treatment (Prochloraz at 500 ppm) at 52°C for 3–4 minutes. Each consignment must be inspected by the United States Department of Agriculture Animal and Plant Health Inspection Service and the National Plant Protection Organization in India as part of the required pre-clearance inspection. Each consignment of mangoes must be accompanied by a phytosanitary certificate issued by the National Plant Protection Organization.

Exports to Japan: Mangoes exported to Japan must have been vapor heat treated at 46°C–49°C for 20–30 minutes, depending on the variety to eradicate fruit fly eggs and larvae. After VHT, the fruits should be treated with a hot water fungicidal solution and allowed to cool and dry before grading and packing.

Exports to Australia: All food products exported to Australia require an import permit. Mango exports to Australia requires pre-export irradiation.

Exports to Malaysia

All food products require a phytosanitary certificate from the authorities in the country of origin. Mangoes exported to Malaysia require the phytosanitary certificate to declare the shipment is free of mango seed weevils.

Exports to Philippines

All fresh fruits and vegetable exported to the Philippines require an import permit and must have a phytosanitary certificate from the place of origin.

Products must originate from areas free of all types of fruit flies. Products may be subject to cold disinfestation and, if so, this should be declared on the phytosanitary certificate. Fruits must also be free of San Jose scale, oriental fruit fly, and codling moth. All fresh vegetables must be free of pests of quarantine concern.

Exports to Indonesia

A phytosanitary certificate from the country of origin is mandatory. Consignments are subject to plant quarantine inspection on arrival in Indonesia. No radiation certificate is required. No import permit is necessary for exports of fruits and vegetables, except sesame seeds. Pesticides regulations apply to fresh fruits and vegetables —i.e., maximum residue levels.

Products must originate from areas free of all types of fruit flies, especially in fresh fruits. Vegetables must be free of pests of quarantine concern.

Fresh fruits may require cold disinfestation treatment for up to 18 days at 2.8°C and fumigation with methyl bromide prior to importation.

As a labeling requirement, the use of Bahasa Indonesia is mandatory on all types of goods.

For export of food and beverages, registration is mandatory with the Indonesian Food and Drug Control Agency.

Appendix 8: Mandi Tax in Major Neighboring States

State	Mandi Tax (%)	Development Charge (%)	Other Taxes	Total (%)
Haryana	1	0	0	1
Madhya Pradesh	1.5	0	0	1.5
Rajasthan (oilseeds)	1	0	0	
Rajasthan (pulses and other commodities)	1.6	0	0	1.6
Rajasthan (fruits and vegetables)	1.5	0	0	1.5
Uttar Pradesh (all commodities)	2	0.5	0	2.5

Source: Krishi Mandi. <http://e-krishimandi.com/CPIIndex.aspx?ReturnUrl=%2f>; Government of Madhya Pradesh. MP Mandi Board. <https://mpmandiboard.co.in/index.php/societies/income-of-societies>.

Improving Agricultural Value Chains in Uttar Pradesh

This technical study reviews agricultural value chains in Uttar Pradesh, India to improve value chains of the selected five focus crops: potato, mango, guava, mustard, and gram. The study identifies areas of investment in agricultural value chain development for the focus crops, private sector engagement, and recommendations for institutional development and infrastructure enhancement. The recommendations are offered as a contribution to the vision of the Government of Uttar Pradesh to ensure food and nutritional security and improve the quality of village life through inclusive and sustainable growth.

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