India Studies in Business and Economics

Ashok Gulati
Kavery Ganguly
Harsh Wardhan *Editors*

Agricultural Value Chains in India

Ensuring Competitiveness, Inclusiveness, Sustainability, Scalability, and Improved Finance

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Editors
Ashok Gulati
Indian Council for Research on
International Economic Relations (ICRIER)
New Delhi, Delhi, India

Kavery Ganguly
Indian Council for Research on
International Economic Relations (ICRIER)
New Delhi, Delhi, India

Harsh Wardhan
Indian Council for Research on
International Economic Relations (ICRIER)
New Delhi, Delhi, India

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Foreword

In response to changing consumption patterns, agricultural production has diversified from food grain to high-value commodities including horticulture, livestock and fisheries. Demand for value-added and nutrient-rich foods is fast replacing calorie-rich grain-based diets. India is the leading producer of milk and a significant producer of poultry meat, eggs, fruits and vegetables and pulses. This provides a huge scope for India to cater to rising domestic as well as global demand for these commodities with potential gains for the farmers. Agricultural value chains in India have been confronted with a tough balance of improving efficiency and ensuring inclusiveness of the primary producer. This makes farmer–market linkages critical to delivering assured returns to farmers and ensure farming remains profitable.

This study on *Agricultural Value Chains in India* analyzes the performance of tomato, onion and potato (TOP), grapes, pomegranates, mango, banana, dairy, poultry and pulses value chains in terms of competitiveness, inclusiveness, sustainability and scalability and access to finance (CISS-F). This is a unique conceptual framework used to study agricultural value chains in a holistic manner. The authors focus on the need and impact of striking a balance between the various elements of CISS-F. The commodity-specific deep dives clearly demonstrate how dairy value chain has been successful in delivering higher returns to the farmers ((75–80)% of the consumer price). Integrator-led poultry value chains have been phenomenal in undertaking costs and risks associated with poultry farming, making it much more remunerative and risk-free compared to backyard poultry. Similar gains in the TOP value chains are much awaited, which currently deliver about 30% of the consumer price to the farmers. Attaining a perfect score on CISS-F may not be possible, but technology, institutions and markets will continue to play an important role in strengthening these value chains and delivering benefits to the farmers and consumers.

We are hopeful that this study will enrich the policy discourse on the need for improving marketing opportunities for farmers by streamlining and organizing value chains. This evidence-based research study will be useful for drawing valuable insights by various stakeholders including policymakers, experts and practitioners for informed policymaking, balanced discourse and improved value chain practices.

We at NABARD and ICRIER are extremely happy to see the research study shape into a book that will favourably impact the national and global outreach. We take this opportunity to congratulate Dr. Ashok Gulati, Infosys Chair Professor, ICRIER, who has been a champion of market led inclusive agricultural growth for undertaking this important research study and for steering the ICRIER team towards a valuable output.

Dr. Deepak Mishra
Director and Chief Executive
ICRIER, New Delhi, India

Dr. G. R. Chintala
Chairman
NABARD, Mumbai, India

Preface

Indian food basket has become increasingly diversified, and consumption of high-value agricultural commodities such as fruits, vegetables, milk, eggs, meat and fish, and value-added food has increased. This demand-driven structural change in Indian agriculture is attributed to rising incomes, increasing population, urbanisation and higher export demand. The fast-developing high-value agricultural markets provide immense opportunity to India's small and marginal farmers to diversify their cropping patterns, boost their incomes and secure sustainable livelihoods.

India's smallholders constitute 86.1% of total farm holdings. The all India average landholding size is 1.08 hectares (ha) (DoAC&FW, Agricultural Census, 2016). Despite being a smallholder economy, India has become self-reliant in cereal production and is a leading producer of many high value agricultural commodities. India produced 281.8 million tonnes of food grains, 307.7 million tonnes of horticulture crops, 176.5 million tonnes of milk, 96 billion eggs and 7.7 million tonnes of meat during TE 2018–19 (DES, 2020; Horticulture Division, 2020; and DAHDF, 2020). However, this record level of production was not accompanied by commensurate increase in farmers' income. Lack of robust market linkages have resulted in poor price realization for the farmers as well as forcing them to dump or destroy the fresh produce. Such instances have been reported several times in the case of horticulture produce which is highly perishable with very low shelf life. Agricultural value chains in India are subject to high fragmentation and intermediation, resulting in substantial losses in quantity and quality of produce, limited processing capacities, and high price volatility. Agricultural policies in India have primarily focussed on augmenting production, without giving due attention towards developing efficient value chains. Further, cereal-centric policies of the government do not adequately recognize the challenges faced by farmers growing non-cereal crops. These policies have led to environmental degradation including fast-depleting water resources in key rice-growing states as well as soil contamination due to unabated use of fertilisers and agrochemicals. The policies lack a holistic approach and long-term direction towards sustainability and scalability of successful value chains across commodities and geographies.

In order to further study the issues and challenges faced by agricultural value chains in India, NABARD initiated a project under the *NABARD Centre for Research* *in Agri-Economics* set up in ICRIER. This book is a culmination of the six commodity value chain studies done under this project over three years. The book presents a comprehensive analysis and evaluation of the performance of selected agricultural value chains across major producing regions in India. The conceptual framework of competitiveness (domestic and international), inclusiveness, sustainability (financial and environmental), scalability (CISS) and access to finance (F) helps to analyze the selected value chains in a holistic manner. The commodities included in the study include vegetables (tomato, onion and potato (TOP)), fruits (banana and mango, grapes and pomegranate), dairy, poultry and pulses (gram and pigeon pea/tur) accounting for more than half of gross value of output of agriculture and allied sectors. The research is based on a combination of secondary data analysis, field visits and discussions with key players in each of the value chains.

The book identifies the drivers of change—technology, institutions and markets, which together have strengthened agricultural value chains to become competitive, inclusive, sustainable and scalable and improved their access to finance. The study finds that technology has catalyzed productivity gains through high-yielding seeds and cross-breed technology for most of the commodities studied here, except pulses. Markets have played an important role in the success of dairy co-operatives, connecting the smallest milk producer to urban markets, poultry sector through integrator model and grapes through export market. However, similar market linkages have not been possible in case of banana and mango. In case of tomatoes, onions, potatoes and pulses, weak market linkages explain extreme price volatilities. Institutions related to farmer collectives have ensured successful farmer-market linkages. Success of the Indian dairy sector is ascribed to the pioneering efforts of the co-operatives, particularly Amul, followed by the private sector, over time. Grapes value chain was led by Mahagrapes, a producer company that successfully linked small grape growers to export markets. Integrator-led poultry sector brought about phenomenal gains to the small poultry growers in terms of risk management, backend support and assured markets. Commodities like tomato, onion, potato, mango, banana, and pulses are yet to witness any such significant institutional impact. However, the Operation Greens scheme launched in 2018 for TOP and further extended to include 22 perishables will take some time before an efficient and inclusive value chains of perishables are developed.

The study shows that while some of the agricultural value chains have made considerable progress on CISS-F, others have scope to catch up. For example, while fruits and vegetables showed lower domestic competitiveness in terms of low farmers share in consumer rupee, dairy farmers have benefited from high domestic competitiveness. In case of international competitiveness measured using nominal protection coefficients (NPCs), all commodities except pomegranate, mango and milk (co-operative model), are found to be export competitive. Financial sustainability depends on the perishability and seasonality of the crop, which affect farm incomes. TOP and pulses are extremely price sensitive and driven by traditional marketing practices. In case of fruits, cultivation of bananas, mangoes, grapes as well as pomegranates is profitable, but requires huge investment. The financial viability of dairy co-operatives is a matter of concern as about 58% of dairy co-operatives have accumulated losses primarily because of governance issues. Indian dairying faces significant fodder shortage which further threatens the financial sustainability of the sector. For poultry sector too, the availability of high-quality and affordable feed is critical for financial sustainability. However, it is environmentally efficient compared to other segments of the livestock sector, but challenged by frequent outbreaks of Avian Influenza (AI). Dairy on the other hand is a huge contributor to greenhouse gas (GHG) emissions and also requires substantial quantity of water. All fruits and vegetables, except bananas, are non-water guzzlers, and so are pulses, indicating environmental sustainability. Scalability of agricultural value chains was measured in terms of area expansion or productivity gains, which impact total production levels, and expansion of exports and processing capacities. The potential of replicability of successful value chains across other commodities and states has been studied as well. Finally, existing gaps in financing, the current reach of organized finance and further potential of innovative financial intervention have been identified.

Based on the analysis presented in the book, important policy suggestions to make agricultural value chains more competitive, inclusive, sustainable, scalable with improved access to finance, have been put forth. These policy measures pertain to four pillars: agricultural finance, technology, markets and institutions. Agricultural marketing policy reforms have been focused on improving efficiency and delivering the economic gains to the farmers. The Farm Laws 2020 have the potential to further strengthen the high-value agricultural value chains in India.

We hope that the research findings and policy suggestions presented in this book will be useful for policymakers, financial institutions, and practitioners, in identifying the challenges confronting agricultural value chains in India and framing policies and innovative financing mechanism for each stakeholder in the value chain.

New Delhi, India

Ashok Gulati
Kavery Ganguly
Harsh Wardhan

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Needless to mention, the responsibility of data and views in this book and any omissions or errors that remain in the text are of the authors alone.

Ashok Gulati
Kavery Ganguly
Harsh Wardhan

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Editors and Contributors

About the Editors

Ashok Gulati is the Infosys Chair Professor for Agriculture at Indian Council for Research on International Economic Relations (ICRIER). Dr. Gulati is an eminent agricultural economist and a former Chairman of the Commission for Agricultural Costs and Prices (CACP), Government of India (2011–2014). He was on the Central Board of Directors of the Reserve Bank of India (RBI) and Board of Directors of National Bank for Agriculture and Rural Development (NABARD). He is currently a Member of the Tenth Audit Advisory Board of the Comptroller and Auditor General of India and also on the Board of Directors of National Commodity and Derivatives Exchange Limited (NCDEX), Kotak Mahindra Bank Limited, and Godrej Agrovet Limited. He has 17 books and several research papers on Indian and Asian agriculture to his credit. Dr Gulati is a prolific writer in leading media on agri-policies. For his significant contribution in the area of agriculture economics and policy making, the President of India honoured him with the "Padma Shri" award in 2015.

Kavery Ganguly is a Senior Research Fellow at ICRIER. She began her career with International Food Policy Research Institute (IFPRI), and worked as Lead—Policy Advocacy and Research with CII-Food and Agriculture Centre of Excellence. She also worked as an independent consultant on Political Economy of Food Price Policy, jointly led by Copenhagen University, Cornell University and UNU-WIDER. Kavery has been working in the area of agriculture and food policy research and advocacy for the past 17 years. She has contributed to research publications including book chapters, research reports, and peer reviewed papers.

Harsh Wardhan is a Consultant at ICRIER, working on issues related to agricultural and food policies, agricultural value chains and food prices. He has over seven years of research experience. Prior to ICRIER, he worked as a consultant with Office of Economic Advisor, Ministry of Commerce & Industry, GoI and as Research/Academic Associate at Indian Institute of Management (IIM), Ahmedabad. He has co-authored a book, *Marketed and Marketable Surplus of Major Foodgrains* *in India, Springer 2017*. He has also published research reports, book chapters, and articles in reputed journals and newspapers. He has completed his Master's in Economics from Ambedkar University, Delhi (AUD) and Bachelor's in Economics from Kirori Mal College, University of Delhi.

Contributors

Sandip Das has been working as Senior Consultant at ICRIER since 2017. Prior to that, he worked as Special Correspondent with The Financial Express for nearly a decade, writing extensively on agriculture and food security. He has also worked with mainstream media organisations such as Press Trust of India, Business Standard, Down to Earth magazine (published by Centre for Science and Environment). He has written research papers on food security and agricultural marketing and contributed to articles on food safety and consumer rights in leading national dailies. He holds Master's degree in Political Science from Jawaharlal Nehru University (JNU), New Delhi, and Diploma in Journalism.

Bhushana Karandikar is a postgraduate in economics and ex-civil servant, Maharashtra state. She has been working on issues related to global food trade, horticulture value chains, food safety, farmer producers organisations, and market access for small farmers, for last thirty years. Her expertise includes monitoring and evaluation techniques, specially of agriculture-related projects. She has worked as a Senior Consultant with IFPRI, HarvestPlus, Gokhale Institute of Politics and Economics, and ICRIER. She has co-authored peer reviewed journal papers, research reports, and book chapters.

T. Nanda Kumar is a former civil servant with specialised knowledge in public policy, agriculture, food, dairying, textiles and international trade and was Senior Visiting Fellow at ICRIER. Prior to that, he was Chairman of the National Dairy Development Board, Anand, Gujarat. He served as Secretary in the Ministry of Food & Public Distribution and Ministry of Agriculture, Co-operation & Farmers Welfare, Government of India. He was also Member of the National Disaster Management Authority (NDMA). He has served on the Boards of NABARD, NCDC, Textile Export Councils, Mother Dairy and various other companies. His work on "Impact of Uruguay Round on Global Spice Trade" was published by the International Trade Centre (WTO), Geneva, in the form of a book. He writes regularly for leading English newspapers.

Manasi Phadke is a project consultant and economist and holds a Ph.D. in Public Finance from Gokhale Institute of Politics and Economics, Pune. She has worked in a range of consultancy assignments spanning the fields of public finance and agriculture economics. She has been involved in designing the results framework for the World Bank-funded project titled State of Maharashtra's Agriculture and Rural

Transformation (SMART). She has given M&E support for the World Bank-funded Project on Climate Resilient Agriculture (PoCRA) as well. Her other assignments include research on farmer producer companies, value chains and agriculture insurance carried out for the Union Ministry of Agriculture, International Food Policy Research Institute (IFPRI) and the Mahalanobis National Crop Forecasting Centre (MNCFC), New Delhi. She is a prolific writer and blogger and a regular contributor to columns in the Hindu Business Line and the Business Standard. She currently hosts a weekly column in the Marathi newspaper, *Sakal*.

Anisha Samantara is a Ph.D. scholar at the University of Bradford, United Kingdom. Previously, she worked as Research Assistant at the Indian Council for Research on International Economic Relations (ICRIER). She completed her Master's in Economics from University of Glasgow, Scotland, and Bachelors in Economics from Lady Shri Ram College, University of Delhi.

Pravesh Sharma is Co-founder and CEO of Kamatan Farm Tech Pvt. Ltd., an agri start-up company. He was earlier affiliated with ICRIER as Visiting Senior Fellow. From 2010–2015, he was the Managing Director, Small Farmers' Agribusiness Consortium (SFAC), Government of India. He is a former 1982 batch IAS officer with extensive experience of the agriculture sector. In his long association with the sector, he served as Secretary, Department of Agriculture, Government of Madhya Pradesh, and India Representative of the UN International Fund for Agricultural Development (IFAD). He was also a Visiting Fellow at Princeton University.

Abbreviations

AEP	Agriculture Export Policy
AHIDF	Animal Husbandry Infrastructure Development Fund
AI	Artificial insemination
AJWA	Anakaputhur Jute Weavers' Association
AMFFRI	Agricultural Marketing and Farmer Friendly Reforms Index
AP	Andhra Pradesh
APEDA	Agricultural and Processed Food Products Export Development Authority
APLM	Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act
APMC	Agricultural Produce Market Committee
ARR	Accounting Rate of Return
ATMA	Agricultural Technology Management Agency
AWS	Automated Weather Stations
BAU	Business as usual
BBY	Bhavantar Bhugtan Yojana
BCR	Benefit–cost ratio
BMC	Bulk Milk Coolers
BRC	Bank Realization Certificate
BRIC	Brazil, Russia, India and China
CACP	Commission for Agricultural Costs and Prices
CAGR	Compound annual growth rate
CBI	Centre for Promotion of Exports from Developing Countries
CIPHET	Central Institute of Post-Harvest Engineering & Technology
CISH	Central Institute for Subtropical Horticulture
CPDO	Central Poultry Development Organizations
CPRI	Central Potato Research Institute
CSE	Centre for Science and Environment
CSR	Corporate social responsibility
CSS	Centrally Sponsored Scheme
CV	Coefficient of variation
DAC&FW	Department of Agriculture, Co-operation and Farmers Welfare

DAHD	Department of Animal Husbandry and Dairying
DAHDF	Department of Animal Husbandry, Dairy and Fisheries
DC	Distribution Centers
DCS	Dairy Co-operative Societies
DEDS	Dairy Entrepreneurship Development Scheme
DES	Directorate of Economics and Statistics
DGCIS	Directorate General of Commercial Intelligence and Statistics
DGFT	Directorate General of Foreign Trade
DIDF	Dairy Processing and Infrastructure Development Fund
DIPP	Department of Industrial Policy & Promotion
DMI	Directorate of Marketing & Inspection
DOGR	Directorate of Onion and Garlic Research
ECA	Essential Commodities Act
ECGC	Export Credit Guarantee Corporation
EDI	Electronic Data Interchange
EGS	Employment Guarantee Scheme
EIA	Export Inspection Agency
e-NAM	National Agriculture Market
EP	Eutrophication Potential
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FAPAFS	Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act
FCI	Food Corporation of India
FCR	Feed conversion ratio
FDI	Foreign direct investment
FGP	Farm gate price
FICCI	Federation of Indian Chamber of Commerce and Industry
FL	Family labour
FLDG	First Loss Default Guarantee
FOB	Free on Board
FPC	Farmer Producer Company
FPO	Farmer Producers Organization
FPTC	Farmers' Produce Trade and Commerce (Promotion and Facilitation)
FSSAI	Food Safety and Standards Authority of India
FY	Financial year
GAP	Good agricultural practices
GCA	Gross Cropped Area
GCMMF	Gujarat Co-operative Milk Marketing Federation
GDP	Gross domestic product
GHG	Greenhouse Gas
GoI	Government of India
GST	Goods and Services Tax
GVA	Gross value added

GVC	Grape Value Chain
GWP	Global warming potential
HDP	High-density planting
HOPCOMS	Horticultural Producers' Co-operative Marketing and Processing Society
HPAI	Highly Pathogenic Avian Influenza
HVA	High-value agriculture
HWT	Hot water treatment
ICAR	Indian Council for Agricultural Research
ICLC	Irrevocable commercial letter of credit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDMC	Indian Dairy Machinery Company Ltd.
IFC	International Finance Corporation
IFGRI	Indian Grassland and Fodder Research Institute
IIHR	Indian Institute of Horticultural Research
ILRI	International Livestock Research Institute
INDC	Intended Nationally Determined Contributions
INR	Indian rupees
IOSR	The International Organization of Scientific Research
IPCC	Intergovernmental Panel on Climate Change
IPPP	Innovative Poultry Productivity Project
IPR	Intellectual Property Right
IRR	Internal rate of return
ISRO	Indian Space Research Organization
ITC-HS	Indian Trade Clarification based on Harmonized System
JDCC	Jalgaon District Co-operative Society
JISL	Jain Irrigation Systems Limited
JNPT	Jawaharlal Nehru Post Trust
KCC	Kisan Credit Card
KI	Key indicators
KII	Key information interview
KMF	Karnataka Milk Federation
KMS	Kharif marketing season
KPS	Kesla Poultry Samiti
LCS	Land Custom Stations
LIT	Low-input technology
LK	Late kharif
LLPD	Lakh litres per day
LMT	Lakh metric tonnes
LPAI	Low pathogenic avian influenza
LPC	Land Possession Certificate
MAC	Multi-Agency Centre
MAH	Milch Animal Owning Household
MDFVPL	Mother Dairy Fruit and Vegetable Private Limited
MDM	Mid-day meal

MEIS	Merchandise Exports from India Scheme
MEP	Minimum export price
MFPO	Meat Food Products Order
MIDH	Mission for Integrated Development of Horticulture
MIP	Market intervention price
MIS	Market Intervention Scheme
MMPO	Milk and Milk Products Order
MMT	Million metric tonnes
MNAIS	Modified National Agricultural Insurance Scheme
MNC	Multinational company
MoAFW	Ministry of Agriculture & Farmers Welfare
MoCI	Ministry of Commerce and Industries
MoFPI	Ministry of Food Processing Industries
MoSPI	Ministry of Statistics and Programme Implementation
MOU	Memorandum of understanding
MP	Madhya Pradesh
MPD	Market price differential
MRDBS	Maharashtra Rajya Draksha Bagayatdar Sangh
MRL	Maximum residue limits
MSAMB	Maharashtra State Agricultural Marketing Board
MSP	Minimum support price
MSSL	Mahindra Shubhlabh Services Ltd.
MT	Metric tonnes
MTR	Mavalli Tiffin Room
NABARD	National Bank for Agriculture and Rural Development
NAFED	National Agricultural Co-operative Marketing Federation of India
NAIS	National Agricultural Insurance Scheme
NAPDD	National Action Plan on Dairy Development
NAS	National Accounts Statistics
NCAER	National Council of Applied Economic Research
NCAP	National Centre for Agricultural Economics and Policy Research
NCCD	National Centre for Cold-Chain Development
NCDC	National Co-operative Development Corporation
NCDEX	National Commodity and Derivatives Exchange
NCPAH	National Committee on Plasticulture Applications in Horticulture
NCR	National Capital Region
NCRPB	National Capital Region Planning Board
NDDB	National Dairy Development Board
NDP	National Dairy Plan
NECC	National Egg Coordination Committee
NEFT	National Electronic Fund Transfer
NeML	NCDEX eMarkets Limited
NFN	NDDB Foundation for Nutrition
NFSM	National Food Security Mission
NGO	Non-governmental organization

NHB	National Horticulture Board
NHM	National Horticulture Mission
NHRDF	National Horticultural Research and Development Foundation
NIAM	National Institute of Agriculture Marketing
NIANP	National Institute of Animal Nutrition and Physiology
NMAET	National Mission on Agricultural Extension and Technology
NMFP	National Mission on Food Processing
NPC	Nominal Protection Coefficient
NRC	National Research Centre for Grapes
NRCB	National Research Centre for Banana
NRP	Nominal rate of protection
NSS	National Sample Survey
NSSO	National Sample Survey Office
NWRS	Negotiable Warehouse Receipts
NZ	New Zealand
OECD	Organization for Economic Co-operation and Development
OF	Operation Flood
OIV	International Organization of Vine and Wine
PAN	Permanent Account Number
PHC	Pre-harvest contractor
PHM	Post-harvest management
PIB	Press Information Bureau
PMC	Price Monitoring Cell
PMFBY	Pradhan Mantri Fasal Bima Yojana
POPI	Producers Organizations Promoting Institutions
PPP	Public–private partnership
PRADAN	Professional Assistance for Development Action
PSF	Price Stabilization Fund
PSS	Price Support Scheme
PSU	Public Sector Undertaking
PVC	Pomegranate Value Chain
RBI	Reserve Bank of India
RBP	Ration Balancing Programme
RBPDP	Rural Backyard Poultry Development Program
RKVY	Rashtriya Krishi Vikas Yojana
RMS	Rabi marketing season
RPI	Retail Price Index
SAMPADA	Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters
SBI	State Bank of India
SC	Schedule Caste
SCH	Single cross hybrid
SEP	Small Exporter's Policy
SFAC	Small Farmers' Agribusiness Consortium
SHG	Self-Help Group

SIDBI	Small Industries Development Bank of India
SMART	Maharashtra's Agri-business and Rural Transformation Program
SMP	Skimmed milk powder
SMSPM	Sub-Mission on Seeds and Planting Material
SOP	Standard operating procedures
ST	Schedule Tribes
SWOT	Strengths, weaknesses, opportunities, and threats
TE	Triennium ending
TOP	Tomato, onion, potato
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
UP	Uttar Pradesh
US	United States
USA	United States of America
USD	United States Dollar
USDA	United States Department of Agriculture
UT	Union territory
UV	Unit values
VAR	Value at risk
VHT	Vapour heat treatment
VKGUY	Vishesh Krishi and Gram Udyog Yojana
WBCIS	Weather Based Crop Insurance Scheme
WDRA	Warehouse Development and Regulatory Authority
WOAH	World Organization for Animal Health
WPI	Wholesale Price Index
WRS	Warehouse Receipt System
WTO	World Trade Organization

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Chapter 1
Introduction

Ashok Gulati

1.1 Background and Scope of the Study

Changing consumption preferences towards high value, nutrient and protein rich foods are signaling agricultural diversification in India. Currently, India is the largest producer of milk, pulses, banana, mango, pomegranate, papaya, lemon, okra, ginger and non-food crops like cotton and jute; the second-largest producer of rice, wheat, fruits and vegetables, tea and one of the leading producers of eggs and meat in the world. India produced 281.8 million tonnes of food grains, 307.7 million tonnes of horticulture crops, 176.5 million tonnes of milk, 96 billion eggs and 7.7 million tonnes of meat during TE 2018–19. Table 1.1 illustrates the production and trade statistics for the selected commodities studied in this book.

However, this record level of production has not translated into commensurate increased economic returns to the farmers in India. Unable to find markets for their produce, farmers have often taken to distress sales, burning crops, and dumping produce on the roads. Agricultural policymaking has for a very long time focused on increasing production without giving due attention to the need to develop efficient value chains. While India has diversified significantly from producing grains to a variety of high-value commodities, these commodity value chains have remained relatively underdeveloped. Agricultural value chains are highly fragmented and subject to a high degree of intermediation, resulting in poor price realization for farmers, substantial losses in the quantity and quality of produce, limited scope for value addition, and high price volatility.

The vulnerability of agricultural value chains became more evident during the coronavirus pandemic in 2020. With the sudden announcement of lockdown 1.0 in March, 2020 across the country, supply chains dealing in fresh and perishable produce were hit. Demand plummeted due to the restrictions imposed on the HoReCa (hotel, restaurant and catering) segment, and because of people keeping away from wet

A. Gulati (✉)
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India

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Table 1.1 Basic Statistics of Selected Commodities (TE 2018–19)

Commodity	Production (MMT)	Export ('000 MT)	Import ('000 MT)	Value of output (INR '000 Crores)
Tomato	19.8 (2)	143	0.1	21.8
Onion	22.8 (2)	1826	4.6	19.4
Potato	49.1 (2)	396	0.4	29.3
Banana	30.6 (1)	116	0.0	33.1
Mango	20.9 (1)	50	0.0	43.4
Grapes	3 (7)	219	5.7	4.8
Pomegranate	2.8 (1)	57	0.0	7.7
Milk	176.5 (1)	23.5 (SMP)	0.6 (SMP)	449.9
Eggs (billion nos.)	96 (3)	412	0.4	78.5
Chicken meat	3.7 (7)	5	0.1	22.0
Tur	4.2 (1)	11	588.5	14.2
Gram	10.2 (1)	115	737	28.8

Source Horticulture Division (2020), DES (2020), DoAHD, DGFT (2020) and MoSPI (2020)
Note Figure in parenthesis is India's rank in global production; export, import data are for fresh only except milk

markets due to fear of infection. In the absence of robust direct marketing channels, farmers could not sell their produce and suffered losses in terms of low price realization and wastage. Despite farmers receiving low prices, retail prices of fresh agricultural produce in many urban pockets did not decline. The high consumer price inflation observed in the months following the lockdown in March, 2020 had been a cause of concern for the policymakers. In its pandemic relief package, the central government announced several packages for the agricultural sector and introduced the Farm Laws 2020, reiterating its vision to liberalise agricultural markets to benefit the farmers. Reforming the Agricultural Produce Marketing Act (APMC) Act to allow direct farming, and contract farming; doing away with the Essential Commodities Act (ECA) to allow free movement and stocking of agricultural commodities; and empowering farmers through the expansion and strengthening of Farmer Producer Organizations (FPOs), were the key components of the announcements. For the first time, the central government pre-empted the states and brought about legal change by way of an Ordinance in June, 2020, followed by enactment through legislation in September, 2020. Despite many challenges presented by Covid-19, the agricultural sector could really benefit from the political will and commitment to bring about long-overdue marketing reforms.

The inefficiencies in agricultural value chains prevent India from reaping the benefits of global trade and becoming a significant player. India's presence in the global markets has been very limited despite it being one of the leading producers of several agricultural commodities. In the domestic markets, farmers are adversely affected as reflected in the low share that farmers receive of the consumer's rupee for a number of agricultural commodities. This makes it even harder for India's predominantly large number of small and marginal farmers to earn remunerative prices. Given that 86.1% of total agricultural land holdings in India are small and marginal (area less than 2 ha), any agriculture growth that does not deliver benefits to the small and marginal farmers cannot be inclusive. Further, the cereal-centric policies of the government have neglected the challenges faced by farmers growing non-cereal crops. These policies have exacerbated the concerns around environmental degradation including depleting water resources in key rice-growing states as well as soil contamination due to excessive use of chemicals. Very little attention has been given towards the sustainability and scalability of successful value chains across commodities and geographies.

With rising incomes, the demand for high-value agricultural crops such as fruits and vegetables, dairy products, eggs, chicken and fish in India has increased over the years. Therefore, it is important to develop value chains that can handle the pre and post-harvest requirements of such commodities, which are different from that of cereals and pulses. First, the value chains should be domestically as well as globally competitive. Second, the value chains should be inclusive to ensure participation of marginal and small farmers. Third, it should be financially and environmentally sustainable; farmers should be able to earn remunerative returns but not at the cost of environmental health and natural resources. Fourth, the impact of successful value chains can be realized to the benefit of farmers and the agricultural sector, in general, if these chains can be scaled up across commodities and geographies. Last, access to finance through innovative financing methods for all stakeholders in the value chain is critical to ensure that these chains are competitive, inclusive, sustainable and scalable.

In this context, this ICRIER-NABARD research study on agricultural value chains was undertaken to analyze and evaluate the performance of selected agricultural value chains across major producing regions in India using the conceptual framework of competitiveness, inclusiveness, sustainability, scalability (CISS) and access to finance (F). The study includes agricultural commodities such as vegetables (tomato, onion and potato (TOP)), fruits (banana, mango, grapes and pomegranate), dairy, poultry, and pulses. The conceptual framework of CISS-F helps understand how agricultural and food policies work on the ground and what more needs to be done at the policy, institutional and operational levels to strengthen the high-value agricultural chains.

1.2 Methodological Framework

Commodity Selection

Commodities studied in this book include high-value agricultural commodities such as fruits and vegetables, livestock and pulses, which account for more than 50% of the value of output from agriculture and allied sectors (Fig. 1.1). Three

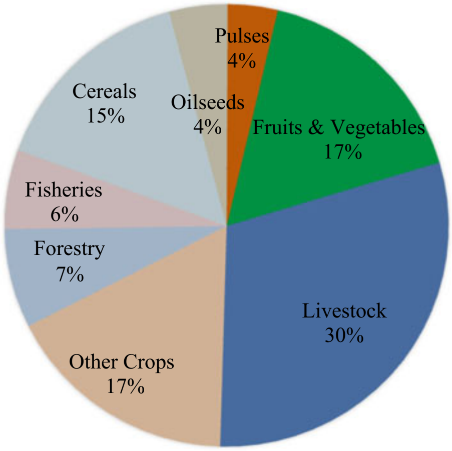

Fig. 1.1 Selection of commodities based on share in GVO of Agriculture and Allied Sectors: TE 2017–18. *Source* National Accounts Statistics 2019, MoSPI

major vegetables—tomatoes, onions and potatoes (TOP)—and four major fruits–bananas, mangoes, grapes and pomegranates—have been selected from the horticulture segment. Milk and poultry have been selected from the livestock segment. In the pulses segment, gram/*chana* and pigeon pea/*tur*, which together account for nearly half of pulses production, have been selected.

Data Collection

The research findings and analysis are based on both primary and secondary sources of data. Secondary data published by the government at the national and state levels; and international databases have been used for most of the analysis.

Field visits were made to major producing regions, *mandis*, processing facilities, farmer producer organizations, etc., of the selected commodities to understand ground realities. The research study did not involve detailed survey, rather, primary information was collected using semi-structured interviews with farmers, traders, market officials and government representatives; and focus group discussions. The list of states and regions visited to study the value chains of the selected commodities has been given in Table 1.2. In all, 24 districts were covered across 10 states indicating the wide spatial coverage of the study.

Table 1.2 Details of field visits

Commodity	State	Region	Purpose
Tomato	Karnataka	Kolar	Kolar APMC-domestic trade
		Bengaluru	Indian Horticulture Institute, Seed companies
	Andhra Pradesh	Chittoor	Processing variety of tomato
	Delhi	Azadpur *Mandi*	Domestic trade—APMC
Onion	Maharashtra	Nashik	Lasalgaon, Pimpalgaon APMC—domestic trade
		Jain Irrigation, Jalgaon	Contract farming of white onion
	Gujarat	Mahuva	Dehydrated onion value chain
	Delhi	Azadpur *Mandi*	Domestic trade—APMC
Potato	Uttar Pradesh	Agra	Traditional value chain
	Gujarat	Mehsana	McCain processing, Contract farming
	Bihar	Nalanda	Traditional value chain without APMC
	Delhi	Azadpur *Mandi*	Domestic trade—APMC
Milk	Gujarat	Banaskantha	Banas Dairy (Co-operative)
	Bihar	Patna	Sudha Dairy (Co-operative)
	Maharashtra	Kolhapur	Gokul Dairy (Co-operative)
		Pune	Private Organized Dairy
	Punjab	Moga	A leading multinational corporation
Banana	Maharashtra	Raver, Jalgaon	Traditional value chain
		Jain Irrigation, Jalgaon	Tissue culture and Banana Processing
Mango	Maharashtra	Ahmednagar	Export facility centre
		Jalna	Export of Kesar variety
		Jain Irrigation, Jalgaon	Tissue culture and Mango Processing
		Mumbai	Irradiation centre, Vashi
Grapes	Maharashtra	Nashik	Domestic trade-APMC, Export model
		Uruli Kanchan, Pune	National research centre grapes, Mahagrapes

(continued)

Table 1.2 (continued)

Commodity	State	Region	Purpose
Pomegranate	Maharashtra	Nasik	Market yard, Domestic trade—APMC
		Solapur	Export model, Domestic trade—APMC
Poultry	Haryana	Hissar	Private poultry farm
	Andhra Pradesh	Madanapalle	Suguna poultry farm
Pulses	Maharashtra	Latur	Pigeon Pea domestic trade
		Mumbai	Vashi *mandi*
	Madhya Pradesh	Indore	Chana domestic trade
		Dewas	Chana domestic trade
		Ujjain	Chana domestic trade

Source Value chain studies

CISS-F Framework

The conceptual framework of competitiveness, inclusiveness, sustainability and scalability and access to finance (CISS-F), which has been used to evaluate the performance of agricultural value chains, is described in detail in this section.

Competitiveness

Competitiveness of value chains is measured for both domestic and international markets. Domestic competitiveness is measured in terms of the farmer's share in the consumer price. International competitiveness is measured by determining the export competitiveness of agricultural commodities using the nominal protection coefficients (NPCs).

To determine **domestic competitiveness**, the share of all stakeholders in the retail consumer price is estimated. As the distinction between costs and margins of stakeholders is difficult to determine, the two have been clubbed together as mark-ups. Mark-up is defined as the increment in cost because of value addition that includes both real costs as well as margins accruing at various stages of the value chain.

For **international competitiveness**, the export and import competitiveness of a commodity, measured by the nominal protection coefficient (NPC), have been calculated. Nominal protection coefficient (NPCs) is the ratio of domestic prices ($\boldsymbol{P}_{\mathbf{D}}$) to an international reference price. Using methodology adopted by Saini and Gulati (2017), NPCs under both exportable ($\mathrm{NPC_X}$) and importable hypothesis ($\mathrm{NPC_M}$) have been calculated. For $\mathrm{NPC_X}$ and $\mathrm{NPC_M}$, the international export reference price (X_r) and international import reference price (M_r) were used respectively, using the following formula:

$$\mathrm{NPC_X} = \frac{P_\mathrm{D}}{X_\mathrm{r}}$$

$$\mathrm{NPC_M} = \frac{P_\mathrm{D}}{M_\mathrm{r}}$$

The calculation above required two monthly price series—domestic wholesale price and international reference price for the particular commodity. For domestic wholesale price ($\boldsymbol{P_\mathrm{D}}$), a weighted average of state wise prices in states accounting for at least 60% of the national output were taken. The international reference price was the border price for exports of the commodities or the free on board (FOB) prices. These were adjusted for quality and two reference prices were estimated:

$$\begin{aligned}\text{International Export Reference Price } (X_\mathrm{r}) &= \text{International price after quality adjustment} \\ &- \text{Trading and marketing margins} \\ &- \text{Transportation cost from farm to port} \\ &- \text{Port handling charges}\end{aligned}$$

$$\begin{aligned}\text{International Import Reference Price } (M_\mathrm{r}) &= \text{International price after quality adjustment} \\ &- \text{Trading and marketing margins} \\ &- \text{Transportation cost from farm to port} \\ &+ \text{Port handling charges}\end{aligned}$$

Trade adjusted NPCs: A time series of trade adjusted NPC values were obtained depending on the value of $\mathrm{NPC_X}$ and $\mathrm{NPC_M}$.

- When a commodity is import competing (M), i.e. if $\mathrm{NPC_M} > 1$, then $\mathrm{NPC_M}$ is taken
- When a commodity is export competing (X), i.e. if $\mathrm{NPC_X} < 1$, then $\mathrm{NPC_X}$ is taken
- When a commodity is in the non-tradable zone (NT), i.e. if $\mathrm{NPC_X} < 1 < \mathrm{NPC_M}$, then NPC values are taken as '1'.

Inclusiveness

Inclusiveness of the value chains is analyzed in terms of the participation of marginal and small farmers in production, and their access to markets, and logistics such as transportation, warehouses, cold storages, etc. A few examples of contract farming are also cited to illustrate how these alternate marketing models affect participation by marginal and small farmers in the value chains.

Sustainability

Sustainability of the value chains has been assessed in terms of financial and environmental sustainability. Financial sustainability has been estimated using the profitability of producing and marketing a commodity. Sensitivity analysis was used to check for the sensitivity of profits of farmers to various scenarios involving price volatility, climate change, etc., for a few commodities. Environmental sustainability has been assessed in terms of water requirement, fertiliser and pesticide consumption and other key environmental factors specific to the farming of the commodities.

Scalability

Scalability of the value chains has been measured in terms of past trends in area expansion or productivity gains, both of which affect the current production levels as well as the future scope of increasing production. Expansion of exports, and opportunities for value addition, which are critical to the economics of scaling up production, have been considered as well. Also, for successful value chains, the potential for replicability across states has been studied.

Access to Finance

Finally, access to finance by various stakeholders in the value chains and the role of innovative financing methods have been studied. Existing gaps in financing, the current reach of organized finance and the potential for innovative financial interventions have been identified. Financial interventions are suggested in order to increase competitiveness, inclusiveness, scalability or sustainability of participants in the value chain.

1.3 Organization of the Book

This book is organized into 9 chapters. This chapter introduces the background, scope and methodological framework of the study. Chapter 2 presents a comprehensive synthesis of all value chains analyzed in this study. The chapter brings out the role of technology, institutions and markets in strengthening agricultural value chains by catalysing each of the components of the CISS-F framework. Chapters 3–8 deal with commodity-specific value chain studies. Chapter 3 explores the value chains of three major vegetables in India –tomatoes, onions and potatoes (TOP); Chap. 4 explores the value chains of two major fruits—bananas and mangoes; Chap. 5 deals with the value chains of grapes and pomegranates; Chap. 6 presents the dairy value chain in India focusing on the milk value chain; Chap. 7 relates to the poultry value chain in India and Chap. 8 analyzes the pulses value chain in India, focusing on gram/*chana* and pigeon pea/*tur*. Each of these six value chain chapters analyze the performance of the respective commodity value chains in terms of their competitiveness, inclusiveness, sustainability, scalability and access to finance. The research findings are used to come up with commodity-specific policy suggestions that could help address existing challenges and strengthen the value chains further. Finally, Chap. 9 presents the way forward and provides some broad policy suggestions relevant for strengthening of agricultural value chains.

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Chapter 2
Evaluating Agricultural Value Chains on CISS-F Framework

Ashok Gulati, Kavery Ganguly, and T. Nanda Kumar

2.1 Technology, Institutions and Markets Driving Value Chains

Technology, institutions and markets together drive agricultural value chains in becoming more competitive, inclusive, sustainable and scalable, and in improving access to finance (Fig. 2.1). Technology has been instrumental in streamlining value chains, improving efficiency, and enabling farmers' participation. Institutions that focused on aggregating marginal and small farmers, empowering them with better bargaining power, inducing economies of scale and creating market linkages have been pivotal in the successful transformation of agricultural value chains. Dairy co-operatives, co-operative unions in the case of grapes and the integrator model in poultry, are some examples. Institutions have been effective in bringing in the right agricultural practices as observed in the case of pomegranate, banana, and mango. Institutions have a critical role in enhancing governance and accountability and addressing equity concerns in high-value agriculture.

Commodities like tomato, onion, potato and pulses, despite high volumes and value but marketed largely through traditional market channels, are more susceptible to price volatility compared to grains. Time and again, farmers have suffered from crashing prices but have not gained as much from price escalation in the wholesale or retail markets. Much of this can be explained by limited marketing opportunities for farmers and the inability to undertake marketing risks. The role of technology, institutions and markets and their critical interplay have been analyzed in greater detail in assessing the value chains in the CISS-F framework.

A. Gulati (✉) · K. Ganguly
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India

T. Nanda Kumar
Former Senior Visiting Fellow, Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India

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Fig. 2.1 Technology, institutions and markets strengthening CISS-F of value chains. *Source* Authors' illustration

2.1.1 Technology

Technological breakthroughs have played an important role in strengthening value chains in the dairy, poultry, and horticulture (primarily potatoes, grapes and bananas) sub-sectors.

In the dairy sector, the issue of low productivity of Indian bovines (milk yield of less than 1 kg/day) was addressed by importing high-genetic merit bulls and, production and import of high-quality semen. The large-scale adoption of artificial insemination (AI) was effective in improving bovine productivity. Innovations in the protocol to select indigenous bulls of higher genetic merit based on pedigree or progeny testing were effective in boosting productivity. Cross breeding technology resulted in average productivity increasing from less than one kilogram per animal per day in the pre-Operation Flood (OF) era (prior to 1970) to 4.5 kg per (in-milk) animal per day. The increased availability of milk resulted in competitive prices and the import of skimmed milk powder (SMP) was no longer necessary to meet domestic demand. Before Operation Flood (OF) III (1985–1996) was completed, India depended on imported SMP to meet domestic milk demand. Milk production increased from 84.4 million tonnes in 2001–02 to 187.7 million tonnes in 2018–19, with the highest productivity gains coming from crossbred cows. This resulted in India becoming competitive in SMP exports in certain years.

Other technology interventions that helped the development of the dairy sector in India included technology to make milk powder from buffalo or mixed (cow and buffalo) milk that ensured that surplus milk in flush season was bought from farmers. This was instrumental in ensuring that farmers did not lose out on income and India could leverage increased export opportunities. Technology related to the fabrication of insulated (non-refrigerated) rail containers for transporting milk and milk dispensing machines (used by Mother Dairy) strengthened milk marketing. Interestingly, the availability of the lactometer had a positive impact on inclusiveness. A simple technology that could determine the quality of milk enabled the smallest milk farmer to participate in the value chain. The awareness that milk adulteration could be detected, and payments for milk were made on easily verifiable quality and quantity, prevented farmers from indulging in malpractices. This laid the foundation of trust in the co-operative milk marketing system in India.

In the poultry sector, backyard poultry did not support the rapid expansion of production through productivity breakthroughs or large-scale market integration. To overcome the productivity challenge, large-scale organized players demanded liberalization of import of improved genetic material. Until 2001, the import of grandparent stock was controlled by permits and governed by a duty structure. A bold decision to allow duty-free import of grandparent stock (like Bowans, Hyline, Lohman LSL, among others) from the USA and other countries enabled the development of crossbred varieties like BV-300. The egg productivity for improved fowls increased from 237.5 per bird per year in 2000-01 to 297 per bird per year in 2017–18.

In the case of poultry meat, technology breakthrough with improved varieties like Cobb, Hubbard, Lohman, among others enabled India to achieve high-conversion ratios and reduced the period needed for chicken to gain the required weight (33–45 days). The technologies suited the integrator model involving a large number of small farmers. The integrators took the responsibility for running and maintaining hatcheries to ensure genetic purity and control over disease outbreak. The development of modern hatcheries in the private sector, modernization of feed mills, development of protocols for the management of small size (3000–5000 birds) farms, standard operating procedures (SOP) for containment of disease and skill development at the farm level also contributed to the growth of the poultry sector in India.

In potato, the introduction of the early season variety *Kufri Pukhraj* and mid-season varieties by scientists at CPRI-Shimla enabled a productivity breakthrough and reduced crop duration. In tomato, a production breakthrough was achieved largely through hybrids developed by the private sector and better crop management. In the case of both potato and tomato, large private processors brought in technologies and best practices for pre- and post-harvest operations. In the case of onion, crop management technology, raised bed planting, micro irrigation, and development of season specific varieties for the *kharif*, late *kharif*, and *rabi* seasons, made a lot of difference in productivity. Dehydration and storage technologies in onion further boosted value addition.

Grape cultivation was transformed by the introduction of the Thomson seedless cultivar of the USA origin. It helped improve both the quality and volume of production to enable India to export table grapes and attain productivity levels comparable globally. In pomegranates, productivity and crop loss issues were overcome by adopting tissue culture of sturdy varieties that could withstand water stress for long spells. These varieties were developed by a private entrepreneur and distributed to farmers. Although aimed at export clusters, the introduction of good agricultural practices (GAP) and traceability criteria such as grape-net and mango-net by Agricultural and Processed Food Products Development Authority (APEDA) brought about positive changes in these value chains. Innovations in packaging also had a positive impact on the marketability of grapes.

Productivity gains in bananas was achieved through the introduction of Grand Nain, a cultivar of the Cavendish variety imported by Jain Irrigation System Limited

(JISL) in 1994 and ready for adoption in the late 1990s-early 2000. Tissue culture technology was extensively used to produce disease free planting material in large quantities across the country. Grand Nain's potential was 200–240 fruits of standard size that is about 32 kg from one plant in about 250 days and yields up to 85 tons per hectare. Such high-productivity levels enabled farmers to earn much higher returns per unit of land. Ripening technologies in the banana sector has improved the quality of the fruit by slowing down the ripening process. Mango has been a traditional orchard crop in India. There was no major breakthrough in yields through the adoption of genetic technology in the case of mango. However, efficient management of orchards through ultra-density planting—a technology perfected by Israel—together with pruning of trees and access to micro irrigation improved productivity significantly.

Unlike in the case of wheat and rice (during the Green Revolution period), there was no varietal breakthrough in pulses, resulting in volatility in domestic production and increasing dependence on imports (with the exception of the year 2016–17). Efforts to enhance productivity of pulses date back to the National Pulses Development Scheme in the 7th five-year plan (1985–1990). Since then, pulses have been part of national technology missions, integrated schemes, National Food Security Mission (NFSM), *Rashtriya Krishi Vikas Yojana* (RKVY), accelerated pulses development program, etc. However, the impact of these program has not been studied adequately to enable an assessment of their role in increasing productivity. Increased production of pulses together with cheap imports resulted in poor price realization by farmers, making production unviable. This is an example of how the concern in agriculture has moved from boosting production to creating and strengthening market linkages for farmers to sell their produce at remunerative prices.

2.1.2 Institutions

Institutions led by government, private sector, and farmers have had their impact on the progress of Indian agriculture. It is interesting to note that each of these institutions have co-existed together with varying degrees of importance, specific to the value chains. Efforts have been made to revitalize institutions to realize higher economic gains as well as farmers' welfare. Institutions have enabled technology adoption and creation of market linkages as observed in the value chains studied here.

The success of Indian dairying is ascribed to co-operatives and, within that the success of the Gujarat Co-operative Milk Marketing Federation Limited (GCMMF) or Amul stands out as exemplary. The co-operative revolution in Indian dairy and the rise of Amul was rooted in the desire to put an end to the non-inclusive monopoly of Polson and tapping the big Bombay market. Support from leaders like Sardar Vallabhbhai Patel and Lal Bahadur Shastri, persistent ground work by local leaders like Tribhuvandas Patel and the innovative genius and technological prowess of Dr. Verghese Kurien shaped the dairy co-operatives. Transparency, trust and technology were the three pillars of the dairy co-operatives in India. The co-operatives were structured on democratic principles; farmers had their rightful share in the value created and consumers received value for money in terms of safe pasteurized milk. The co-operatives also played an instrumental role in rendering the dairy value chain inclusive by linking the smallest milk farmer to the market. Milk farmers in co-operatives receive (75–80)% of the consumer price, which is the highest among other high value chains. However, the success of Amul could not be replicated by other dairy co-operatives and their role in leveraging technology, creating market access for farmers, and generating value addition in dairy has been limited. Designing farmer-owned institutions need careful thought, committed leadership and sustained nurturing, which for several reasons were missing in co-operatives in other states.

The case of poultry is an equally fascinating story of how private sector-led institutional architecture scripted a resounding success story. An integrator-led farmer participatory model allowed farmers to rear (3000–10,000) poultry birds on a contract basis. The integrators developed an unambiguous farmer-friendly contract that included conditional buyback arrangements. The integrator provided high-genetic merit day-old chicks, arranged for vaccines, trained farmers in administering vaccinations, provided feed and bought back the birds and, in some cases, eggs at pre-agreed prices. The farmer was paid for managing the birds subject to a limit on mortality and an agreed weight with premium on better management. Effectively, market and price risks were undertaken by the integrator. The production risks were substantially reduced by technology and veterinary support. The contract farming model worked well without the cumbersome legal arrangements envisaged in the erstwhile contract farming law. The National Egg Coordination Committee (NECC), set up in 1982, provided a major price incentive by setting prices through voluntary compliance which it claims to have structured in such a way that farmers received about 75% of the consumer price. The call '*my egg, my price, my life*' resonated well with farmers.

In the grape sector, Mahagrapes, a union of 16 grape growers' co-operative societies in Maharashtra, played a significant role in creating market linkages, ensuring farmers' participation in price discovery and gradually expanding exports. Mahagrapes was the first entity to venture into grape export. Subsequently, the private sector, with the help of APEDA and easy access to financing took over the export market and most recently, Sahyadri—a farmer produces organization based in Nashik has emerged as the leading exporter of grapes. The Maharashtra Grape Growers Association (*Maharashtra Rajya Drakasha Bagayatdar Sangh*—MRDBS) ensures that farmers have access to technology related to production and provide the required support to make the chains competitive and inclusive. This is a case where farmer led association created synergies with marketing organization and successfully delivered the benefits to the farmers. Set in the same geographical region in Maharashtra, unlike in the case of grapes, there has been no major institutional development in the case of pomegranates. In case of bananas, Mahabananas—a federation of 26 banana growers' co-operatives in Maharashtra comprising 8000 farmers—was set up on the same lines as Mahagrapes. However, it did not succeed in bringing about any significant transformation in the sector.

In case of tomato, onion and potato (TOP), any significant transformative role of institutions is yet to be observed. Production, value addition and marketing of TOP are undertaken largely in the traditional way. Although, Operation Greens launched in 2018 for TOP aimed at achieving price stabilization, and building efficient value chains to enhance farmers' share in consumer rupee. Similarly, for pulses, the value chain is managed and operated in a traditional manner and there have been no major institutional changes.

Dairy, poultry and grapes succeeded mainly on account of existence of one of the most important elements in a value chain, i.e., 'trust.' While the brands earned consumer trust, transparency in operations and processes helped earn farmers' trust and the models successfully integrated small farmer producers in the value chain. The Anand pattern of milk marketing did not succeed in large parts of eastern India. Issues related to lower animal productivity and very low access to veterinary services as well as political and administrative meddling prevented the co-operative model from being successful in the eastern region. The success of institutions in the grape sector has been limited to three districts in Maharashtra –Nashik, Sangli and Solapur. However, these models demonstrate the role of institutions in enabling successful adoption of technology, creating market linkages and delivering gains to marginal and small farmers.

2.1.3 Markets

Economic growth and population increase have led to an increase in the demand for food, particularly, milk, eggs, fruits, vegetables and pulses. The growth in the production of the commodities studied here has been largely in response to increasing market opportunities supported by technology and institutions. While increasing minimum support price (MSP) led to an increase in the production of pulses, failure of markets left large number of farmers unable to sell their products at remunerative prices. Markets played an important role in the success of dairy co-operatives. It was due to the Bombay market that Amul could expand its operations and share the profits with farmers. However, there have been times when co-operatives have delivered remunerative prices to the farmers, irrespective of market conditions. Inclusive market access also ensured that the growth of the dairy sector had a positive impact on the lives of the smallest milk farmers. In the poultry sector, markets helped farmers earn higher prices through integrators. In the case of grapes, tapping the export market by Mahagrapes was critical in making grape cultivation a profitable venture for farmers in a very inclusive manner. Similar market linkages are missing in mango, banana and pomegranate. These value chains reflect the significance of institutions in creating inclusive market access.

Weak market linkages in tomato, onion and potato explain the extreme price fluctuations that impact both farmers and consumers. While there are large markets for these commodities, there are not many examples of innovative marketing models that have enhanced market access for marginal and small farmers or have been sustainable and scalable across geographies. The success of contract farming in potato and tomato has been very limited and has had a negligible impact on stabilizing prices. Onion being a notified commodity and politically sensitive is largely traded through regulated markets. Processing levels are quite low in these perishable commodities and for the value chains to be viable, the price points for fresh raw material are critical. Hence, any escalation in prices has a negative impact on processing capacities.

Agricultural markets have been admittedly imperfect, influenced by frequent central and state government interventions, most of them with an unambiguous consumer bias. Minimum export price (MEP) and export bans (as in the case of onions), and imposition of ad hoc ban on stocking and enforcing stocking limits (as observed in the case of onions and pulses) have been used quite frequently to ease price inflation. In addition, there are indirect controls like movement restrictions within and outside the state implemented under the ambit of various control orders promulgated under the Essential Commodities Act (ECA). Marketing through APMC markets attract dual levy of market fees when commodities move from one state to another. Traditional market chains no longer serve the farmers the way it was envisaged. Farmers have little opportunity to sell their produce outside regulated APMC *mandis*. Traders and middlemen operating in these *mandis* through licenses are found to have a stronghold and operate like cartels influencing price discovery in the market. Over time, the monopoly power of the APMCs has had a negative impact on market efficiency as well as on protecting the interests of the farmers. Often dairy co-operatives have to seek state government's approvals to fix the sale price of milk, which often is not based on market demand, but political pressure. The only exception is the GCMMF (Amul), which has a larger consumer base outside Gujarat, unlike other co-operatives, which operate within the state. With respect to international trade, it is observed that even where export competitiveness is established, exports have actually not taken place. This is on account of a policy environment that sacrifices export potential to protect the interests of domestic consumers. OECD-ICRIER (2018) estimated the Producer Support Estimates (combined effect of input subsidies and output pricing) for the period 2000 to 2016 at -14%. This implies an implicit taxation of agriculture and a pro-consumer bias driven by distortions in trade and marketing policies.

Agricultural marketing reforms have been directed towards improving efficiency of markets and delivering higher gains to the farmers, but implementation has been inadequate. The Farm Laws 2020[1] have the potential to strengthen agricultural value chains and render these chains profitable for the farmers by ensuring direct marketing linkages, contract farming, rationalization of marketing costs, incentivizing storage, and aggregation of farmers through farmer producer organizations (FPOs).

For strengthening CISS-F of agricultural value chains, it is important for technology, institutions and markets to work in tandem. It is difficult to segregate the

[1] The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020. Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020. Essential Commodities (Amendment) Act, 2020.

impact of these factors on the value chain. As the value chain matures, the relative importance of these factors changes, but each continues to be relevant for the development of the value chains. For instance, in the absence of the institution of co-operatives or FPOs, it is difficult to assess if the dairy and grape sectors could have leveraged technology for inclusive market access. Without the Bombay market for milk and export market for grapes, institution and technology could not have been as effective.

2.2 Competitiveness of Value Chains

2.2.1 Domestic Competitiveness

Table 2.1 illustrates the farmer's share in consumer rupee for different value chains. Farmers' price realization in horticulture value chains is lower than that in the dairy value chain. Milk, despite being more perishable than horticulture products, has been more profitable for farmers. The levels of processing and value addition are much higher in dairying than in horticulture, extending shelf life and economic returns. Assured procurement and market linkage through both co-operatives and the private sector have contributed to the competitiveness of the dairy sector. Traditional value

Table 2.1 Domestic competitiveness of value chains

S. No.	Commodities	Domestic Chain	Farmer's share in consumer price (%)
1	Tomato	Producing Regions to Delhi	32.4
2	Onion	Producing Regions to Delhi	29.1
3	Potato	Producing Regions to Delhi	26.6
		Nalanda to Patna	(40–42)
4	Grape	Nashik to Delhi	43
5	Pomegranate	Nashik to Delhi	45
6	Banana	Jalgaon to Delhi	35.5
7	Mango	Malihabad to Delhi	21
8	Dairy–Milk	Co-operatives (All India average)	75
		Bihar Co-operative—Sudha	76
		Pune Private Dairy	70
9	Poultry	Eggs	75
10	Pulses—Pigeon Pea/*Tur*	Maharashtra to major cities	(49–66)
11	Pulses—Gram/*Chana*	Madhya Pradesh to major cities	(46–67)

Source Value chain studies

chains of fruits and vegetables are too fragmented and suffer from a long chain of intermediation that reduces the farmers' share in the consumer rupee. However, contract farming in potato or public sector led marketing chains like Mother Dairy have delivered much higher prices (63.5%) to farmers compared to regular value chains. Farmer producer companies (FPCs) and/or targeted markets like exports have also been successful in delivering higher returns to farmers.

With a massive glut of pulses in India for the last few years, prices have crashed at all levels. In several markets, wholesale market prices have dived below the minimum support price, leaving farmers in a situation where they are unable to cover the costs of cultivation. Farmers have a very limited window of participation in the pulses value chain (limited to the arrival season after harvesting), unlike other stakeholders (millers and traders) who trade in the commodity throughout the year. On an average, the wholesale price of pigeon pea/*tur* has been about (49–66)% of the retail price in the selected cities for the years 2014–2018. In the case of gram/*chana*, wholesale price was about (46–67)% of the retail price in the selected cities. With markets failing to clear the supply of pigeon pea/*tur* and gram/*chana*, government intervened through public procurement to help farmers, which had limited impact. Domestic competitiveness of value chains is not only restricted to increasing the share of farmers' income in the consumer price but also ensuring that the prices received by the farmers render farming a profitable venture.

2.2.2 Global Competitiveness

Figure 2.2 summarizes the trade adjusted nominal protection coefficients (NPCs). Except pomegranate, mango and milk (Gujarat co-operative), all other commodities have average value of NPC less than 1. The analysis suggests that tomato, onion and potato are export competitive. However, frequent distortions in Indian trade

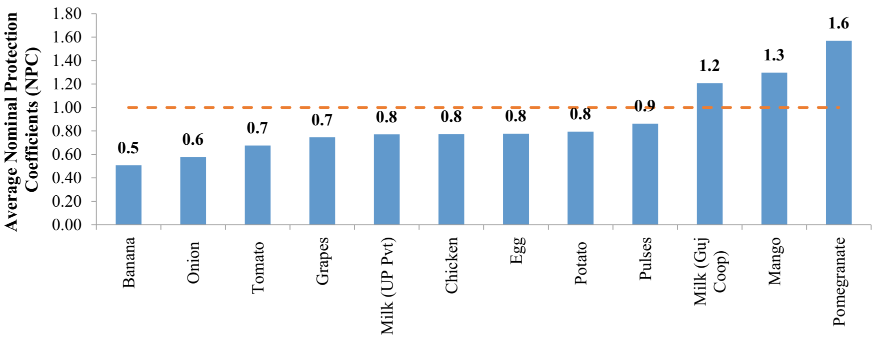

Fig. 2.2 Trade adjusted average nominal protection coefficients (NPC)-2002–03 to 2017–18. *Note* For pulses, average NPC value is NPC values of gram (kabuli chana) between 2004–05 and 2013–14 *Source* Value chain studies

policies lead to substantial fluctuations in actual exports. India accounts for 3% of global tomato exports, occupying the 8th position in the world. However, it is a net importer of processed tomatoes. Despite being export competitive in fresh tomatoes, India is not a major player in processed tomatoes owing to high-input costs. China is the global leader in tomato paste exports, attracting Indian ketchup manufacturers, who find it cheaper to import Chinese tomato paste than to procure from India. Infrastructure constraints, the time of supply to export markets and quality differences, have affected efforts to increase exports. Policy uncertainties vis-à-vis our largest market, viz., Pakistan has compounded the problem. Variability in the export of onions has been moderate. Onion is included in the Essential Commodities Act (ECA), and its export is governed by a minimum export price (MEP) fixed by the government from time-to-time. These discretionary steps have often made it difficult to create a reliable and consistent export market for onions, lowering price realization by farmers. There has been high variability in the export of potatoes, which are competitive and the competitiveness has increased after 2014–15.

After 2011–12, exports of grapes became competitive and this is reflected in the growth of exports. According to primary research, farmers get 71% of f.o.b price. In the case of pomegranates, export became competitive after 2013–14. Farmers get nearly 80% of the f.o.b price in case of exports, which is much higher than that received in the domestic value chain. Competitiveness was created by planting high-yielding planting material, undertaking disease control measures, incorporating market requirements in the production cycle, and including small growers in all these processes.

Since 2006–07, the export competitiveness of bananas has been increasing as NPC values have been declining. Indian farmers are selling bananas at a much cheaper rate and there is a dearth of trade policies that support banana farmers. It means even though bananas are export competitive in the international market, Indian farmers are unable to benefit due to weak market access. Lack of pre-harvest techniques results in poor quality of bananas not suitable for exports and improper handling during post-harvest results in wastage to the tune of (20–24)% (NRCB 2015). Mangoes have been export competitive between 2002–03 and 2017–18. However, India's mango export is based on the brand value of varieties like Alphonso, Kesar and Totapuri. Therefore, price comparison with other competing varieties may not give the right picture. This is evident from continuing exports of mangoes in spite of NPC being above one.

The export competitiveness of the dairy sector varies across states, co-operatives and private sector players, as well as liquid milk and processed products. This reflects that competitiveness has been attained at the cost of inclusiveness. The private sector in Uttar Pradesh (mostly unorganized) and Maharashtra has been competitive for a greater number of years (15 out of 17 years) compared to co-operatives in Maharashtra (9 out of 17); Gujarat (5 out of 17); and Uttar Pradesh (11 out of 17). The highly volatile global prices of SMP and the commitment of co-operatives to pay higher prices to farmers make the model uncompetitive. Co-operatives could explore exporting processed dairy products to open up marketing opportunities. Unless global prices are really high, as was the case in 2012–13, co-operatives cannot compete in global markets. Unlike the private sector, co-operatives are not in a position to adjust procurement according to market demand, which leaves them with stocks that cannot be sold off at competitive rates due to the highly volatile global price scenario.

Currently, India accounts for less than 0.4% of the global trade in poultry and poultry products. India has proven to be competitive in egg exports (comprising of hen eggs in shell, eggs dried and eggs-liquid). Japan and Gulf have been the major export destinations. Eggs have been export competitive since 2003, but have lost the competitive edge since 2014. India is yet to find a place in chicken meat exports due to rising production costs, which have doubled since the Avian Influenza (AI) struck the country in 2006. Poultry meat has been competitive from 2003–04, but was able to find a place in the global market only after 2010.

India has been consistently importing pulses, primarily yellow peas and chickpeas, which together account for 44% of pulses import (TE 2017–18). Import of pigeon pea/*tur* shot up in 2013–14, when domestic production fell. India is dependent on very few countries for pulses import—53% of yellow peas are imported from Canada and 81% chickpeas from Australia, which makes it vulnerable to production and price fluctuations in these countries. Nearly, 53% of the pigeon pea/*tur* is imported from the African countries and the rest from Myanmar. In terms of trade competitiveness, Saini and Gulati 2017 estimate that India's *kabuli chana* has been a net exportable commodity since 2006–07, except for the years 2004–05 and 2005–06. Since 2005–06, nominal protection coefficients (NPCs) have been consistently below 1, except in 2012–13 when NPC was 0.96 due to rising domestic prices following a bad crop in 2011–12. India has been consistently dependent on imports to meet the domestic consumption of pulses and hence incentivised imports by (0–10)% import duty (basic custom duty), although there exists bound duty rate of 100%. With a glut in pigeon pea and gram/*chana*, the government raised tariff levels and brought about quantitative restrictions on the import of these pulses in 2017 onwards.

2.3 Inclusiveness of Value Chains

Nearly 70% of farmers growing fruits and vegetables are small and marginal (operating on less than 2 hectares) (Fig. 2.3). Small farmers have a comparative advantage in the production of horticulture commodities, which are highly labor intensive and short duration crops. Most of the trade takes place at APMC markets, which are accessible to all farmers, but has a monopolist nature and is dominated by a few large traders and commission agents. Although farmers are inclusive by way of participation, they have no role in price determination due to their low-bargaining power. Contract farming models such as those of McCain and PepsiCo for potato and Jain Irrigation for onion have benefitted participating small and marginal farmers. The number of farmers engaged in such contract farming differs from company to company. PepsiCo has been working with around 12,000 farmers, spread over 6400 hectares across Punjab, Uttar Pradesh, Karnataka, Bihar, West Bengal, Gujarat and Maharashtra (Bayer CropScience 2010). Nearly 700 farmers were engaged in contract farming by McCain, covering an area of 7000 acres in Mehsana, Gujarat

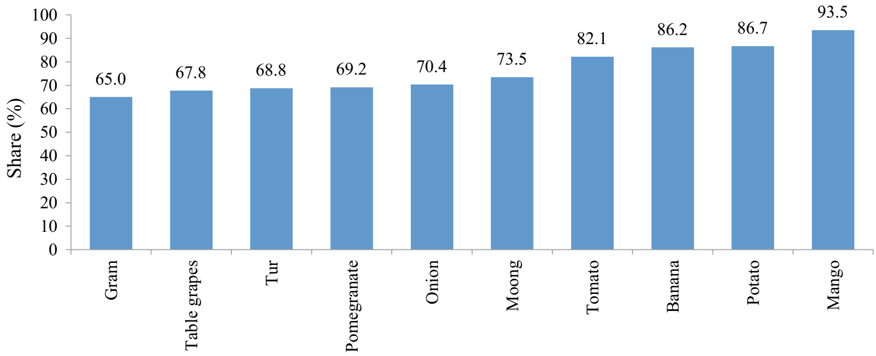

Fig. 2.3 Share of small and marginal farmers in production process of selected commodities. *Source* Agricultural Census 2015–16

(Field Visit, 2017). For onions, Jain Irrigation Systems Limited has been working with 5000 farmers from Aurangabad and Jalgaon in Maharashtra and the nearby districts of Madhya Pradesh.

However, there has been an increasing preference for large farmers due to the ease of backward linkage and control over the quality and quantity of produce required for niche markets and uses. Onion production is largely concentrated in the Nashik region of Maharashtra, and the two principal markets of Pimpalgaon & Lasalgaon are located in that region. Large farmers have some influence on onion prices, which are subject to recurring policy restrictions, and movement and storage restrictions. The low-cost onion storages at the farm level promoted by NHRDF have enabled farmers to sell later during the year. In contrast, although there are large cold storage capacities for potatoes, marginal and small farmers are unable to access these through the warehouse receipt system. Cold store owners are the major price arbiters (often financiers) in the value chain and farmers have no direct access to such infrastructure. However, pockets where large companies like PepsiCo and McCain have entered into contract farming agreements, farmers are protected from price risks, besides getting quality inputs and technical support.

Both grapes and pomegranates are grown largely by small and marginal farmers. Traceability through Grapenet and Anarnet has enabled greater participation of farmers. However, the inclusiveness of the grapes value chain in terms of export opportunities is much stronger than pomegranate, owing to the role played by Mahagrapes. Pomegranate is a resilient crop, which is able to withstand 3–4 weeks of dry spell, poor quality coarse soil, and is intercropped. This crop was introduced under the Employment Guarantee Scheme (EGS) of Maharashtra that enabled the participation of small and marginal farmers. Pomegranates are sold through auction in *mandis* and there is a private *mandi*-perfect market, dealing exclusively in pomegranates located in Nashik. In the case of grapes, about 50% of cold storages are owned by farmers, farmers' groups and proprietary concerns, with high inclusivity.

Mango, a less water intensive crop that is widely intercropped, provides seasonal income to farmers. Mango is cultivated both as orchards and homestead gardens, but the bulk of production comes from the latter. Out of 2.1 million banana growers, nearly 87% are marginal and small. Small farmers have a comparative advantage in growing fruits as these are labor intensive, short duration crops and the returns are much higher than in the case of cereals. However, farmers' participation in the value chain is limited to the farm gate which deprives them of playing an active role in price determination.

In dairying, co-operatives have been the most inclusive. All farmers who are members of co-operatives have ownership rights, participate in decision-making, have access to markets, are eligible for a share in profits based on the milk they supply, and have a vote in co-operative elections. With about 18% of the co-operative members being women, the model is gender inclusive as well. In the case of private domestic and multinational players, milk procurement is driven by market demand. Many of the players are into value added products rather than in liquid milk, and their linkage with dairy farmers is supposedly somewhat limited.

The Indian poultry sector has attracted large and small farmers alike to improve their livelihoods. Backyard poultry which includes small growers comprise of 20% of the poultry operations. The non-governmental organization model of poultry farming provides opportunities to small backyard poultry growers to participate in the poultry value chain. The integrator model driven by economies of scale, and stringent food safety standards that are required for catering to fresh and processed export markets, have provided market linkages to poultry farmers.

Pulses are less water intensive, more climate resilient, and require less crop care. These factors make it easier for resource poor smallholders to cultivate the crop. About 18.1% of the area under pulses was irrigated in TE 2013–14 and about 4% and 35.1% of area under pigeon peas and gram, respectively. Participating in production is the first step of the value chain and as one goes up the pulses value chain, it is observed that it is not as inclusive and smallholders do not benefit from the way it is structured. At an aggregate level, (32–53)% of different types of pulses produced are marketed. In pulses, about 79% of *moong*, 63% *urad*; 50% of lentils (*masur*); and 44% of *tur* are marketed through local private traders, which restricts farmers' direct interface with the wholesale market and hence, their chances of higher price realization. General awareness about minimum support price (MSP) and procurement agency is as low as (5–18)% among farmers growing pulses.

2.4 Sustainability of Value Chains

Tomato, onion and potato (TOP) form an integral part of the staple food in India, and their increasing production levels are capable of meeting export demand as well. These crops are also environmentally sustainable as these are not water intensive. Tomato is amenable to intensive cultivation on small plots of protected or open land including homestead gardens. An improved *kharif* production technology (raised bed with micro irrigation) doubled the productivity of onion. The uptake of micro irrigation for cultivation of tomato, onion and potato is possible under contract farming arrangements.

While these crops are environmentally sustainable, the financial sustainability of these chains is quite fragile. Extreme price volatility, high perishability and price sensitivity of these crops are some of the issues that affect farm incomes negatively. There have been recurrent periods when farmers have been saddled with production, but were unable to find markets, forcing them to dump the crops. This is commonly observed in the case of tomato and potato. Moreover, potato cold chains, where all price arbitrage opportunities are controlled by cold store owners, offer farmers barely any opportunity to realize the actual market price. Financial sustainability is not an issue specific to farmers, but affect other stages of the value chains. For instance, the onion dehydration industry (partly financed by government subsidy) in Mahuva has been facing a serious crisis with only 15–17 out of 110 units being operational and the others on the verge of closure (as in 2018).

Grapes and pomegranate cultivation are environmentally sustainable as these crops require 200 L (litres) and 180 L of water per kg of crop compared to 4000 L required for rice cultivation. Unlike grapes, pomegranates are more susceptible to pest attacks and diseases, which require the use of chemicals. Consequently, it adversely affects both environmental and financial sustainability (adverse effect on exportability) because of the presence of pesticide residue. Grapes cultivation is a profitable activity, but requires high investments and intense supervision. The rate of return on investment is high compared to many similar activities. There are large production risks as well. The accounting rate of return (ARR)[2] is threatened by the issue of non-payment by exporters. About (50–60)% of export value is paid in advance to farmers and the rest of the payment is uncertain. Improvement in varieties is likely to enhance ARR significantly. Pomegranate farmers get a high return on investment in the case of exports, while the variability in domestic market prices affects their profitability. The biggest threat to financial sustainability comes from water stress. The crop is unviable in water stressed years and the farmer often ends with a negative return.

Unlike the staple TOP vegetables, where price stability has been a major concern for both farmers and consumers, banana prices have been less volatile. The benefit cost ratio (BCR) comes out to be 1.6, meaning bananas have been a profitable crop.[3] Banana is a water intensive crop and needs timely irrigation, almost 70–75 times annually. The annual water intake of banana is estimated to be 1800–2000 mm. This is greater than the 900–1300 mm water requirement of rice for 3–4 months. However, the adoption of drip and sprinkler irrigation systems reduces the water intensity of the crop. Field visits showed that almost the entire area under banana

[2] Accounting rate of return (ARR) is the rate of return calculated using present year revenues and recurring costs. This is in contrast to Internal rate of return (IRR) IRR which uses costs incurred and revenues earned over the lifetime of the project.

[3] For every rupee incurred on the production and marketing of bananas, banana farmers get a return of INR 1.6. BCR values of less than 1 will mean cultivation is not profitable.

cultivation in the Jalgaon region in Maharashtra is under drip irrigation. Drip and sprinklers supplied by Jain Irrigation Systems Limited (JISL) are most suitable for tissue cultured banana plants, reducing water intake by 45%, and increasing yield by up to 52%. Bananas are one of the safest fruits for consumption in terms of pesticide residue. However, according to Banana Link, since Cavendish is the single most traded variety in the world, it has become prone to pests, fungi and diseases.[4] Due to this, large quantities of insecticides and pesticides have to be sprayed on the plants. High dosage of fertilizers and pesticides has a huge environmental impact affecting the soil, water, animals and humans. Banana fiber can be an excellent substitute for other water intensive natural fibers like cotton as these can be manufactured using banana pseudo stems which are usually discarded by farmers, and burnt.

Mango cultivation is a seasonal activity as India's peak mango season is April-June. Mango trees do not need water throughout the year. Being a seasonal fruit, it does not require irrigation immediately after the harvesting season. As farmers grow mango as part of an inter-cropping system, water requirement is much lower than other horticultural crops such as banana. Mango grows well in region when there is rainfall of 750–2500 mm during June–September. For zones receiving rainfall of less than 750 mm, orchards must be irrigated two to three times after they begin to fruit. In terms of financial sustainability, growers who maintain their orchards well and market produce themselves find mango cultivation highly feasible. Commercial cultivation of Kesar has fetched 2.25 as return on investment, making it a highly profitable.

The Environment and financial sustainability of dairy sector are impacted by the contribution of animals to greenhouse gas (GHG) emissions in the form of enteric fermentation (methane emissions), water footprint of animal population, cost of feed and fodder, and the overall financial condition of co-operatives and other players. Within agriculture, livestock accounts for 54.6% GHG emissions as enteric fermentation. Within livestock, buffaloes account for 40.2% of methane emission followed by indigenous cattle at 36.4%, crossbred cattle at 15.8%, and the rest at 7.6% (2016 data) (MoEFCC 2021). The ration balancing program under the National Dairy Plan launched in 2012 has demonstrated reduction of enteric methane emissions per kg of milk in dairy cows and buffaloes by 13.7% (NDDB n.d.). Balanced rations have been effective is reducing the water footprint of milk by 14% (1236 to 1062 litre/kg). Scientific feeding practices and use of water efficient fodder in the form of Total Mixed Ration (TMR) can further reduce the water footprint of milk. Feeding accounts for (60–70)% of the cost of milk production and adequate availability of quality feed has been a challenge. Balanced rations have also helped farmers reduce the cost of feeding animals by 16.3%. The financial viability of dairy co-operatives is a matter of concern. Data from 175 dairy co-operatives suggest that about 58% co-operatives accumulated losses, primarily because of governance issues. If the co-operatives are unable to sustain themselves financially, and large milk producing regions are left uncovered, despite the preferential, concessional

[4] Banana Link is a not-for-profit co-operative based in Norwich, which works for fair and sustainable banana and pineapple trade.

finance, and subsidies provided to the sector, the growth of the sector across regions is unlikely to be equitable.

For poultry sector to be sustainable, availability of high quality and affordable feed is crucial. About 47% of maize consumption in India is on account of poultry feed. Both productivity and price of maize affect the industry. Studies show that poultry is the most environmentally efficient of all livestock (Sluis 2007). This could be used to great advantage in promoting the sector. The environmental sustainability of the poultry sector is challenged by frequent disease outbreak that affects small growers much more. With the wet market accounting for 90% of the domestic market, these pose real environmental risks. The outbreak of Avian Influenza (AI) caused major losses to farmers because of production losses and sudden fall in demand and price. AI resulted in a major blow to layer and broiler producers in Manipur in 2007. With (43–79)% of their total household income generated from poultry farming, producers lost about INR 316 lakh, and received only INR 99 lakh, about 31% of the financial loss (Kumar et al. 2008). While the Prevention and Control of Infectious Disease in Animals Act 2009 provides the basic legal framework to control such events, poor compliance in culling, disposal and quarantine remains a major issue and can threaten the financial sustainability of the poultry sector.

Pulses are environmentally more benign, less water intensive and more climate resilient as compared to many other crops. Hence, increasing the production of pulses in an environmentally sustainable manner is feasible. In 2017–18, inflation in pulses was at an unprecedented low of (−)26.7% compared to 34.6% in 2015–16 and 18.3% in 2016–17 which have a serious impact on the supply and demand situations. With wholesale market prices below the MSP, farmers have been unable to recover their costs of cultivation, which makes pulses cultivation financially unsustainable.

2.5 Scalability of Value Chains

Scalability of production of TOP is likely to come more from increase in yield levels rather than increase in area. Given the current yield levels, there is scope for increasing production with the aid of technology—high-yielding seeds, micro irrigation and soil management. Besides, enhancing processing levels and increasing shelf life of fresh produce can add to the scalability of these value chains. Export opportunities can also help scale up production.

Production of tomatoes increased from 7.2 million tonnes in 2000–01 to 20.7 million tonnes in 2016–17. Between 2010 and 2017, production increased at a CAGR of 1.3% despite a decrease in cultivated area by 2.7%, owing to a CAGR in yield of 4.1%. Similarly, onion production grew at 4.9% during the same period with the area under the crop increasing at 4% and yield growing at only 0.9%. Potato production increased at a rate of 2.4% with 2.2% coming from an expansion in area under the crop and 0.2% coming from yield. Scalability of the onion value chain can be achieved through increase in exports. Although onion accounts for 50% of exports of fruits and vegetables, onion exports as a percent of production declined from about

24% in 2005–06 to about 10%, in recent years. However, unless farmers have direct access to export markets, it is unlikely that farmers will be able to benefit from higher price realization as these markets are controlled by traders and commission agents. In the context of the potato value chain, one of the interesting developments is the emergence of Banaskantha, a water stressed district in Gujarat, as the largest potato producing district. Here, yields have improved substantially with the adoption of micro irrigation promoted by large potato processing companies like McCain and Balaji wafers.

Production of grapes went up from 1 million tonnes in 2000–01 to 2.9 million tonnes in 2017–18, registering a CAGR of 5%. About 75% of the area under grapes is in Maharashtra, followed by 20% in Karnataka. Grape farming in Maharashtra is concentrated in three districts (Nashik, Sangli, Solapur), mainly due to climatic factors. Production is scalable vertically (economies of scale) provided it is confined to areas suitable for grape farming. However, horizontal scalability (economies of scope) across different related products (raisins and arils) needs induction and nurturing. Given the competitiveness in production, scalability of exports is feasible with more emphasis on pressed and dried categories, and the introduction of high-yielding red grape varieties. Production of pomegranates improved since 2007–08, primarily due to increased exports, and increase in domestic prices. The availability of tissue cultured planting materials from sturdier varieties has contributed immensely to the growth in area and productivity. Cultivation of pomegranates expanded to Gujarat, Andhra Pradesh, and Rajasthan. Scalability is possible in areas that are climatically suitable for the crop. However, vertical scalability is possible only if there is a serious effort to make investments in technology for processing and export of arils (pomegranate seeds).

India's banana production increased from 10.1 million tonnes in TE 1993–94 to 30.6 million tonnes in TE 2018–19. As bananas have proved to be a profitable crop, area under banana cultivation increased. Also, farmers have shown keen interest in newer technologies that yielded productivity increase. The introduction of tissue culture cultivars, especially Grand Nain variety, has demonstrated significant increase in yields. Other reasons that triggered this quantum jump in banana production were adoption of micro irrigation, precision farming, and high-density planting.

There has been not much change in the mango production pattern in key producing states. On the new varietal development front, there has not been a major breakthrough in the last decade or so. The last mango variety (Arunika) was developed by Central Institute for Subtropical Horticulture (CISH) in 2008. The old variety, Amrapali remains a favourite. Without varietal developmental, scalability of the mango value chain will remain limited. There is a need for development of long shelf life mango varieties without compromising on the taste or flavor. Due to its short shelf life, export opportunities for mango are limited. Lack of standardisation of production technology and extension of technical knowledge to farmers has been responsible for the slow pace of adoption of high-density planting (HDP) technology in mango plantations in the country. A reduction in the cost of HDP can improve scalability. There is hardly any advance estimates of production or sowing data available for mangoes, unlike those available for cereals, pulses, oilseeds, potato, and onion crops.

These factors result in lower price discovery, which impede the scaling up of mango production.

Birthal et al. (2006) estimated that 37% of the growth in milk production was on account of increase in productivity of in-milk animal. The average yield of indigenous cows are 2.8 kg per day while it is 7.5 kg per day for exotic/crossbred cows and 5.2 kg per day for buffaloes (for 2016–17). The strategy for increasing production primarily through an increase in bovine population is neither sustainable nor scalable. Increase in productivity on a continuous and sustainable basis is the only option, which can be achieved through genetic improvement with adequate emphasis on genomics, Artificial insemination (AI) and the use of sex sorted semen. Processing of milk, which is 21% of production (2017–18), is likely to increase given the rising demand for dairy products.

Despite there being favorable domestic and global demand conditions, issues related to inadequate infrastructure, inefficient marketing linkages, and price instability of poultry feed pose challenges to the scaling up of poultry farming. The Innovative Poultry Productivity Project (IPPP) launched in 2017 proposed to upgrade the subsistence model of backyard poultry farming (comprising of 45 chicks per beneficiary) to an entrepreneur model with up to 600 broilers in a year and 400 low-input technology (LIT) birds in about three years. The LIT birds model would help in the transition and subsequently, scaling up to (1000–2000) birds, towards larger commercial scale poultry farming (DAHD 2017). Scalability could be further achieved through the introduction of broilers in (about 200–500 birds) backyard poultry clusters, to cater to a large number of small markets. Development of indigenous varieties to capture the new niche market for free range chickens is another option. Environmental and food safety concerns will create large opportunities for processed meat, particularly white lean chicken meat. Animal welfare activism could also affect the current poultry farming and marketing models. This will require large investments in processing facilities and the development of a cold chain right up to the retailer.

There is scope for increasing production of pulses through increase in productivity in the leading producing states. Nearly 60% of *tur* is produced by Maharashtra, Madhya Pradesh and Karnataka. Gram is predominantly produced in Madhya Pradesh accounting for about 40% of total production. In order to scale up production, pigeon pea and gram can be promoted in states such as Andhra Pradesh and Gujarat, respectively that have lower production, but higher yield levels. Besides, diversifying to other types of pulses such as *urad, moong* and *masoor*, among others, can provide greater consumption choices. Scaling up pulses production is somewhat constrained by the import of cheaper pulses, which bring about immediate relief in the event of high inflation.

2.6 Access to Finance in the Value Chain

Various stakeholders such as farmers, traders, processors, exporters, and retailers access both formal and informal sources of finance. It includes government intervention in the form of particular schemes, subsidies, price support or interest subvention schemes. The usual financing patterns for processors, exporters and traders in the value chain in many ways determine the control of these stakeholders over the prices and risks involved.

Farmers with *kisan* credit cards (KCCs) are able to access formal credit, but are forced to approach informal money lenders, friends and relatives because of their inability to repay the loans. This has been observed in the case of potato farmers in Bihar and grape farmers in Maharashtra. The interest rates charged by informal credit agents are exorbitantly high—(2 to 5)% per month. Field visits confirm that about 80% of the TOP farmers depend on informal credit sources. In the comparatively developed region of Nashik, onion farmers have access to institutional finance and have been able to get KCC. A pledge loan scheme (at 6% interest per annum with an interest subsidy of 3%, if repayment is made within 180 days) of warehouse receipts is also implemented by Maharashtra State Agricultural Marketing Board (MSAMB) for all farmers growing different crops. The district co-operative bank is a major source of financing. In Mahuva, Gujarat, bank credit is not available to small farmers. Co-operative dairy farmers have better access to finance than those working with private players. In the poultry sector, the credit requirement of the farmers is very limited because of the integrator model, which takes care of all investment related activities in the chain. However, poultry farmers can avail the re-finance scheme offered by NABARD.

There are several government schemes that extend financial support towards development of commodity value chains. The Pradhan Mantri Kisan SAMPADA Yojana (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters) of Ministry of Food Processing Industries (MOFPI) provides a subsidy of 35% for setting up of onion cold chains and processing units and similar support is available for potato. There are subsidies from National Horticulture Board (NHB) and National Horticulture Mission (NHM) for setting up grape gardens. APEDA provides financial support for post-harvest management and export infrastructure. There is need to design a risk hedging instrument for farmers for export or market related risks. Investments are required in cold chains for pomegranates and in technology for processing of arils. Government schemes like Mission for Integrated Development of Horticulture (MIDH), which provide subsidies for ripening chambers and pack houses, and the SAMPADA Yojana, which provides loans for processing units and cold chains, are some of the financing sources for intermediaries. To promote banana exports, APEDA provides export promotion schemes. Subsidies under NHB and NHM are available to mango farmers. APEDA provides assistance for setting up pack-houses and vapor and hot water treatment facilities exclusively for exports. State governments have their own schemes to support farmers. The other major financiers are cold storage owners who see arbitrage opportunities in the market.

Despite provision of the warehouse receipt system (WRS), farmers have not availed it to the desirable extent.

Financing of dairy co-operatives has been possible with support from Government, NCDC, NDDB, World Bank and NABARD. However, private dairy processing units have not been provided similar benefits though their share in processing is almost the same as the co-operative sector. Given the increasing demand for processing, financing options for the private sector need to be strengthened. Also, large number of retailers will need to invest in the consumer end of the cold chain for effective compliance with quality standards, and will require financing. In the pulses sector, milling, processing, and marketing of pulses is financed by stakeholders through bank loans and/or personal capital. Depending on the scale of business and relationship between millers, traders and commission agents, credit is available at market determined interest rates.

2.7 Conclusion

The above synthesis provides a snapshot of how the selected value chains have performed in terms of the CISS-F framework and the role of technology, institutions and markets in achieving key milestones. As Indian agriculture diversifies increasingly toward high-value commodities, value chains will have to be strengthened in terms of CISS-F. Efficient market linkages will be important not only to match demand and supply, but also ensure that quality standards are maintained throughout the chain. For India, the issue of inclusiveness remains central to value chain efficiency. Hence, making agriculture profitable for small and marginal farmers through higher realization of the value of output, and greater risk mitigation, without distorting markets, will require more pragmatic policy interventions.

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Chapter 3
Tomato, Onion and Potato (TOP) Value Chains

Ashok Gulati, Harsh Wardhan, and Pravesh Sharma

3.1 Introduction

Tomatoes, onions and potatoes, popularly known as TOP vegetables, are the three largest cultivated, produced and consumed vegetables in India. Their production has increased dramatically over the years, making India the second-largest producer of all the three vegetables in the world, after China. Recent figures put tomato production at 19.8 million metric tonnes (MMT), onion production at 22.8 MMT and potato production at 49.1 MMT in TE 2018–19. However, this does not bring much cheer to the vegetable farmers. Reeling under over production, they have been resorting to distress sales, burning their crop or discarding them on the roads. The current market situation begs the question why, despite record levels of production, we have not been able to do justice to our farmers. The answer lies in value chain fragmentation, price volatility, quality and quantity losses and low levels of processing that characterise the market for horticultural crops in India. The prevalence of these problems has weakened India's potential in the global horticulture trade and also resulted in low returns to farmers. With around 41% share in total vegetable acreage, TOP contributes only 39% to total value of output of vegetables (Fig. 3.1).

Unlike cereals and dairy, where procurement and marketing are quite developed, a robust value chain for vegetables is missing. The reasons lie in the perishable nature of the crop, regional and seasonal concentration, and lack of storage facilities. Therefore, it is essential, to make the vegetable value chain more demand-driven, where the farmers do not face the problem of plenty. To overcome these issues, the Government of India had announced Operation Greens (OG) scheme for TOP crops in 2018, on similar lines of the Operation Flood (OF) for milk. With an initial

A. Gulati (✉) · H. Wardhan
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India

P. Sharma
Former Senior Visiting Fellow, Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India

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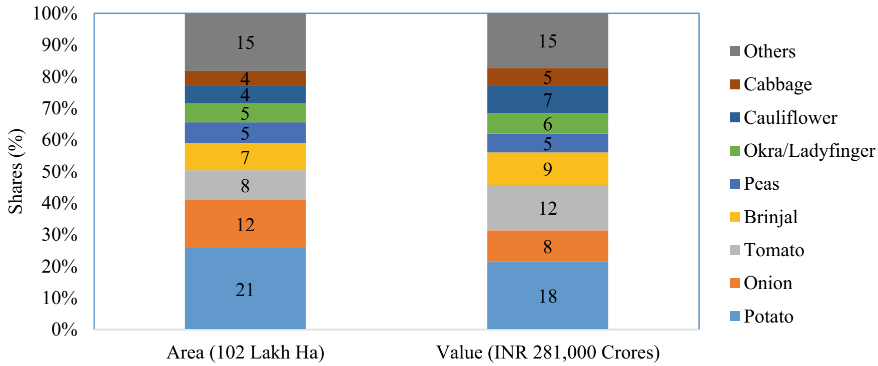

Fig. 3.1 Share of vegetables in area and value (TE 2018–19). *Source* DoAC&FW, NAS (various issues), MoSPI

outlay of INR 500 crores, the scheme is being implemented by the Ministry of Food Processing Industries (MoFPI). The OG scheme comprises of both short term and long term components, focusing on price stabilization measures and an integrated development of value chains, respectively. NAFED, as the nodal agency for the price stabilization measure intervenes during a glut situation to move out excess supply from producing regions to storages near deficit consuming regions. For both transportation and storage, 50% subsidy is provided by MoFPI. The long term measure aims to create an integrated value chains for TOP wherein a grants-in-aid of 50% (70% in case of FPOs) is provided to project implementing agencies. The scheme is at the initial stages of implementation and it will be some time before it is able to generate results similar to Operation Flood.

With this backdrop, the chapter analyzes the existing value chains of the three vegetables—tomato, onion and potato and provides policy recommendations to develop more competitive, inclusive, sustainable and scalable value chains with access to finance (CISS-F). The study can be of significant help to policymakers in formulating policies aimed at creating an efficient value chain for achieving the dual objectives of stabilizing prices and delivering fair share to farmers while ensuring the availability of affordable vegetables to consumers. This chapter examines the challenges faced at each stage of the value chain from planting up to final consumption. The methodology followed in the chapter assesses the competitiveness, inclusivity, scalability, sustainability and financial requirements (CISS-F) of the TOP value chain.

3.2 Competitiveness

The competitiveness of the TOP value chain has been assessed in terms of international competitiveness using NPC (Nominal Protection Coefficient) and the efficiency of the domestic value chain, by estimating the farmer's share in the consumer's rupee.

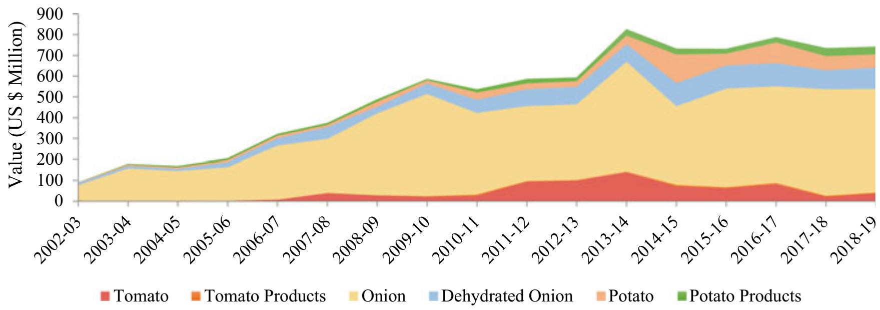

Fig. 3.2 Exports of TOP vegetables from India. *Source* DGFT (2018)

3.2.1 International Competitiveness

Tomatoes, onions and potatoes are the largest traded vegetables, globally. While India has remained the number one exporter of onions in the world, it barely exports a fraction of the total global demand for tomatoes and potatoes.

India's share in global exports of fresh tomatoes, onions and potatoes in TE 2017 was 2%, 20% and 3%, respectively (Fig. 3.2). The total export of fresh and processed form of TOP was valued at USD 755 million in TE 2018–19.

Apart from fresh vegetables, India also exports processed tomatoes (paste), dehydrated onions and processed potatoes. Although India is the largest exporter of dehydrated onions in the world, it is not among the major exporters of tomato paste.

Tomato Exports from India: Problems and Prospects

India exported 268 thousand tonnes of tomato in 2016–17, which declined to 55.8 thousand tonnes in 2017–18, and increased to 105 thousand tonnes in 2018–19. The decline in 2017–18 was due to import bans imposed by Pakistan, the largest importer of Indian tomatoes, as a result of political tensions. The constant rift between the two countries is reflected in the volatile agricultural trade. In TE 2016–17, Pakistan imported 75% of total tomato exports from India, which declined to 46% in TE 2018–19, followed by the UAE at 21%, Bangladesh at 14% and Nepal at 12%. Between 2014–15 and 2018–19, Pakistan imported tomatoes worth USD 29.7 million, i.e, 55% of the tomato exports from India (Fig. 3.3).

India exported 0.17 million tonnes of tomatoes (fresh and fresh equivalent to paste), which is less than 1% of 20 million tonnes of tomatoes produced in TE 2018–19 (Fig. 3.4). India accounts for about 2% of global tomato exports, occupying 13th position in the world, and is a net exporter of the processed tomatoes (Fig. 3.4). China is the largest exporter of tomato paste in the world, with a 28% share in global exports (TE 2017), followed by Italy (21%) and the USA (13%). The major tomato juice exporters are Germany (15%), Italy (14%) and the USA (11%).

India's minimal presence in tomato paste export market can be attributed to higher input costs. China processes tomato paste at much cheaper rates, making it the global

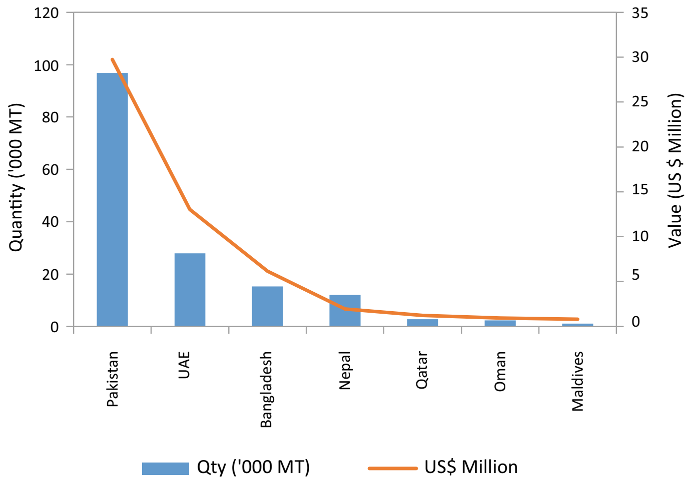

Fig. 3.3 Top export destinations for Indian tomato (five year average of 2014–15 to 2018–19). *Source* UN Comtrade Database

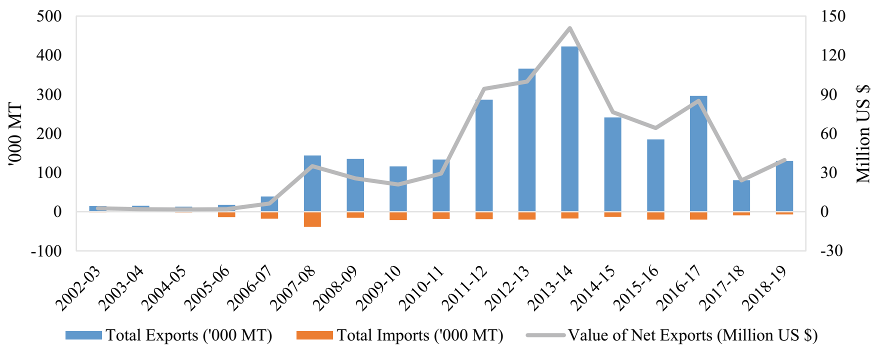

Fig. 3.4 Tomato and tomato products net exports from India. *Source* Directorate General of Foreign Trade

leader. Even Indian ketchup manufacturers find it cheaper to import Chinese tomato paste rather than procure from India.

Onion Exports from India: Problems and Prospects

Onions from India have a huge global demand because of its high pungency and year-round availability. India's onion exports have increased considerably after it was canalised through NAFED and 12 other bodies. India exported 2.42 million tonnes of fresh onions in 2018–19, which was almost 45% more than what India exported in 2017–18 (1.68 million tonnes). However, the trade policy in India is haphazard and makes India's exports very volatile. With frequent imposition of minimum export prices (MEP) or complete export bans, India is losing its credibility in the global onion export market. This gap in exports from India encourages other nations like Pakistan to increase its exports. The Netherlands, despite not being a major producer, has emerged as a top exporter on the back of their efficient storage and packaging solutions.

The varieties which are popular for exports include the NHRDF developed Agrifound Dark Red and Agrifound Light Red (big onion), Agrifound Rose (small onion), and Agrifound Red (multiplier onion) (NHRDF). Apart from these, Pusa Ratnar, Pusa Red, and Pusa White Round are also popular. The Rose variety of Krishnapuram in Karnataka is premium quality and attracts a higher price than the medium-sized onions from Maharashtra. While India is able to export much of its onions to its neighbours and Gulf countries (Fig. 3.5), exports to European countries is at a nascent stage. European countries prefer the yellow varieties of onion, which are large in size like Tana F1, Arad-H, Suprex, Granex 55, HA 60 and Granex 429. These were developed especially to cater to export markets (APEDA).

According to APEDA, modern pack-houses for sorting, grading and packing of quality onions are already available at major production centres. Guidelines for the maximum permitted residue levels (MRLs) for identified pesticides, grade designation, and quality development are also in place.

Even for dehydrated onions, India is among the largest exporters in the world along with Malaysia with 27% share each, followed by the USA (12%) and Egypt (4%) (Fig. 3.6). These top four countries account for around 70% of the world's total dried/dehydrated onion export. Dried onion or dehydrated onion (ITC HS Code: 7122000 Onions, Dried, Whole/Cut/Sliced/Broken/In Powder but Not Further Prepared) is in the form of dried flakes, slices, granules or powder. India has the largest hub of dehydration units for onions in the world. These products are generally exported to Europe, Russia, Africa, and the Middle East countries.

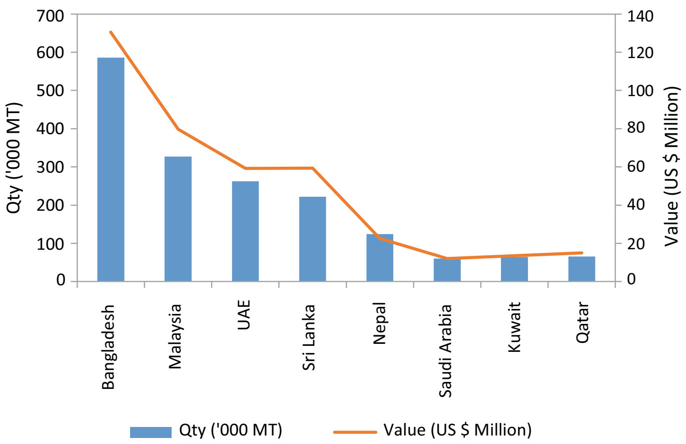

Fig. 3.5 Major export destinations for Indian onion (TE 2017–18). *Source* APEDA

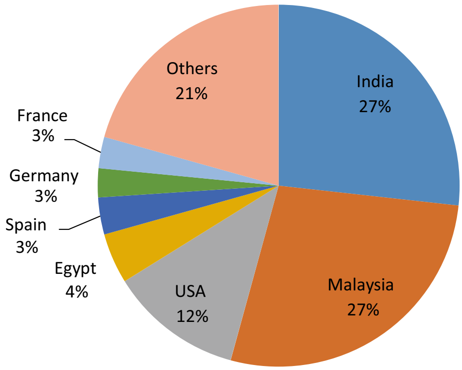

Fig. 3.6 Share in global dehydrated onion exports (TE 2018). *Source* UN Comtrade Database

Potato Exports from India: Problems and Prospects

India, despite being the second-largest producer of potatoes in the world, is not a big player in potato exports, and accounts for only 2.6% of global potato exports. The corresponding figures for Pakistan and China are 4.5% and 4.1%, respectively. However, India's potato exports have increased over time. In value terms, India's potato exports have increased from USD 2.4 million in 2002–03 to USD 63.4 million in 2018–19, peaking at USD 138 million in 2014–15. In volume terms, India's exports were only 0.37 million tonnes in TE 2018–19, a minuscule proportion of India's production of over 53 million tonnes.

Potato from India is largely exported to neighbouring countries with nearly 76% going to Nepal (Fig. 3.7). Sri Lanka, Oman, Malaysia, Mauritius, Kuwait, Maldives, Indonesia, and UAE are other important destinations. Pakistan, which imported around 129,000 MT in 2014–15, has not imported any potatoes since then.

As far as imports are concerned, processing companies import tissue culture since bulk imports of potato are banned. This is one way in which high yielding varieties can be made available to Indian farmers. India exports the *Kufri Sindhuri*, *Kufri Jyoti*

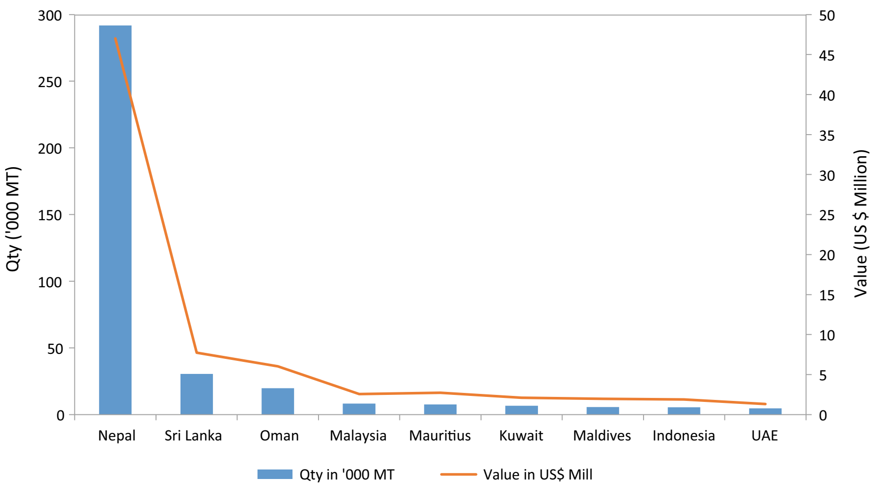

Fig. 3.7 India's potato exports, country-wise (TE 2018–19). *Source* APEDA (2018)

and *Kufri Chandramukhi* varieties of table potatoes. While the first two are in great demand in Nepal and Bangladesh, the third one is very popular in Afghanistan (Rana 2017).

The Netherlands and Germany together control 54% of the global exports of potato flour, meal, powder, flakes, granules, and pellets.[1] In this category, India's share is only 2% of global exports. At a more disaggregated level, India is the third-largest exporter of potato flour, meal, and powder. However, it needs to be pointed out that India is a net importer of potato starch[2] because of the virtual non-existence of the starch making industry in India. China and the European Union are India's competitors in export of processed potato.

Nominal Protection Coefficients

To compute the nominal protection coefficients (NPCs) for TOP, two price series were taken: domestic price series and international reference price series. Domestic prices have been taken as the weighted average of prices prevailing during the harvesting months of the largest producing states that account for around 60% of national output. For international reference prices, the unit value of exports has been used. International prices include port handling charges but are net of domestic transportation costs, trading, and marketing margins and costs. This indicates the import parity price or the price at which India could have imported. This was done for the importable hypothesis model. For the exportable hypothesis model, port handling charges, domestic transportation, trading, and marketing margins were subtracted from the international price. Prices have also been adjusted for quality. These charges have been estimated as a percentage of the wholesale price based on interactions with stakeholders during the field visit.

For tomatoes, wholesale prices prevailing in Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat, and Odisha were taken. The computed values of NPC along with the export values for tomato have been shown in Fig. 3.8. The results show that tomato has been always competitive in the international market, yet the export to production ratio has been always low in India. India has not fully utilised its potential of exporting tomato like it has done for onion. There have been huge fluctuations in tomato exports from India, which is the result of import bans imposed on Indian tomatoes by our neighbouring countries, especially Pakistan, due to political reasons. This leads to undue pressure on tomato traders and farmers who are unable to sell their produce when a glut coincides with bans imposed by importing countries. Despite tomatoes being available throughout the year, exports have not picked up. Figure 3.8 also shows how India reached its peak tomato exports during 2013–14, when it exported 4 lakh tonnes of tomato.

Market Price Differential (MPD), which is the difference between domestic and international prices, has been negative for the entire period of the study (2002–03 to 2018–19), implying that trade policy has been pro-consumer (Fig. 3.9).

[1] HS Code 1105.

[2] HS Code: 110813.

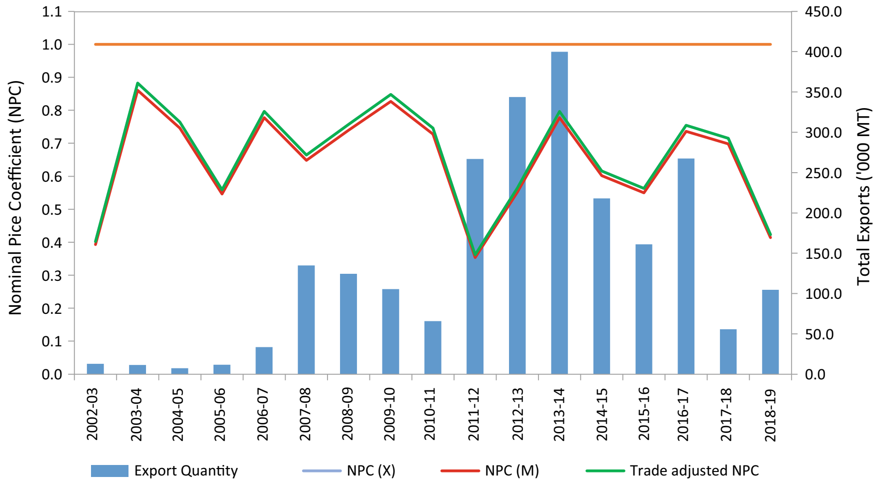

Fig. 3.8 NPC and export value for tomato. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

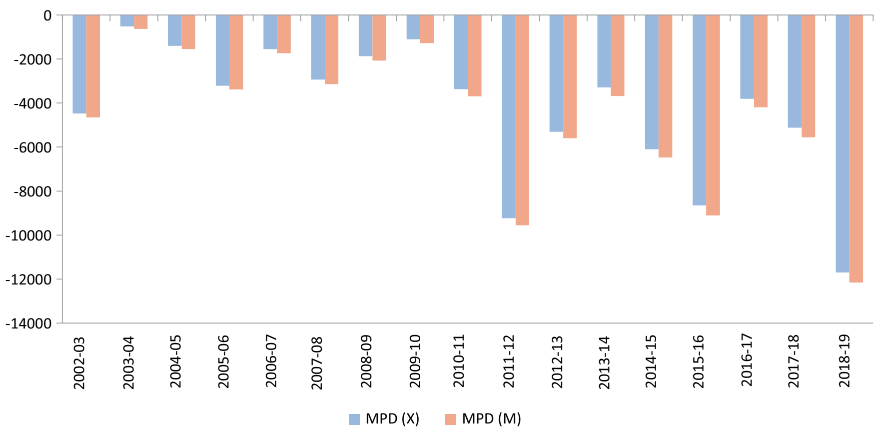

Fig. 3.9 Market price differential (MPD) for tomato. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

For onion, we have compiled the average wholesale prices from Agmarknet for the top 3 producing states, namely Maharashtra, Madhya Pradesh and Karnataka, which accounts for around 60% of the total onion production in India. The average price for a financial year is the average of the prices prevailing in the harvesting months of the crop. For Maharashtra and Madhya Pradesh, April and May prices were taken, and for Karnataka, July to November (*kharif* season harvest months) prices were taken. As international prices for onion were unavailable, we used the unit value of onion exports from India as a proxy for FOB prices. The nominal protection coefficient calculated for onions is consistently less than 1, indicating the export competitiveness of onions from India (Fig. 3.10).

Figure 3.11 shows the nominal rates of protection (NRP), indicating a consumer bias in trade policies. Market price differential (MPD) for onion is negative for all years studied, which indicates a pro-consumer bias in trade policy (Fig. 3.12). This is evident from the fact that the government imposes minimum export price and other trade restrictions as soon as prices shoot up.

Due to fluctuations in domestic price, and market arrivals of onions, the Indian government resorts to measures aimed at reducing prices to safeguard the interests of

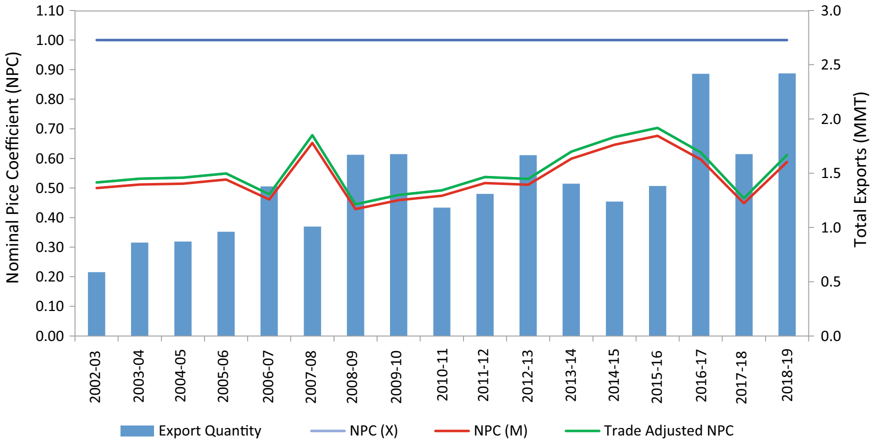

Fig. 3.10 Nominal protection coefficient for importable and exportable hypothesis for onion. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

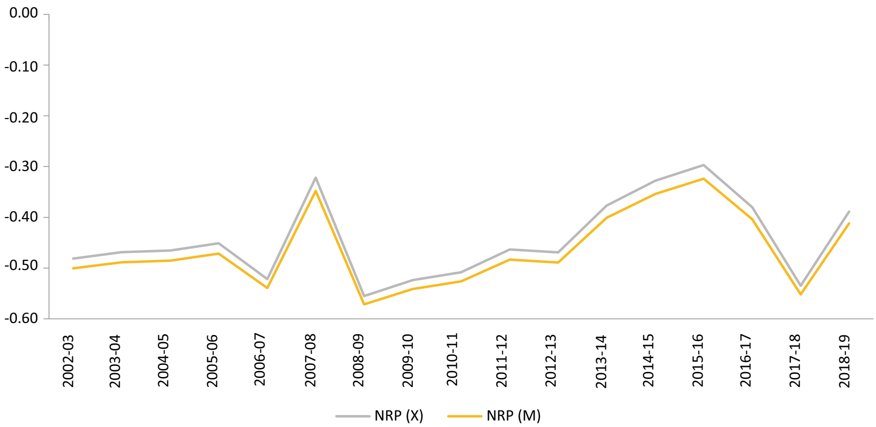

Fig. 3.11 Nominal rate of protection for importable and exportable hypothesis for Indian onion. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

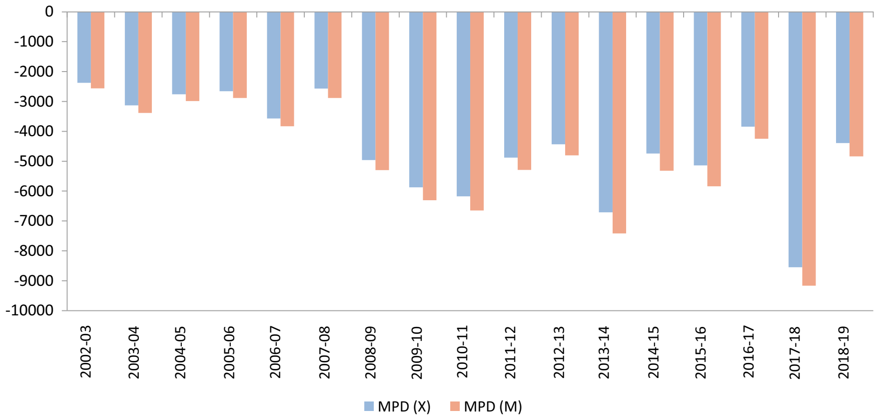

Fig. 3.12 Market price differential (MPD) for onion. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

consumers. Hence, Indian trade policy for onion is very unstable. It can range from a complete ban on exports or increasing the minimum export price (MEP) to freeing exports of onion and reducing import taxes. For example, onion exports were prohibited from December 2010 to February 2011 and then, briefly again in September 2011.

Minimum export prices (MEP) have been imposed on onions several times ranging from USD 0 to USD 1150 per MT for the normal variety of onion (Fig. 3.13). Since December 2015, onion exports were free. MEP was again imposed on November 23, 2017, at USD 850 per MT. In the first week of February 2018, MEP was removed as onion prices started coming down. There were a number of policy measures introduced in 2019 by the government to curb retail prices, which crossed INR 40/kg

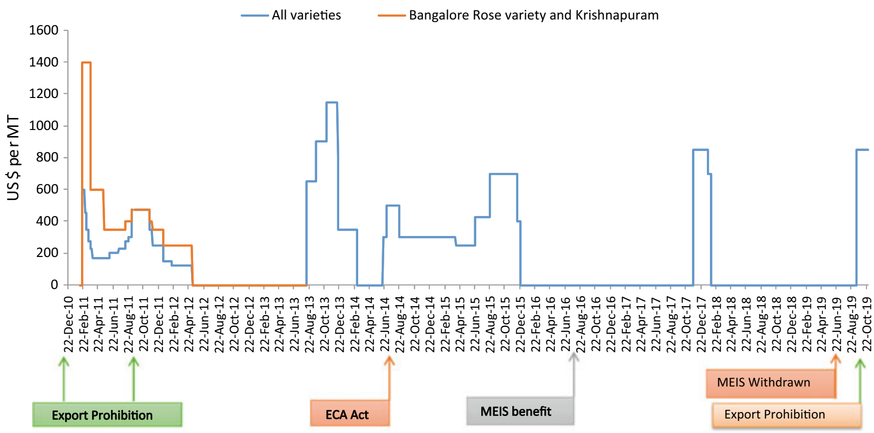

Fig. 3.13 Timeline for MEP and other trade policies for onions in India. *Source* Created by Authors using information from Directorate General of Foreign Trade (DGFT)

in mid-September and further to INR 50–60/kg. After imposing an MEP of USD 850/MT on September 13, 2019, the government imposed stocking limits on traders and wholesalers. However, when these measures did not cool prices, it banned all varieties of onions from being exported. This frequent imposition and removal of MEP on onions hamper the credibility of India as an onion exporter as high MEP discourages domestic exporting firms from selling their produce overseas. Importing nations resort to buying onions from elsewhere like Pakistan. The imposition of MEP not only destroys India's credibility as an exporter, it also deprives farmers of higher prices for their produce. A datewise timeline of the imposition of MEP on onions has been shown in Fig. 3.13. The red line shows the MEP imposed on the premium Rose and Krishnapuram varieties of onions from Bangalore, which was always higher than the common variety of onion, before April 2012. Since August 2013, a common MEP was imposed on all varieties of onion.

Another policy concern was the inclusion of onions as an essential commodity under the Essential Commodities Act (ECA) in 2014, which empowered states to take up de-hoarding measures and monitor prices regularly. It was under ECA that the stocking limits were imposed in September 2019 on wholesalers and retailers. However, it proved to be ineffective in controlling the prices, which went beyond INR 100/kg mark in several cities in December-2019. By enacting the amended Essential Commodities Act[3] in September 2020, the government paved the way for deregulation of onion prices. Revoking ECA will encourage private investment in storage, thus reducing wastages and further helping farmers to reap benefits of storing their produce during glut and selling off later in the lean season. The benefits of some schemes like the Merchandise Exports from India Scheme (MEIS) was extended to onion in August 2016 to encourage farmers to export in case of low domestic onion prices. This is done by giving subsidy to exporters, when domestic prices are low. However, when there is a shortage of onion in the domestic market, India also imports onions from countries like Egypt, Pakistan, and Iran to meet the shortage.

For potatoes, the domestic wholesale price has been taken as the weighted average of wholesale prices prevailing in Uttar Pradesh, West Bengal, Gujarat and Madhya Pradesh. These four states accounted for around 68.5% of total potato production during TE 2017–18. Since potato prices in Bihar are not readily available because of the abolition of APMC Act, their prices have not been included. Wholesale prices for only the harvesting months of *rabi* crop (December to March)[4] have been considered. The export unit value of potato is taken to be the international reference price, adjusted for domestic transportation costs, marketing margins, and port handling charges. These charges have been estimated as a percentage of the wholesale price based on interactions with various stakeholders, during field visits. NPC values for both exportable and importable hypotheses have remained below 1, indicating potatoes have been generally export competing, except three years (Fig. 3.14).

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[3] http://egazette.nic.in/WriteReadData/2020/222038.pdf.

[4] http://agricoop.gov.in/sites/default/files/Monthly%20Report%20on%20Potato%20for%20May%2C%202018.pdf.

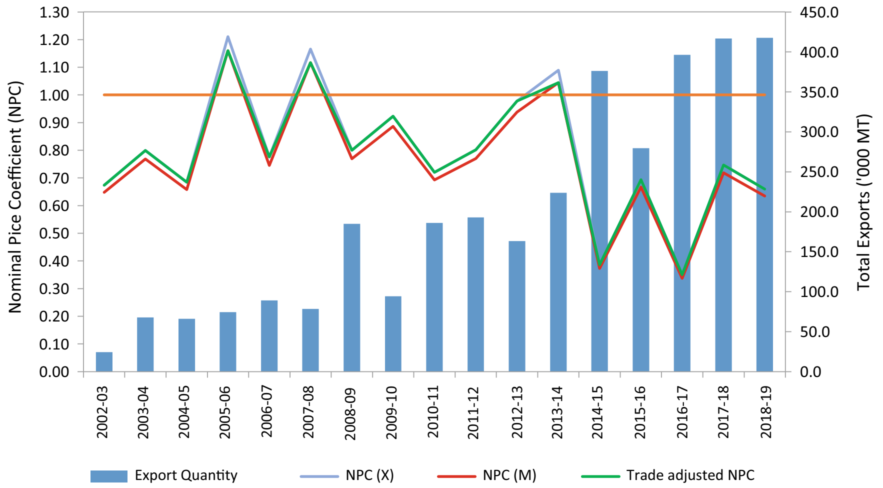

Fig. 3.14 Nominal protection coefficients for potato at wholesale market level. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

Potatoes were import competing in 2005–06, 2007–08 and 2013–14. The export competitiveness of potatoes increased after 2013–14, leading to a significant jump in potato exports.

Potato has been also subject to a haphazard export policy. As potato forms an important part of the average Indian's consumption basket, high minimum export prices (MEPs) have been imposed occasionally to prevent the domestic prices of potato from shooting up. This is a clear indication of a consumer bias in trade policy (Saini and Gulati 2017). In July 2016, MEP of USD 360 per tonne was imposed on potato export.[5] This policy was changed in December 2016, when the export of potato was permitted without any MEP and prevails till date.[6] This perhaps explains why despite being the second-largest producer of potato, India held only 2.4% share in global potato exports in TE 2016.

Market price differential (MPD), which measures the difference between domestic price and international reference price, has been negative in recent years, indicating a pro-consumer bias in trade policy (Fig. 3.15). This is reflected in the imposition of MEPs in fear of rising consumer prices in years when there is a shortage and removing the same in years of surplus production. MEP on potatoes was imposed in June 2014 and removed in February 2015. In July 2016, MEP of USD 360 per tonne was imposed again in fear of increase in domestic price, which lasted until December 2016.

[5] http://dgft.gov.in/Exim/2000/NOT/NOT16/noti1516.pdf.

[6] http://dgft.gov.in/Exim/2000/NOT/NOT16/Noti%20No.32ENGLISH.pdf.

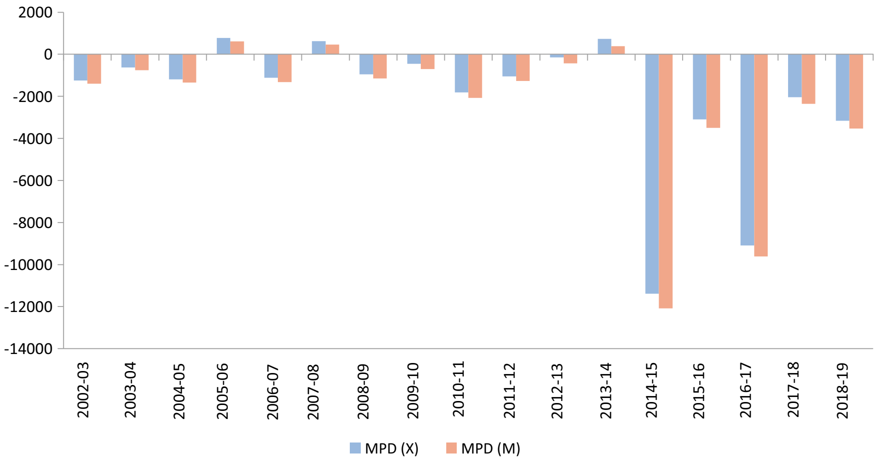

Fig. 3.15 Market price differential (MPD) for potato. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT, and Field Study

Of the three commodities, the highest variability in NPC measured using coefficient of variation (CV) was observed for potato at 30%, followed by tomato at 22%. For onion, coefficient of variation was 15%. This implies that there is a higher degree of variation in domestic and international prices for potato and tomato, while onion prices have lesser degree of variation.

3.2.2 Domestic Price Formation (Efficiency)

An imperfect market structure and inefficient value chain for vegetables often lead to volatility in domestic prices as there is high market intermediation between the farmer and end consumer. The costs incurred and margins earned by these intermediaries inflate the prices. As opposed to intermediaries, farmers have rarely benefitted from increased production. The farmer's share in consumer rupee varies across seasons and geographies. It also depends on the marketing channel or how many intermediaries are involved in the value chain. A direct farmer to consumer marketing channel, for example, a farmer producer company having a retail outlet, will deliver maximum return to the farmer as a share of consumer rupee. A traditional value chain involving farmers with commission agents, traders, wholesalers, and retailers will give farmers the least share. This section analyzes efficiency of both traditional value chain and organized value chain models (Table 3.1).

Table 3.1 Traditional value chain models for analysis of domestic price formation

Model	Crop	Value chain
Traditional	Tomato	Major supplying regions to Delhi through APMC
	Onion	Major supplying regions to Delhi through APMC
	Potato	Major supplying regions to Delhi through APMC
	Potato	Nalanda to Patna without APMC
Organised	Tomato	Processing value chain
	Onion	Dehydrated onion value chain
	Potato	McCain contract farming value chain
	Fruits and vegetables	Farmers to Safal retail outlets

Major producing states and consumption centres for tomatoes, onions and potatoes have been shown in Figs. 3.16, 3.17 and 3.18, respectively indicating the flow from production centres to major consumption centres in metropolitan cities. Regional concentration of production of TOP and consumption throughout the country leads to extreme volatility in prices. The need to transport these perishable commodities from surplus to deficient regions escalates the costs further. Andhra Pradesh, Madhya Pradesh and Karnataka supply their tomato produce to the northern states. Onions are mainly sourced from Maharashtra, Madhya Pradesh and Karnataka. Potato is mainly grown in the Indo-Gangetic plains of northern India with Uttar Pradesh, West Bengal and Bihar being the three largest states, and has to be transported to the southern parts of the country. As shown in the maps, Delhi is one of the major consumption centres for TOP. Arrivals at the Azadpur *mandi* (regulated wholesale market) for tomato, onion and potato stood at 1.8 LMT, 3.5 LMT, and 4.6 LMT, respectively in TE 2018–19.

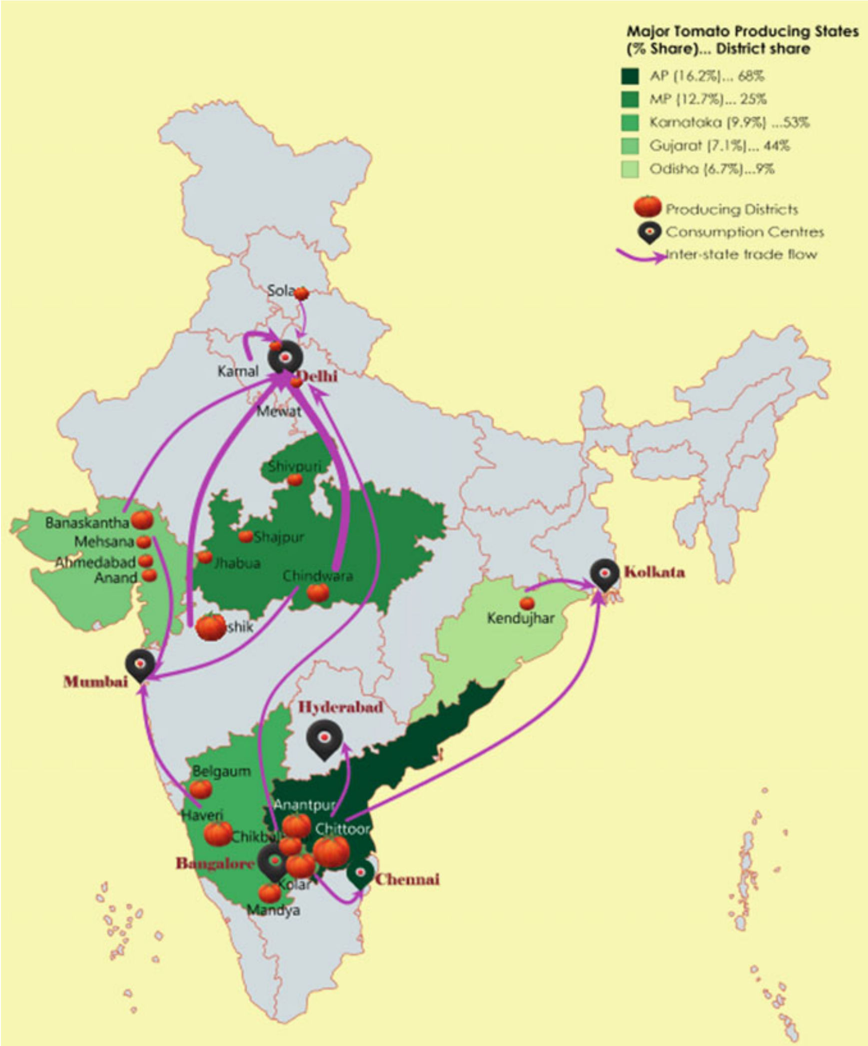

Fig. 3.16 Major production and consumption centres for tomatoes in India. *Source* Using data from MoAFW

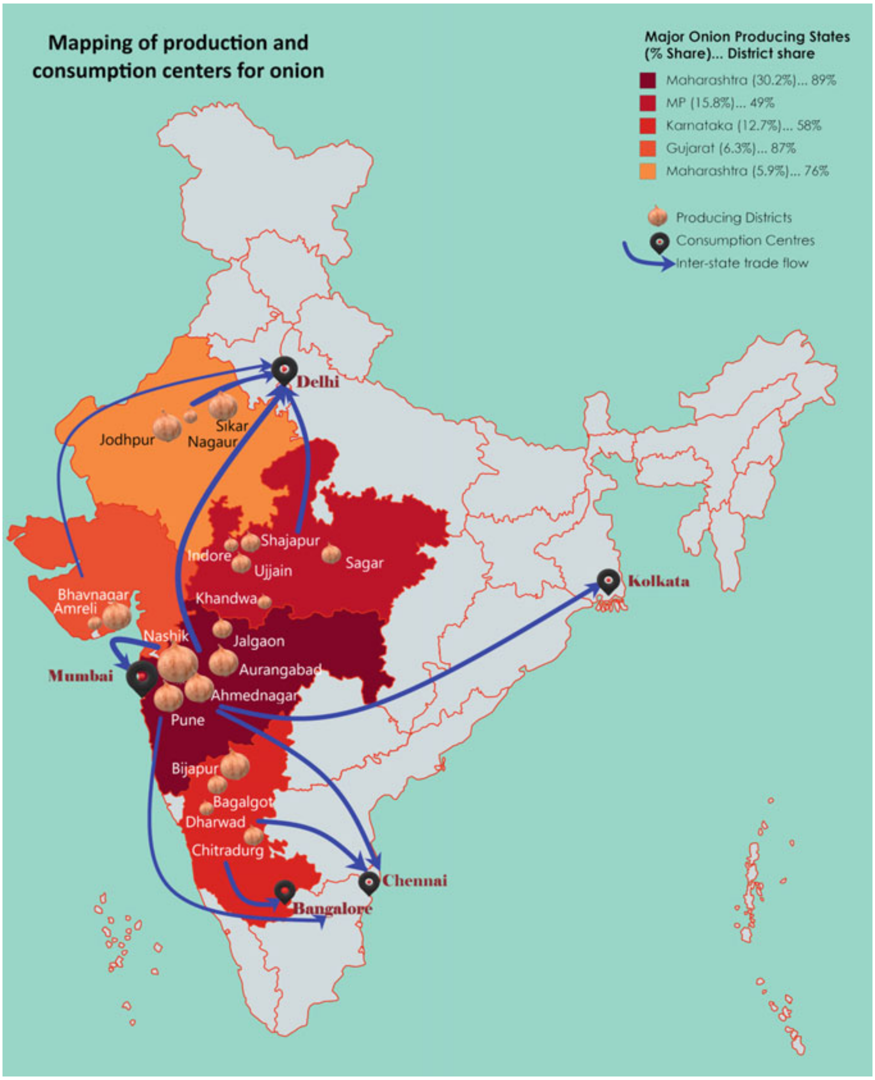

Fig. 3.17 Major production and consumption centres for onions in India. *Source* Using data from MoAFW

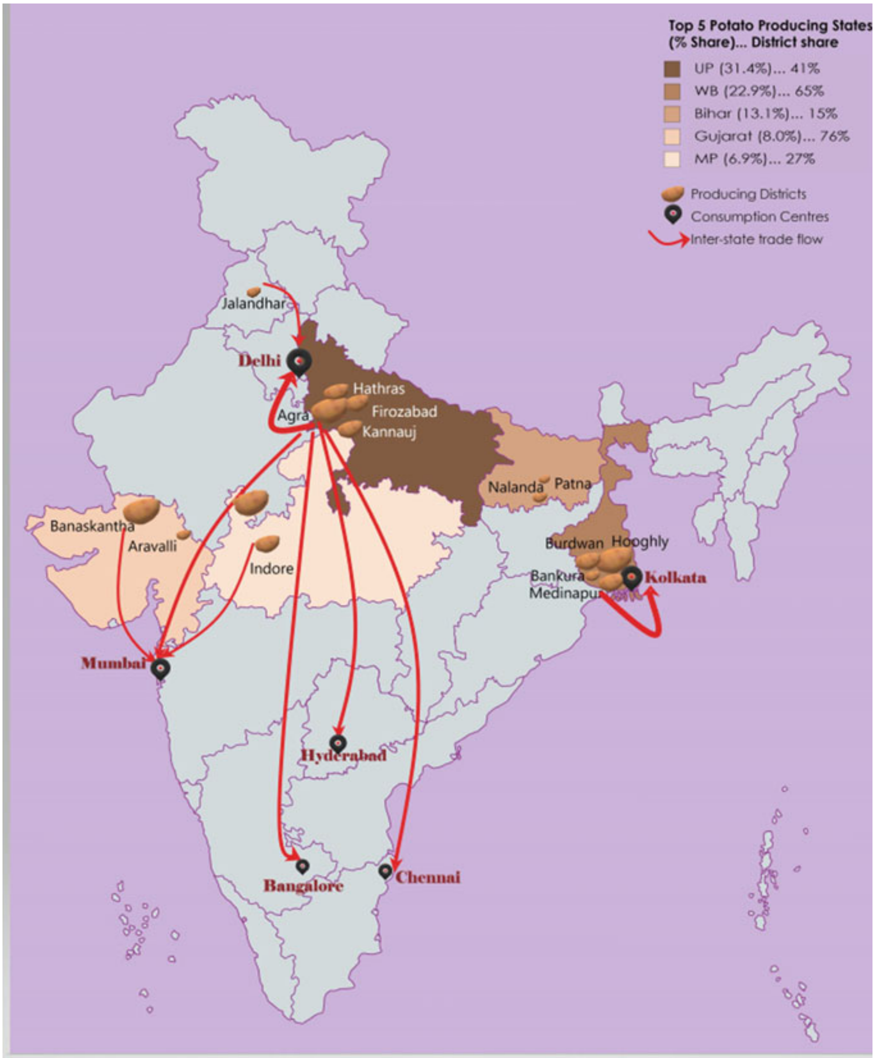

Fig. 3.18 Major production and consumption centres for potato in India. *Source* Using data from MoAFW

Tomato Value Chain

Tomato is grown in most Indian states, but very few states have surpluses that get transferred to other states. Metropolitan cities are the major consumption centres for tomatoes and hence to study farmer's share in consumer rupee, we have considered Delhi as one of the largest consumption markets for tomatoes. In Delhi's Azadpur *mandi*, tomatoes are supplied from different parts of the country. Major supplying states include Maharashtra, Karnataka, Himachal Pradesh, Madhya Pradesh, besides adjoining regions in Haryana, Rajasthan and Uttar Pradesh. Tomatoes from these places are supplied at different points of time making tomatoes available all-round the year in Delhi.

A farmer has a number of options for selling tomatoes. For example, in Karnataka, a farmer has the following options: the traditional wholesale market, HOPCOMS (Horticultural Producers' Co-operative Marketing and Processing Society Ltd), SAFAL Market, Namdhari Fresh, etc. However, a majority of the farmers still sell their produce through the traditional channel i.e., wholesale market. A recent study by the Indian Institute of Horticultural Research (IIHR) states that 60% of the produce is marketed through the traditional value chain and the rest goes through the other chains of HOPCOMS and SAFAL.

To estimate the farmer's share in consumer rupee, we have used tomato wholesale prices from major *mandis* supplying to Delhi—Pimpalgaon (Maharashtra), Kolar (Karnataka) and Solan (Himachal) as well as Gujarat, Haryana and Rajasthan adjusted for their harvesting months and seasonality and taking three-year average of TE 2018–19 (details in Table 3.2). The *mandi* fees and official commission charges at Kolar, one of the largest tomato *mandis* in the country, have been used. While these charges are supposed to be borne by traders, the burden ultimately falls on farmers who get a price net of these charges. Data gathered during field visit suggests that the commission fees earned by commission agents and traders are much higher than

Table 3.2 Costs and margins of tomato value chain from producing regions to Delhi

Stakeholder	Cost and margin (INR/quintal)	Share in consumer rupee (%)
1. Price received by farmer	1123	32.4
2. Total trader's cost	498	14.4
3. Traders margin (4-2-1)	387	11.2
4. Delhi wholesale price (Max price from Agmarknet)	2008	
5. Semi wholesaler total cost	341	9.8
6. Semi wholesaler margin (10%)	201	5.8
7. Price to retailer	2549	
8. Retailer cost and margin	914	26.4
9. Price paid by consumers (Delhi retail price)	3463	100.0

Source Authors' calculation using data from Agmarknet, DoCA, and Field Visit

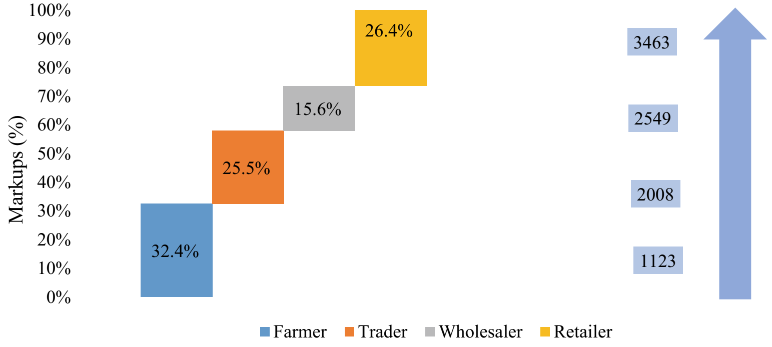

Fig. 3.19 Mark ups for tomato value chain. *Source* Authors' calculation using data from Agmarknet, DoCA, and Field Visit

what is officially prescribed by the APMC. The official commission fee in Kolar *mandi* including rent for crates and annual licence fee charged by APMC is about 8%. The transportation cost from Kolar to Delhi is about INR 1000/q. Using this, we have calculated transportation cost on a pro rata basis for other *mandis*. Subtracting the price received by farmers and total cost borne by traders from the wholesale price at Delhi's Azadpur *mandi*, we get an approximate value for trader's margin. The retail price for Delhi has been taken from the Department of Consumer Affairs. All other data on costs have been gathered during field visits. Figure 3.19 shows the markups for the tomato value chain from major producing regions to Delhi.

Onion Value Chain

To estimate farmer's share in consumer rupee for onions, we have considered Delhi, which is one of the largest consumption markets for onions. Depending on the season, there is a lot of volatility in the returns and margins of each stakeholder in the value chain. Therefore, we have taken the season-wise weighted average of prices for three years (2016–17 to 2018–19) to calculate price received by farmer. The weights are based on the share of onion arrival in Azadpur *mandi* from major *mandis* in Maharashtra (Lasalgaon), Madhya Pradesh (Indore), Gujarat (Mahuva) and Rajasthan (Jodhpur). Retail prices have been taken from Price Monitoring Cell, Department of Consumer Affairs (DoCA), and not from National Horticultural Board, which does not have a standard method of collecting retail prices. As Delhi's wholesale price is the average wholesale price of onions of all qualities arriving from markets across India, we have taken the average of the maximum prices reported on Agmarknet for Delhi, Maharashtra and MP, which cater to more than 60% of Delhi's demand for onions.

For trader's costs, we have relied on data gathered during our field visit to Lasalgaon, the largest onion wholesale *mandi*. According to information provided by the Lasalgaon APMC *mandi*, traders need to pay 1% *mandi* fees to the APMC, which is the main source of income for the *mandi*. The official rate prescribed by the *mandi* for commission charges paid by onion traders to commission agents is 4%. The other official charges prescribed by the *mandi* are as follows:

Charges for weighing per quintal	: INR 3.6
Charges for *hamali* (loading) per quintal	: INR 4.5
Charges for *warai* (unloading) per quintal	: INR 0.87
Total charges per quintal	: **INR 0.92**

Total labour cost works out to be INR 70 per quintal. The average transportation cost per quintal per km is 28.4 paise. Using average arrival as weights, we computed the transportation charges from different *mandis* to Delhi. Transport cost includes fuel and driver allowance. The cost for packing includes cost of the packing material (Jute) at INR 60 per quintal. Other costs include weight loss of (1–2)% within an hour of the auction. Storage losses include 15% weight loss for rabi onions during April–June and 30% during August–September. These figures are for A Quality onions and for average quality of onions, the losses are much higher. There is also 1.5% transit loss while transporting, loading and unloading.

Trader's margins are Delhi wholesale prices less Lasalgaon wholesale prices and trader's cost.

Based on the prices, costs and margins given above, the farmer's share of the consumer's rupee works out to 29.1% and for retailer's it is 30.6% (Table 3.3). During a glut, often farmers are not able to cover their cost of production. Figure 3.20 shows the mark ups for the onion value chain from major producing regions to Delhi. The costs and margins of other stakeholders are based on interactions with traders, commission agents and wholesalers. Hence, it is likely that these may not reflect the true margins, due to reporting biases.

Table 3.3 Costs and margins of onion value chain from producing regions to Delhi

Stakeholder	Cost and margin	Share in consumer rupee (%)
1. Price received by farmer (From Agmarknet)	701	29.1
2. Total trader's cost	417	17.3
3. Trader's margin (4-2-1)	164	6.8
4. Delhi wholesale price (Max price from Agmarknet)	1282	
5. Semi wholesaler total cost	265	11.0
6. Semi wholesaler margin (10%)	128	5.3
7. Price to retailer	1674	
8. Retailer cost	150	6.2
9. Retailers margin (10-7-8)	587	24.4
10. Price paid by consumers (Delhi retail price)	2412	100.0

Source Authors' calculation using data from Agmarknet, DoCA, and Field Visit

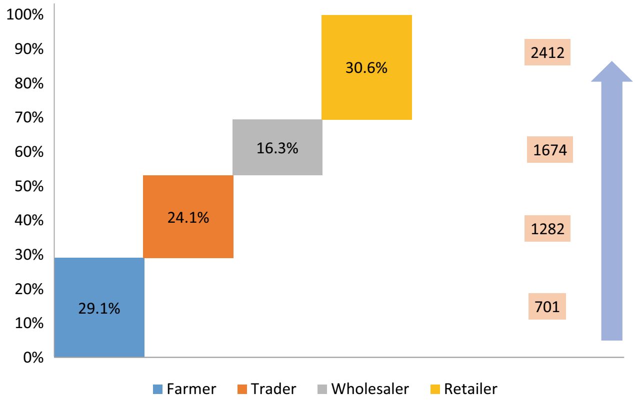

Fig. 3.20 Mark ups for onion value chain. *Source* Authors' calculation using data from Agmarknet, DoCA, and Field Visit

Potato Value Chain

Agra is the largest potato producing district in India. Delhi as well as the southern states are important markets for potatoes from Agra. Traders in Agra cater to many markets in Maharashtra and cities like Hyderabad, Chennai, Bengaluru, etc. and so on. Arrivals of potatoes are the highest during the harvesting months of December to March, after which potatoes from cold storages arrive in the market. Usually, when a trader buys potatoes from the cold storage, there can be two sorts of arrangements. One, the trader buys at his own risk, in which case the cost of transporting it to the relevant market is borne by him. In this case, it is possible for the trader to make a profit or a loss, depending on the price that he is able to secure. In the second case, the trader just facilitates the transaction; the wholesalers from other states place the order with the trader, who gets a guaranteed commission per quintal. However, during periods of glut, traders also work on fixed commission, because of low demand at the consumption centres.

In Delhi, potatoes mainly arrive from Agra and Punjab. Fresh potatoes from Punjab start arriving in Delhi markets in the second half of November and continue to arrive until February. Fresh potatoes from Agra arrive between December and March, after which potatoes from cold storages are supplied. To estimate the farmer's share in the consumer rupee, the weighted average (using arrival share in Delhi) wholesale prices during the harvesting months from Agra and Jalandhar have been used for TE 2018–19. Wholesale prices for Delhi have been taken from Agmarknet. Retail prices are a simple average of the prices prevailing in Delhi during the harvesting months of the *rabi* crop (November to March) for 2016–17 to 2018–19, taken from Price Monitoring Cell, Department of Consumer Affairs (Details in Table 3.4).

The potato value chain in Agra is an example of a highly inefficient value chain, where the farmer gets a measly 26.6% of the consumers' rupee and the retailer appropriates the maximum share (Fig. 3.21). The retailer's costs and margins together account for a massive 47.8% of the consumer's rupee. Not only does the farmer not

Table 3.4 Costs and margins for potato value chain from producing regions to Delhi

Stakeholder	Cost and margin	Share in consumer rupee
1. Price received by farmer	469	26.6
2. Total traders cost	128	7.3
3. Traders margin (4-2-1)	20	1.1
4. Delhi wholesale price	616	
5. Semi wholesaler total cost	243	13.8
6. Semi wholesaler margin (10%)	62	3.5
7. Price to retailer	921	
8. Retailer cost and margin	844	47.8
9. Price paid by consumers (Delhi retail price)	1765	100.0

Source Authors' calculation using data from Agmarknet, DoCA, and Field Visit

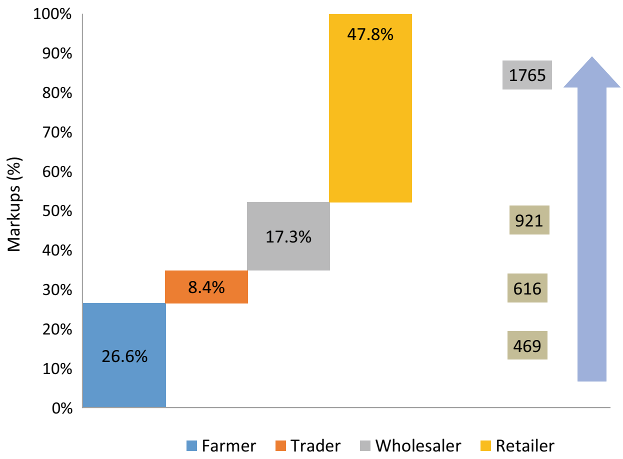

Fig. 3.21 Mark-ups for potato value chain. *Source* Authors' calculations using data from Agmarknet, DoCA (2018) and Field Visit

get a fair share of the consumer price, he does not even cover his overhead cost, which includes transportation and labour costs. Currently, even the best price received by the farmer is so low that he is not able to recover the costs of storage. The idea behind storage is to enable the farmer to take advantage of future increase in price.

To estimate the price spread between the wholesale and retail price, we have estimated the farmer's share in the consumer's rupee for major metro cities (Table 3.5). It is found that potato prices are the highest in Mumbai, followed by Chennai and the cheapest in Delhi.

Table 3.5 Farmer's share in consumer rupee in major metro cities

Market	Average prices of harvest months (TE 2017–18)	Farmer's share in consumer rupee (%)
Agra wholesale price	557	
Delhi retail price	1461	38.1
Mumbai retail price	1824	30.5
Chennai retail price	1738	32.0

Source Authors' calculations using data from Agmarknet and DoCA (2018)

Potato Value Chain: Nalanda to Patna

Nalanda is the largest potato producing district of the third largest potato producing state of Bihar. Potatoes produced in Nalanda (mainly *Kufri Pukhraj* variety) are consumed mostly in Bihar and Jharkhand. Farmers take a sample of their produce to the *mandi* (although Bihar repealed APMC law in 2006) where traders quote a price and later purchase the produce from the farmers' field. Such marketing practices include the presence of commission agents who charge fees from both farmers as well as traders.

Based on figures obtained from field visits and Patna wholesale and retail prices from DoCA, the mark-up of each stakeholder in the value chain has been estimated. There are two scenarios for potato sale: At the time of harvest (Feb 2018) and at cold stores (April 2018). As time-series data for potato prices in Bihar is not readily available, we have used Nalanda wholesale prices from information gathered during field visits. For retail prices, we used DoCA retail prices for Patna. Table 3.6 shows that Nalanda potato farmers get (40–42)% of the consumer's rupee. However, given the cost of cultivation of INR 480 per quintal (DES), farmers tend to make a loss, especially small and marginal farmers who sell their produce immediately after harvest due to lack of storage facilities. Despite loss in potato cultivation, farmers reported covering the losses through multi-cropping with other vegetables.

The above analysis for the traditional value chain model shows that TOP farmers get anything from 26.6% to 42.2% on an average. The inefficiency of the traditional marketing channels makes it imperative to have integrated, demand-driven value chains and alternate marketing models that provide higher returns to farmers. The central government announced APMC reforms on many occasions in the past (Model APMC Act 2003, APLM Act 2017). However, not all states have ushered in these reforms. The latest reform undertaken by the government is the Farmers' Produce Trade and Commerce (Promotion and Facilitation) or FPTC Act enacted by the Parliament in September 2020.[7] The Act ensures freedom of choice for sale and purchase of farmer's produce and transparent and barrier-free inter-state and intra-state trading, bypassing the *mandi* system. This would also mean that no market fees or cess would be charged on farmer or traders who are not using *mandi* services. These reforms in APMC will ensure that farmers are able to save the costs of marketing

[7] http://egazette.nic.in/WriteReadData/2020/222039.pdf.

Table 3.6 Potato value chain from Nalanda to Patna

S. No	Item	INR per Quintal		% Share		Source
		Feb-18	Apr-18	Feb-18	Apr-18	
a	Price received by Farmers or traders (in April)	450	700	40.3	42.2	Field visit
b	Traders cost	100	100			Field visit
c	Traders margin	25	30			Field visit
d	Storage cost		80			Field visit
e	Total trader's cost and margin	125	210	11.2	12.7	(Sum b to d)
f	Wholesaler's price	575	910			(a+e)
g	Wholesaler's cost and margin	138	307	12.4	18.6	(h−f)
h	Sale price of wholesaler	713	1217			DoCA
i	Retailers cost and margin	403	440	36.1	26.5	(j−h)
j	Retail price (Patna)	1116	1657	100.0	100.0	DoCA

Source Authors' calculations using data from (DoCA 2018) and Field Visit

through APMC *mandis* as well as allow large buyers to directly purchase from farmers and FPOs, without going through the *mandi* system.

Domestic Price Formation for Organised Value Chain Model

In this section, we discuss a few models of organised value chain for tomatoes, onions and potatoes such as Chittoor tomato pulping industries, Mahuva dehydration industries, Jain Irrigation onion dehydration model, McCain Foods Limited and SAFAL fruits and vegetables. The idea behind studying these value chains is to compare them with traditional value chain models and ascertain which models are more efficient and fetches better returns for the farmer.

Tomato Processing Value Chain

While fresh tomatoes are used as vegetable, topping or in salad form, various value-added products from tomatoes like ketchup, tomato puree, tomato juice, etc. are also popular. Chittoor in Andhra Pradesh is the largest tomato producing district and is also a hub for the tomato processing industry. While these units manufacture tomato paste, various national and international brands like Kissan of Hindustan Unilever, Maggi of Nestle, Del Monte, Heinz, Tops and Cremica are the largest tomato ketchup manufacturers in India. While these products have high household demand, the rise in HoReCa (Hotel, Restaurants and Catering) business has boosted the demand for tomato-based products.

The varieties of tomatoes that are used for processing include 3140 *desi* tomato, Natti (local) and hybrid tomatoes like Namdhari, Sapata, and Abhinav. For tomato pulping industry in Chittoor, no contract farming with the producers are in place and processors procure their raw material from Kolar or Madanapalle *mandi*. Contract farming with tomato growers was discontinued long ago because farmers tend to sell their produce in *mandis* whenever *mandi* prices are higher than the contract price. However, farmers can bring their produce to the processing centres directly. However, Indian tomatoes have low yields which increase the cost of raw material, making India uncompetitive in processed tomato. Because of high fluctuations in tomato prices in India, processing units are unable to process tomato round the year and process other fruits and vegetables. It is only sustainable for the processors to process tomatoes when tomatoes are procured at prices less than INR 4 to 4.50 per kg. On the other hand, China is able to produce tomato paste at a much cheaper rate because of low cost of raw material and processing. Even Indian manufacturers prefer importing cheap Chinese tomato paste.

The process in a typical tomato pulping unit is as follows. Fresh tomatoes are procured and sent to collection centres and washed. These can be stored at ambient temperature (18 °C for up to 3–4 days) and when it is time to process, stored tomatoes are again washed by machines. These are then sorted and graded manually before being crushed for the final product.

As tomato paste is one-step value addition, it is sold in a B2B model. Manufacturers of tomato ketchup, puree and juice purchase tomato paste from these units for manufacturing final products. Around 8 tonnes of the *desi* variety of fresh tomatoes is equivalent to 1 tonne of tomato paste and 7.5 tonnes of the hybrid variety is equivalent to 1 tonne of tomato paste.

One kilogram of branded tomato ketchup requires 333 g of tomato paste (30% is tomato paste), which means that it requires 2.5 kg of fresh tomatoes (1 kg of tomato paste requires 7.5 kg hybrid fresh tomatoes). This means if branded tomato ketchup in India is sold for INR 125 per kg and it used 2.5 kg of fresh tomatoes that were bought at INR 4/kg (i.e. for a total of INR 10) for the processor to be financially viable, the farmer's share is 8% of the consumer price for tomato ketchup. This is because there are actual costs of processing involved.

Onion Processing Value Chain

Fresh onions can be processed into a number of dehydrated forms like onion flakes, powder, granules, etc. However, there is very low demand for these products domestically, as Indian consumers are used to fresh onions. India produces about 75,000 MT of dehydrated onions, which is about (3–4)% of total onion production (1 kg dehydrated onion = 10 kg fresh onions). Processed onions largely cater to the export market (80–85%) and the rest is mostly consumed by the domestic food industry. A majority of the dehydrated onion units in India are located in Bhavnagar district of Gujarat, with a high concentration in Mahuva. These units procure the raw materials (white or red onions) directly from the *mandi* without engaging in contract farming; they operate for only a few months in a year (February to June) when white onion prices are low. Hence, Mahuva farmers get no extra benefit because of the presence of dehydration units in their area. With low international demand and negligible domestic demand for dehydrated onion products, these units often have a high pile-up of previous year's stock, making them financially unsustainable.

On the other hand, Jain Irrigation Systems Ltd. (JISL) has emerged as India's leading onion dehydration company and one of the world's largest companies. The onion dehydration model of JISL is one of the most successful onion value chain models in India. It has engaged with onion farmers around Jalgaon through contract farming. The total number of farmers engaged in contract farming is about 5000 from areas like Jalgaon, Dhule, Shahada in Maharashtra and even places like Khargone in MP.

JISL provides the following to contract farmers:

- Seeds at cost basis at 7 paise/sapling to be directly transplanted in the fields.
- Drip irrigation equipment (at trade discount).
- Sprinklers.

They also provide extension services to ensure that the specific standards of the company are met. One Jain agronomist (*gramsevak*) is deployed in each of the villages to provide information on nutrition management, sowing, and harvesting.

The company works with mostly small and marginal farmers. With support from JISL, they not only produce high yielding quality onions, but also get insured against the price volatility.

The price received by the growers is assured by the company before planting. In 2018–19, the price was fixed at INR 5.50/Kg for *rabi* onions, when the market price is usually lower than the assured price. If the market price is higher than the assured price, then the market price less 60 paise is given to the farmers. For example, if the market price is INR 11/Kg, then they are paid INR 10.40/Kg. In this way, onion contract farmers are able to overcome the risks of price volatility, which their counterparts in Mahuva are not able to.

Potato Processing Value Chain

Among all TOP vegetables, potato has the highest share of processing at around 7%. Potatoes can be processed to make ready to eat products like chips, wafers; ready to cook snacks like potato patty, and French fries or dehydrated products like potato powder. There are a number of national and international brands that are manufacturing potato-based products with contract farmers. For instance, PepsiCo's Frito Lay is a good example of engaging smallholders to grow potatoes matching international standards. A study by FAO shows that contract farming for Pepsi provides farmers higher margins, proper extension training and assured returns (Punjabi 2015).

In this section, we discuss the value chain model of McCain Foods Ltd. in detail. McCain Foods is the world's largest producer of French fries and potato specialties. McCain's products like French fries, potato wedges and patties are marketed in over 160 countries, with global sales of USD 6 billion. In addition, the Canadian group is one of McDonalds' main suppliers of French Fries. In India, McCain has a world-class potato processing facility in Mehsana, Gujarat.

Seed potato is developed from imported germplasm using a combination of tissue culture, corporate contract farming. Punjab is a preferred location for growing seed potatoes because the prevalent temperature facilitates their growth and prevents aphid infestation (aphid cannot thrive in low temperatures). This ensures production of quality seed, which is then distributed to contract farmers in Gujarat at INR 22–23/kg. The company does not profiteer from the seed business, as the seed is specifically produced for restricted use by the company.

In Gujarat, contract farming takes place in three districts (Banaskantha, Sabarkantha and Mehsana). In 2016–17, the company engaged with around 700 farmers covering an area of 7000 acres. From June to August, the company selects growers who will work with them for the season. It is important to note that the company does not give any advance payment to these farmers. On the contrary, the farmer makes three kinds of payments to the company:

1. INR 1000/acre at the time of distribution of seed in October. This is non-refundable
2. 50% of the seed cost
3. A post-dated cheque to recover the seed cost in case the farmer does not deliver.

Although all input costs are borne by the farmers themselves, agronomists and other specialists employed by the company visit the farms at regular intervals to ensure that potato is being grown according to the company's specifications. In case the farmer does not adhere to company guidelines and the quality of the produce is below a tolerance margin of 1%, the price paid to the farmer is reduced. Beyond 3%, the produce is sent for regrading and this cost has to be borne by the farmer himself. In case the farmer does not deliver the promised crop, there is no legal enforcement of the contract. The company blacklists the farmer and does not work with him in the future.

In 2016–17, McCain procured 83,000 tonnes of potatoes at INR 850–900 per quintal, depending on the variety. This is almost double the price that Agra potato farmers get for their best quality table potatoes. Based on interactions with farmers, the per quintal cost of producing processing variety potato is around INR 665. Item-wise details of costs are provided in Annexure 3.1. Based on an average yield of 321 quintals per hectare, returns ranging from INR 60,000 to INR 76,000 per hectare accrued to the farmers. This meant that farmers, on an average, earned (28–35)% of the sale price under the contract farmer arrangement with McCain (Table 3.7).

In addition to McCain, there are other companies, both Indian (Balaji Wafers) and Multinationals (PepsiCo) that operate in Gujarat.

Table 3.7 Costs, revenue and returns of McCain farmers in 2016–17—Summary table

S. No	Area under contract farming	7000 acres in Gujarat (~2833 ha)
1	Number of McCain farmers	700
2	Price received by McCain farmers	INR 850–900/q
3	Average yield of McCain Farmers	321 q/ha
4	Revenue earned by McCain farmers (2 * 3)	INR 272,850–288,900/ha
5	Costs of McCain farmers	INR 213,284.5/ ha
6	Returns earned by McCain farmers (4–5)	INR 59,565.5–75,615.5/ha (~28–35%)

Source McCain

Fruits and Vegetables Value Chain: SAFAL Model

The SAFAL model of Mother Dairy started as the first-ever fruits and vegetables retail chain in 1988. It aimed to develop direct linkages between farmers and urban consumers on the lines of Operation Flood. However, unlike milk, fruits and vegetables are not homogeneous products and hence, require individual sorting and grading. This makes supply chain management much more challenging. As some amount of weight loss is inevitable in fruits and vegetables, minimising losses due to lack of proper storage facilities is the key to developing a successful supply chain. SAFAL tried to address the issue of lack of proper storing facilities by developing a model in which fresh fruits and vegetables are procured and distributed within a 48-h timeline, not requiring any pre-cooling or specialized storage.

SAFAL is only responsible for the supply of fruits and vegetables from the Mother Dairy's distribution centres (DC) to its retail outlets. Collecting the produce and bringing it to the DC has been entrusted to farmers' associations (Fig. 3.22).

Farmers are paid the rate which is prevalent at Azadpur *Mandi*. Since farmers are not bound by legal contract with SAFAL, they have the freedom to decide whether or not to sell their produce to SAFAL. Farmers do not benefit from selling to SAFAL during periods of glut when the prices are low which adversely impacts the farmer-consumer linkage.

SAFAL claims to pay 63.5% share of the consumer rupee to fruits and vegetables farmers (Fig. 3.23). This is better than what farmers get in a traditional value chain, but is still a long way behind the dairy farmers who receive 85% of consumer rupee.

Fig. 3.22 SAFAL value chain of fruits and vegetables

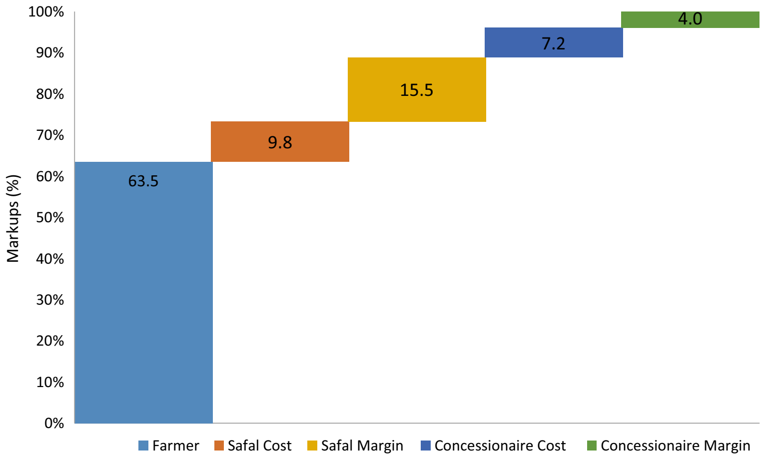

Fig. 3.23 Mark-ups for SAFAL fruits and vegetables value chain. *Source* Mother Dairy Fruits and Vegetables Private Ltd. (MDFVPL)

SAFAL earns around 15.5% through this whole process and the concessionaire earns 4%. A detailed table on the costs and margins of the SAFAL model of value chain is provided in Annexure 3.2.

3.3 Inclusiveness

Indian agriculture is predominantly characterised by smallholdings. Over the years, average farm sizes have been falling and the number of smallholdings increasing. The share of small and marginal farmers has increased from 70% in 1970–71 to 86.1% in 2015–16. These farmers, having an area of less than 2 ha, own just 46.9 of the total landholding. In fact, the average size of landholdings in India is 1.08 ha (DoAC&FW, 2020). Despite this, India has become self-reliant in food production and is the largest producer of many agricultural commodities. Horticulture is one of the fastest-growing sectors in agriculture; total horticulture production was 306.8 MMT in 2017–18 (NHB 2017; DoAC&FW 2018a). Hence, small and marginal farmers have an important role to play in agricultural growth in India. Any agriculture policy without the small and marginal farmers at its core cannot address the issue of inclusiveness. In this section, we evaluate the TOP value chains on various aspects of inclusiveness including that in production, marketing, post-harvest management and contract farming.

Table 3.8 Share of different farmer groups for major crops 2010–11

Crop	Small and marginal	Semi-medium	Medium	Large	All classes
All crops	81.3	11.7	5.9	1.1	100
Vegetables	87.5	8.2	3.7	0.6	100
Tomato	82.1	12.2	4.9	0.8	100
Onion	70.4	18.8	9.4	1.4	100
Potato	86.7	9.4	3.4	0.5	100

Source DoAC&FW 2020, Agricultural Census (2015–16)

3.3.1 Inclusiveness in Production

Horticulture production has been largely undertaken by small and marginal farmers. The short duration, labour intensive crops are more remunerative than cereal crops.

Table 3.8 shows that in India, 82.1% of tomato farmers, 70.4% onion farmers and 86.7% potato farmers are in the small and marginal category. For tomato, the share of marginal and small farmers is around 70.3% in Andhra Pradesh, 61.9% in Madhya Pradesh and about 66.5% in Karnataka. In the case of onions, Maharashtra has 67.9% share of small and marginal farmers, while Madhya Pradesh has 44.8% and Karnataka has around 55%. For potato, Bihar has one of the highest share of small and marginal farmers (96.1%) followed by West Bengal (94.5%) and Uttar Pradesh (86.9%).

For TOP cultivation, the right kind of irrigation, fertilisers, pesticides and credit for inputs are needed. If not constrained by these factors, farmers are free to decide what crops they want to grow. However, as all the three TOP vegetables experience high price volatility due to regional and seasonal concentration of production, the farmer's cropping decisions can change based on profit trends in the preceding year.

3.3.2 Inclusiveness in Marketing

Vegetable farmers in India face problems in marketing their produce because of the imperfect market structure. There are a number of intermediaries present in the system between the farmer and the end consumer, leading to retail price inflation without commensurate benefit to farmers. There are very few marketing options for a vegetable farmer; they mostly sell through the Agricultural Produce Marketing Committee or APMC *mandi*. Apart from that, there are very limited options in organised retail, like SAFAL, HOPCOMS and processing units, which directly procure from farmers. When it comes to the export market, there is a decently developed export value chain only in the case of onions as India is the largest (20%) onion exporter in the world; India's share in tomato (3%) and potato exports (2%) is minuscule.

While some states have taken fruit and vegetable out of APMC Act, some have only reduced or abolished the market fee charged. There are also states that have delisted fruit and vegetable from APMC, but continue charging market fee or cess or service charge (Chand and Singh 2016). A NITI Aayog report ranked states based on an Agricultural Marketing and Farmer Friendly Reforms Index (AMFFRI), an index measuring the reforms and liberalization of APMC *mandis* in states. Maharashtra, Gujarat, Rajasthan, Madhya Pradesh and Haryana were the top five states in the implementation of various reforms, while Puducherry and Delhi were at the bottom two. Among the top three potato producing states, Uttar Pradesh ranks a distant 13th, West Bengal ranks 19th and because Bihar repealed the APMC Act it was not part of the study. An analysis of marketing reforms undertaken by Uttar Pradesh shows that there is no provision for several farmer-friendly reforms in the UP APMC Act, 2003. For instance, there is no provision for farmer-consumer markets, direct marketing and contract farming in the Act. On the contrary, these reforms are provided for and notified in the Gujarat APMC Act. States that have not adopted the reforms yet should implement these so that farmers are able to reap benefits. The FPTC Act of 2020 announced by the Government of India, makes direct selling, bypassing the *mandi* system possible.

In primary APMC *mandis* like Lasalgaon, Kolar and Mahuva, the auction process is between farmer and trader through a commission agent. Upon bringing the produce to the *mandi*, the farmers participate in an open auction system in which the price of their produce is determined on the spot. After the auction, each farmer gets a receipt in which the farmer's details, total amount sold and price received are entered and a similar slip is given to the trader. Farmers are paid either through cash, cheque or NEFT, mostly on the same day or within a few days.

As the auction process is open and any farmer can take part in the trading process, APMC *mandis* are inclusive. The user charge collected by the *mandi* is the sole source of income for APMC. Some of the *mandis* like one in Mahuva, Gujarat, introduced farmer-centric schemes and help farmers financially for fencing, irrigation and insurance, making the whole process more inclusive. With Agricultural Produce Marketing Committees (APMCs) enjoying a monopoly due to lack of other marketing channels, the whole auctioning procedure is controlled by powerful traders and commission agents; farmers have virtually no bargaining power. Layers of *mandi* fees and commission charges are added, increasing prices without any value addition or benefit to farmers (Fig. 3.24). Our field visits to major *mandis* (Azadpur, Lasalgaon, Pimpalgaon, and Kolar) revealed that actual commissions charged are way above the prescribed charges. Although, officially these charges are levied on buyers, the ultimate burden of commission falls on the farmers.

Central government through NAFED and state governments procure onion and potatoes or give subsidy to the farmers. However, all farmers are not part of such schemes as there is a lot of paper work involved and the volume of procurement is often inadequate to cover all eligible farmers.

For onions, Lasalgaon and Pimpalgaon are the two largest *mandis* in India and onions from here are supplied to all parts of the country. Hence, the prices determined here has a cascading effect on onion prices in other markets across the country. Although APMCs have provision for transparent auction process, it is well known that

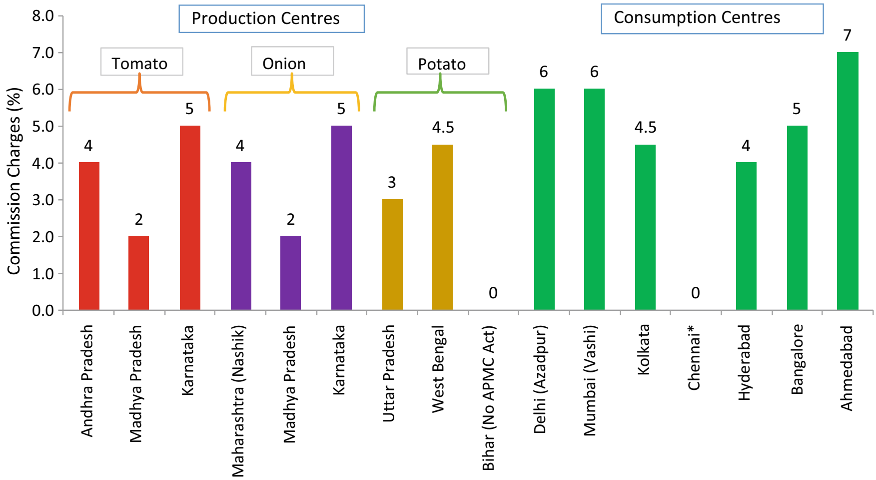

Fig. 3.24 Commission charges for fruits and vegetables at different *mandis* across India. *Source* Various APMC *mandis*, DMI

a handful of powerful traders control the entire market. Due to their low bargaining power, small and marginal farmers have no say at what price they want to sell. Hence even though the value chain is inclusive in terms of participation, small and marginal farmers have poor bargaining power and hence are unable to influence price determination to their advantage.

3.3.3 Inclusiveness in Post-harvest Management

The regional and seasonal concentration of potato and onion production poses many problems in the absence of well-integrated value chains. The rise in temperature in the Indo-Gangetic plains after the harvest necessitates transfer of potatoes into cold storages, which are inadequate, inefficient and unevenly distributed. For instance, the largest potato producing state, Uttar Pradesh, has a well-developed network of cold storages, accounting for 40% of total cold storage capacity in India. However, Bihar, the third-largest producer of potato, having 14% share in production, only accounts for about 4% of the total cold storage capacity in India. As on August 31, 2020, India had 8186 cold storages with a capacity of 374 LMT.[8]

The hub of potato production in Bihar, Nalanda, has only 17 functioning cold storages. At one time, Nalanda had the largest number of cold storages in the country, but the increase in the number of cold storages has not kept pace with the requirement. High rent charges at INR 240 per quintal of potato excludes certain categories of farmers. Small and marginal farmers do not get a chance to store their produce

[8] PIB September 23, 2020.
https://pib.gov.in/PressReleasePage.aspx?PRID=1658114.

in cold storages as large traders or farmers pre-book their space in advance in the limited number of cold storages available. This questions the inclusivity of farmers in post-harvest management.

Due to lack of storage facilities, high rent of existing cold storages, and the lack of access to cold storages for small and marginal farmers, a large part of their produce is just sold right after harvest. Hence, there is not only a need for more cold storages in the country but also efforts need to be made to make these cold storages more affordable and accessible to small and marginal farmers.

3.3.4 Inclusiveness in Contract Farming

In India, the Model APMC Act, 2003 and Model Contract Farming Act, 2018 provide for contract farming after which a majority of states amended their APMC Act to make a provision for contract farming. However, only 14 states have notified the rules till date. The more recent 'Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services' or the FAPAFS Act[9] enacted by the Parliament in September 2020 is another attempt by the government to legalize contract farming. The Act attempts at putting out a national framework for contract farming for farm services and sale of farming produce between farmers and agri-business firms, processors, wholesalers, exporters or large retailers at mutually agreed remunerative prices.

Contract farming is an alternative marketing arrangement that not only insulates farmers from risk, but also encourages innovation and technology adoption among farmers. Although there exists contract farming in fruits and vegetables, there is scope for further expansion.

McCain Foods Ltd is engaged in contract farming of potato in three districts of Gujarat (Banaskantha, Sabarkantha and Mehsana). All input costs are borne by farmers themselves and there are strict quality norms that farmers have to adhere to. In case of non-adherence to company guidelines or low quality of the produce, the price paid to the farmer is reduced. In case the farmer does not deliver the promised crop, the farmer is blacklisted and cannot enter into future contracts with the firm.

McCain's contract farming model gives better returns to the farmers compared to what the traditional farmers receive, in the form of assured income especially in times of glut. However, McCain plans to focus on improving yield through mechanization and economizing on supervision costs. In 2017–18, they had planned to engage 600 farmers, eventually bringing down their engagement to 500 farmers in the next few years. Therefore, the McCain model, though financially profitable for farmers, is not as inclusive. However, it is a good example of the success of the contract farming model in providing an assured income to farmers.

PepsiCo's Frito Lay is a popular example of inclusive contract farming model, where a large MNC has engaged with the smallest of potato farmers in West

9 http://egazette.nic.in/WriteReadData/2020/222040.pdf.

Bengal and other states. PepsiCo's 360-degree farmer connect program has transformed the lives of small and marginal farmers across India. The program includes assured buy back, supply of high-quality seeds, advanced technical know-how, loans through SBI and insurance facilities from leading insurance companies. PepsiCo has been engaging with Indian farmers since 2004–05 to produce processing variety of potatoes. Around 45% of these farmers across West Bengal, Maharashtra, Punjab, Gujarat, UP, Karnataka, Bihar, Haryana and Chhattisgarh are small and marginal. However, a few case studies (Kaur 2014; Dutta et al. 2016) conducted on PepsiCo suggest that marginal farmers are not preferred by the firm for contract farming. Even the participation of small farmers is less as compared to the semi-medium, medium and large farmers. As a rule, only farmers with 5 acres, of land or more can be engaged as contract farmers, which excludes marginal farmers. The contracting player prefers to procure through aggregates rather than dealing with individual farmers.

Jain Irrigation Systems Ltd (JISL) entered into a contract with farmers in and around Jalgaon, one of the major white onion growing regions of Maharashtra for their onion processing business. The company provides high yielding variety of white onion seeds at subsidised rates to farmers. The company also takes care of the technological requirements of farmers like drip irrigation systems. Farmers also benefit from the extension services of the company, which are aimed to ensure that the produce meets specified quality standard. A case study by the FAO has shown that the services provided by JISL to its contract farmers also contribute to mitigating the various risks faced by onion growers (Punjabi & Mukherjee 2015). The study has compared farmers associated with traditional value chain and those working with JISL on various parameters and concluded that contract farmers in JISL benefit from higher margins due to higher productivity and lower price risk due to the minimum guaranteed price. Because of these benefits, small and marginal farmers have an incentive to join the supply chain. JISL works with farmers on both ends of the value chain providing them with inputs like fertilisers, seeds, micro irrigation systems, and extension services, and finally purchasing their raw produce for processing.

Although contract farming has many benefits as farmers are able to access technology, credit, marketing channels and information with low transaction costs, there is a preference for large and medium farmers over small farmers, who have higher access to capital and greater risk taking ability. Technology adoption is easier for large farmers. As some of the requirements of contract farming makes the participation of small and marginal farmers difficult, such impediments can be overcome by organizing them into collectives like FPOs.

3.4 Sustainability

The consumption of fruits and vegetables has increased rapidly over the years in India. According to the 68th round of NSSO survey, monthly per capita consumption of tomato, onion and potato has increased by 74%, 50% and 48%, respectively in rural areas and by 52%, 32% and 41%, respectively in urban areas between 2004–05 and 2011–12. During 2011–12, NSSO reported monthly per capita consumption of tomato at 586 g, onion at 842 g and potato at 1.965 kg in rural India and at 806 g, 1.162 kg and 951 g respectively in urban India (NSS 61st Round 2007; NSS 68th Round 2014). Among vegetables, potatoes, onions and tomatoes are the three largest consumed vegetables in both per capita quantity and value terms. In order to cater to ever-increasing demand, TOP value chains should not only be financially sustainable for farmers, processors and other stakeholders but should also not put undue pressure on the environment. In this section, we evaluate the TOP value chains on financial sustainability and environmental sustainability.

3.4.1 Financial Sustainability

While there has been a dramatic increase in the production of horticultural crops in India, market inefficiency and lack of well-integrated value chains are a key impediment to farmers benefitting from these record levels of production. Recent market conditions have served as a reminder that a bountiful monsoon and a bumper crop are not synonymous with increased farm incomes. Newspaper reports have been highlighting the pitiable condition of tomato, onion and potato farmers, who have been forced to resort to distress sale or even dump the crop on the roads because the price offered was way lower than the cost of cultivation. A look at the average wholesale and retail prices of both potato and onion along with the corresponding cost of production data shows that farmers are perpetually subject to the vagaries of the "boom and bust cycle" (Figs. 3.25 and 3.26). The dotted lines give the cost of

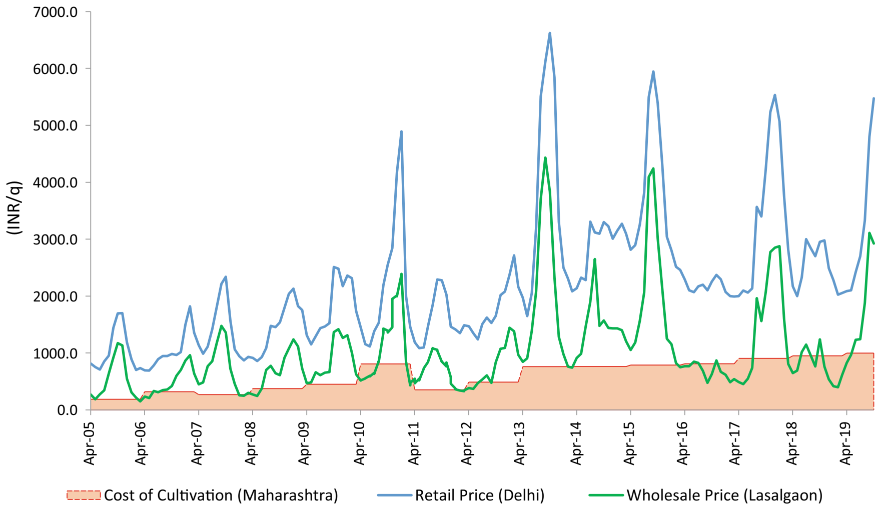

Fig. 3.25 Onion: cost of cultivation, wholesale and retail price. *Source* Cost from DES and NHRDF, Retail price from DoCA, Wholesale price from Agmarknet

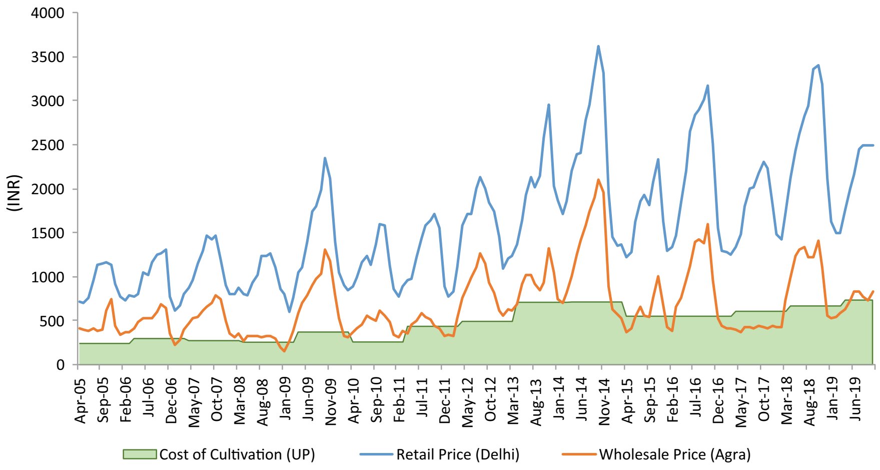

Fig. 3.26 Potato cost of cultivation, wholesale and retail price. *Source* Cost from DES and NHRDF, Retail price from DoCA, Wholesale price from Agmarknet

cultivation. When the price received by a farmer is less than the cost of cultivation, farming of a particular crop becomes financially unsustainable for him.

Sustainability of Tomato Farming in Kolar

Even though there has been an improvement in the production of tomatoes due to introduction of hybrid seeds, marketing and processing of tomatoes, efforts to contain volatility in tomato prices have not been successful. Almost entire production of tomatoes in India is supply and not demand-oriented leading to large fluctuation in prices. If a particular year was profitable for tomato cultivation, then a majority of farmers cultivate tomatoes the following year, resulting in glut. This is due to the absence of real-time season-wise data on acreage, which may be used to predict price movements. If farmers have real-time data and can be advised on the prospects of a particular crop, they will have a better idea of what to cultivate based on market demand conditions. The decision to cultivate a particular crop should be demand and market-driven and not supply-driven.

Kolar is the second-largest tomato *mandi* in India after Nashik and here tomatoes are grown in all the three seasons (rabi, kharif and summer (early kharif)). This makes it an important *mandi* for tomatoes in India which supplies tomatoes to Andhra Pradesh, Tamil Nadu, Delhi and all the way to Bangladesh and Pakistan. Data on cost of tomato production is taken from Indian Institute of Horticulture Research, Bengaluru. Price data is the season-wise weighted average for TE 2017–18 for the harvesting months. Benefit-cost ratio estimated shows that tomato cultivation is profitable in Karnataka as returns are much higher than costs (Table 3.9).

Table 3.9 Cost and returns for Karnataka Tomato farmers

Cost and returns for Karnataka tomato farmers (INR per Quintal)		
S. No	Item	TE 2017–18
1	Cost of production	183
2	Overhead cost	215
3	TOTAL COST incurred by the farmer (1 + 2)	398
4	Price received by farmer	1355
5	Returns earned by the farmer	957
6	Benefit-Cost Ratio (BCR)	3.4

Sources Cost of Cultivation data from Mysore et al. and Price data from Agmarknet

Sustainability of Onion Farming in Nashik

According to farmers in Lasalgaon, cultivation of onions is profitable in some years, and unprofitable in others. This is because prices are very volatile and the farmer has no idea what price he will receive before the auction. For this reason, a farmer also grows corn, soybean and grapes to reduce the risk involved in onion cultivation. According to farmers, their average cost comes out to INR 700–800 per quintal if only labour, fertiliser, seed, transplanting and harvesting costs are included. However, if electricity and self-labour are also included, then the cost rises to INR 1000–1100 per quintal. As per cost of cultivation data provided by NHRDF, the average cost of cultivating a quintal of *kharif* onion in Maharashtra is INR 844 per quintal and INR 793 per quintal for *rabi* onions. The detailed break up of cost of production for both *kharif and rabi* onions in Maharashtra is given in Annexure 3.3.

Apart from the cost of production, a farmer incurs labour and transportation charges for bringing the produce to the *mandi*. Unlike potato farmers, onions farmers incur no charges for storage as most of them have their own storage structures. Transportation charges for bringing the produce to the market vary between INR 40 per quintal and INR 60 per quintal, depending on the distance from the farm to the *mandi*. Prices in the Lasalgaon market are very volatile. During *rabi* 2017–18 (April–May), the average price in Lasalgaon was INR 472 per quintal. During *kharif* 2017–18, farmers received an average price of INR 2566 per quintal and during late *kharif*, the price received by Lasalgaon farmers was INR 1762 per quintal. Hence, to estimate farmer's share, we have calculated season-wise average prices and costs for TE 2017–18. The farmers earn higher profits during the *kharif* season during the months of October to December, when the stored *rabi* season is out of stock and fresh kharif crops arrive in the market.

It is clear from Table 3.10 that the returns to farmers are very volatile and there are high chances of negative returns during the *rabi* harvest period, when the market is flooded with fresh arrivals. The opposite happens when the *kharif* onions start arriving in the market. However, due to the inefficiencies present in the traditional onion marketing channel, and the cost and margins of various stakeholders, the benefit of the increase in *kharif* onion prices may not really translate to higher incomes for farmers.

Table 3.10 Lasalgaon onion farmer's cost, price received and returns

Components	2015–16			2016–17			2017–18			TE 2017–18			TE 2017–18
	R	K	LK	R	K	LK	R	K	LK	R	K	LK	All-season
Cost of Production	802	762	762	793	844	844	934	852	852	843	819	819	835
Transportation and labour cost	50	50	50	50	50	50	50	50	50	50	50	50	50
Total cost	852	812	812	843	894	894	984	902	902	893	869	869	885
Average price received by farmer	1118	2130	909	768	722	549	472	2566	1762	786	1806	1073	997
Profit	266	1318	97	−75	−172	−345	−512	1664	860	−107	937	204	112
Benefit-cost ratio (BCR)	1.3	2.6	1.1	0.9	0.8	0.6	0.5	2.8	2.0	0.9	2.1	1.2	1.13

Source Authors' calculation using data from NHRDF, Agmarknet and Field Visit
Note R: Rabi, K: Kharif, LK: Late Kharif

Sustainability of Onion Dehydration Industry in Mahuva

Mahuva, a small coastal town in Bhavnagar district, around 265 km from Ahmedabad is the largest onion dehydration hub in India. Mahuva has around 130 dehydration plants (110 in Mahuva and the rest around Mahuva) engaged in processing onions, garlic and other vegetables. However, onion dehydration is the main money-spinner for these plants as it accounts for 90% of the revenue. Mahuva is also the largest white onion growing region in India.

Since the middle of 2000s, Mahuva became the hub of dehydration industry in India. The industry flourished in Mahuva because of support from the state government in terms of their industrial policy, easier process for setting up industries and subsidies and grants provided by the state government to agro-based industries in Gujarat.

The minimum capacity is 6 tonnes per day per plant in Mahuva and the average ranges between 7 and 8 tonnes per day. This capacity is way below the capacity of Jain irrigation (JISL), which is the largest dehydration plant in India. The total capacity of all Mahuva units is around 1.25 lakh tonnes annually and the total value of dehydrated onion is around INR (750–800) crore. Despite so much potential, the domestic market for dehydrated onion in India is negligible. With 85% of production exported, the industry caters mainly to overseas markets, primarily Europe, Russia, Africa and Middle East countries. Yet, it faces challenges on many fronts due to inefficient trade policies of both the Indian government as well as governments of importing countries. Lack of awareness about dehydrated onions among domestic consumers has restricted domestic demand. Another challenge the industry faces is excess supply, resulting in low prices of the finished product. All these factors threaten the sustainability of dehydrated onion business. According to some media reports[10] and field visit to Mahuva, a majority of the dehydration plants are on the verge of closure. Even when the quality of the finished product is good, prices are not competitive and the benefit of dehydrated onions is going to foreigners. The Ministry of Commerce and Industry had reduced transport assistance under the MEIS scheme from 7% to 3%. This illustrates the unsustainability of dehydration units which have been driven by government subsidies and not actual demand of dehydrated onions.

Sustainability of Potato Farming in Agra

In TE 2014–15, 1.48 million tonnes of potato were produced in Agra. It is a major hub from where potatoes are sent to markets across India, especially to Maharashtra and the southern states like Telangana, Andhra Pradesh, Tamil Nadu and Karnataka. Owing to a well-developed network of cold storages, almost 90% of the potato produced in Agra is stored in cold storages and the rest is sold immediately after harvest. The farmers store their potatoes in cold storages by the end of March. The cold storage effectively plays the role of the marketplace, where traders from Uttar Pradesh and other states converge to buy potatoes and then sell to wholesalers in

[10] http://www.fnbnews.com/Fruits-Vegetable/gujarat-onion-dehydration-units-on-verge-of-closure-due-to-price-hike-41944.

http://knnindia.co.in/news/newsdetails/sectors/onion-dehydration-units-in-gujarat-are-at-dying-stage-due-to-rise-in-unsold-stocks.

various states. The cold storage owner thus becomes a key intermediary in the potato value chain (Reardon et al. 2012).

Farmers in Agra reported costs as high as INR 700–800/quintal. However, according to the more conservative estimates provided by the National Horticultural Research and Development Foundation (NHRDF), the estimated cost of production of potato in Uttar Pradesh for 2016–17 was INR 480/quintal. The average yield considered by NHRDF was 275 quintals per hectare. Adjusting that to 240 quintals per hectare (as per NHB statistics and field inputs), the cost of production comes out to be INR 551 per quintal. For a detailed break up of costs, see Annexure 3.4.

Table 3.11 gives an overview of the average returns earned by Agra potato farmers who sell their produce just after harvest (in TE 2017–18). Farmers who sell their produce just after the harvest incur labour and transportation costs averaging around INR 50/qunital. As 2016–17 was a glut year, the average returns were negative for TE 2017–18.

Farmers who decide to wait and sell their produce after the harvest months have to incur the cost of renting a cold storage from the end of March to the end of November. The cold storage charges are INR 220 per quintal (the rate for 2017–18 season). This charge is fixed for the season, irrespective of the duration for which the crop is actually stored. The cold storage owner also provides financing to the farmer, based on mutual trust. The farmer pledges the potato stored in the cold storage or promises to store after harvest, on the basis of which he borrows money. The finance is usually given for around 6–8 months, at a rate of 2% per month. Taking into account all the above-mentioned costs, the total cost incurred by the farmer comes out to be INR 787 per quintal.

The price received by the farmers in June 2017 (when the field visit was conducted) ranged from INR 400–600, depending on the quality of potato. When the second visit was conducted in September 2017, the prices had dropped even further, to INR (150–400) per quintal. On the back of a bumper harvest and falling potato prices, the Ministry of Agriculture and Farmers' Welfare announced in April 2017 that it would procure a maximum of one lakh tonnes under the market intervention scheme

Table 3.11 Agra Potato farmers' costs, price received and returns

Cost and returns for Agra potato farmers (INR/Q)					
S. No	Item	2015–16	2016–17	2017–18	TE 2017–18
1	Cost of production	551	551	607	570
2	Overhead cost	50	50	50	50
3	Total cost incurred by the farmer (1 + 2)	601	601	657	620
4	Price received by farmer	537	452	682	557
5	Returns earned by the farmer	−64	−149	25	−63
6	Benefit-cost ratio (BCR)	0.9	0.8	1.0	0.9

Source NHRDF (2018) and Field Visit

(MIS) through a state agency.[11] The purchase was to be made at INR 487 per quintal. Additionally, INR 121.75 per quintal or the actual overhead expenses (whichever is less) was also to be paid for including transportation, *mandi* tax, godown charges, etc. But with the cost of production at INR 787 per quintal, the price offered under MIS was hardly appealing to the farmers and no farmer we interacted with sold at this price. They preferred to wait until November and see if market prices improved.

3.4.2 Environmental Sustainability

Food security has become a sustainable development issue in India; hence, it is important that we give importance to crops that use fewer resources and are cost-effective to grow. Above all, crops should not put undue pressure to the environment, i.e. it should be environmentally sustainable.

Water Usage

TOP vegetables are relatively less water-intensive as compared to cereals and sugarcane (Table 3.12). There is no serious threat to the water table in the tomato belt (Andhra, Karnataka, MP), onion belt (Maharashtra (Nashik), MP, Karnataka) and potato belt (UP, West Bengal, Bihar), as mentioned in the Central Ground Water Body's reports (CGWB, 2014). However, four *talukas* of Nashik district fall under semi-critical category in terms of ground water resources, which means there is no further scope for ground water development. Use of drip irrigation or sprinklers can reduce water usage to a great extent in areas where it is necessary and viable. Even though the use of sprinklers is in wide use for tomato cultivation, especially in Andhra Pradesh and Karnataka, its use in onion (except in Maharashtra) and potato

Table 3.12 Water requirement and number of irrigations for potato and onion

Water requirement of different crops		Number of times irrigation required for onion and potato		
Crop	Water requirement (mm)	Season	Onion	
Rice	900–1300		DOGR	NHB
Wheat	300–400	Kharif	5–8	8–10
Maize	450–650	Late Kharif	10–12	12–15
Sugarcane	1800–2400	Rabi	12–15	15–20
Cotton	650–900			
Potato	500–700	Season	Potato	
Onion	350–550	Rabi	8	
Tomato	600–800			

Source Agropedia (2018), DOGR (Directorate of Onion and Garlic Research), ICAR and NHB

[11] http://pib.nic.in/newsite/PrintRelease.aspx?relid=160877.

cultivation is limited. The Central Ground Water Board in its report on Aquifer Map and Ground Water Management Plan (CGWB, 2018) states that micro irrigation techniques in the cropped area under onion have the potential to save water at 0.26 m per km^2. Traditional cultivation practices including flood irrigation are not sustainable and should be replaced by micro irrigation systems. Contract farmers engaged with private companies like McCain, PepsiCo and Jain Irrigation have been able to improve productivity by using micro irrigation system. All the farmers working with McCain have either drip or sprinkler irrigation systems installed in their fields. This is a mandatory condition imposed by the company. This bodes well for environmental sustainability as these micro irrigation methods economize on water use by generating savings of (30–50)% and facilitate 25% savings on fertilisers (ICAR-Central Potato Research Institute 2015). If micro irrigation is adopted by traditional farmers as well, it will not only be beneficial for them but will save a lot of water.

Another important issue is that of 'virtual trade of water', which refers to the import and export of hidden water in the form of commodities. India is a net exporter of water with food grains accounting for most of its export. India's major exports are rice, cotton, sugar and soybean, all of which are water-intensive crops. China, on the other hand, is a net importer of water as it imports water-intensive soybeans, cotton, meat and cereals and exports fruits and vegetables, and processed food. Promoting the cultivation of vegetables, which are not water-intensive, will go a long way in promoting sustainable use of water in Indian agriculture.

Fertilisers and Pesticides

Sustainable agriculture practices minimize agricultural inputs while increasing productivity and profitability. Research institutes for tomatoes, onions and potatoes (IIHR, DOGR, NHRDF and CPRI) have recommended balanced and sustainable use of fertilizer and pesticides. However, farmers often use excessive amounts of fertilizer and pesticides in the hope of greater returns, resulting in high pesticide residues in the product. In general, TOP crops do require manure and fertiliser, but the quantity depends on the variety, soil type, region, season, etc. Onions that yield 300 q/ha removes 73 kg nitrogen, 36 kg phosphorus and 68 kg potassium. Potatoes require higher amounts of fertilizer than onion—120–150 kg N, 45 kg P_20_5 and 100 kg K_2O per hectare (NHRDF). Fertilizer and pesticide use in excess of recommended levels is a risk to the environment. In fact, organic vegetable farming with multi-cropping and the use of vermicompost should be encouraged.

Organic Waste Disposal Mechanism

According to a report by ICAR-CIPHET, the overall harvest and post-harvest losses in the case of potato ranged from (5 to 8)% and for onions from 5.49% in Gujarat to 12.72% in Maharashtra and other western hilly and plateau regions. The national level average was reported to be 6.05%. The report further states that the storage loss has reduced considerably owing to the development of cold storage networks, most of which are used for storing potatoes (ICAR-CIPHET 2015). However, other studies consider the ICAR-CIPHET estimate to be an underestimate. According to the report by the Committee on Doubling Farmers' Income (Volume III), total post-harvest losses in the case of potatoes from the time of harvest to the wholesale point range from 18 to 26% (Committee for Doubling Farmers' Income 2017). CPRI estimates 16% wastage along the entire potato value chain (ICAR-Central Potato Research Institute 2015). An ASSOCHAM-MRSS India study on cold chains in India states, "On an average, about 30–40% of horticultural produce gets wasted annually in India due to lack of cold chain infrastructure which includes both storage and transportation facilities" (ASSOCHAM-MRSS 2017). In India, except for a few pockets of potato and onion production, farmers have no or little access to cold storage for potato and improved storage structures for onion. Apart from post-harvest losses, there is also a lot of wastage at the marketing stage due to spoilage. While some APMC *mandis* recycle this waste to produce manure, the capacity is limited. Hence, there is an urgent need to set up vegetable compost units inside the *mandi* complex. This will not only enable production of organic manure but also bio gas. Various farmer producer organizations or trader's associations should also be involved.

3.5 Scalability

There have been structural changes in Indian agriculture with the composition of agricultural output shifting from traditional food grains to high-value products because of increasing demand. The Indian food consumption basket has become increasingly diversified and expenditure on fruits, vegetables, milk, eggs, meat and fish, and beverages and processed food is rising, leading to changes in cropping pattern in the country (Sharma and Wardhan 2017). The composition of India's export basket has also diversified from traditional products to horticulture, livestock, and processed products.

In India, area under horticultural crops as a proportion of the gross cropped area (GCA) has increased from 9.59% in TE 2004–05 to 12.12% in TE 2014–15. Area under vegetables, as a proportion of the total area under horticultural crops was around 39.5% in TE 2014–15, up from 35.1% in TE 2004–05.

3.5.1 Scalability of Area and Production

India's tomato production increased almost five times from 4.2 million tonnes in 1991–92 to 19.4 million tonnes in 2018–19 as did the production of onions from 4.7 million tonnes to 23.5 million tonnes. Potato production approximately tripled from 18.2 million tonnes to 53 million tonnes (Figs. 3.27, 3.28 and 3.29).

Although overall production has been increasing, farmers tend to decrease their crop acreage if the previous year has not been profitable. For example, tomato production declined by 13% in 2014–15 compared to the previous year. There have been decline in onion acreage every second or third year. This shows how TOP cultivation

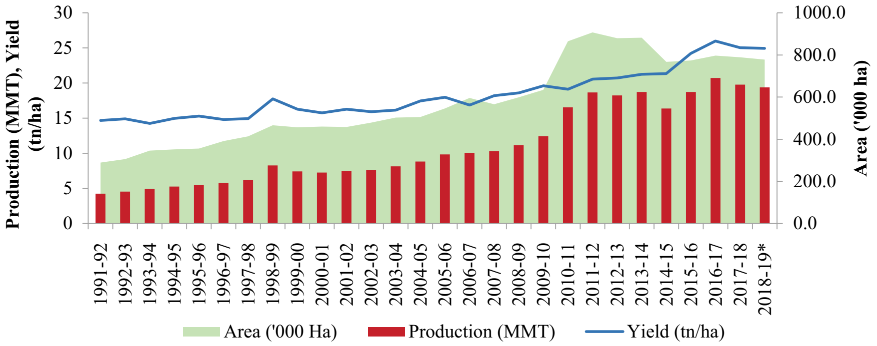

Fig. 3.27 Tomato area, production and yield—All India. *Source* NHB (2017), FAOSTAT (2018), DoAC&FW (2018a)

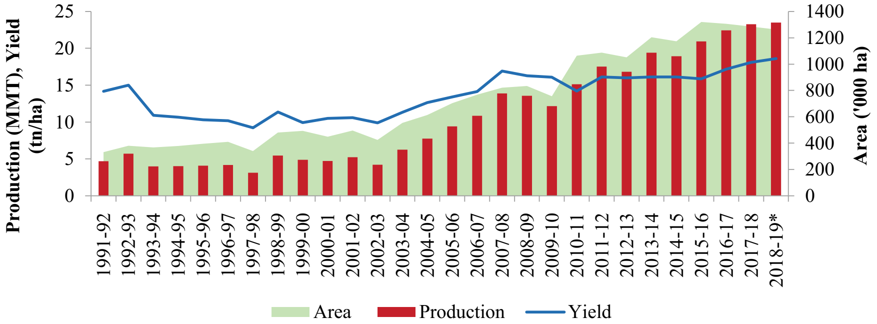

Fig. 3.28 Onion area, production and yield—All India. *Source* NHB (2017), FAOSTAT (2018), DoAC&FW (2018a)

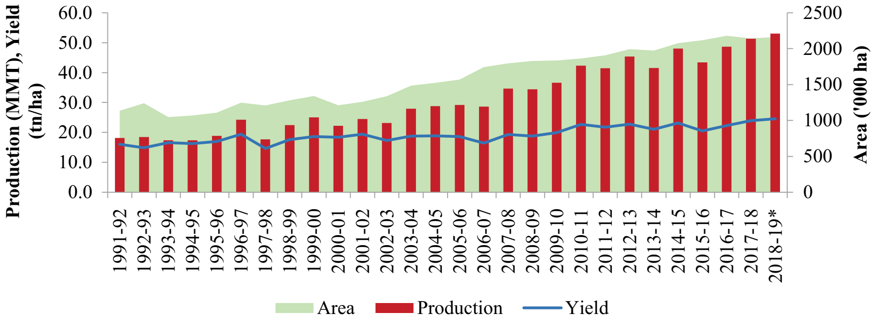

Fig. 3.29 Potato area, production and yield—All India. *Source* NHB (2017), FAOSTAT (2018), DoAC&FW (2018a)

Table 3.13 Compound Annual Growth Rates (CAGR) of Area (A), Production (P) and Yield (Y)

Decade	Tomato CAGR (%)			Onion CAGR (%)			Potato CAGR (%)		
	A	Y	P	A	Y	P	A	Y	P
1960s	2.9	0.4	3.3	4.9	0.6	5.5	3.3	3.1	6.6
1970s	11.2	0.3	11.6	4.5	−0.8	3.7	5.0	4.4	9.6
1980s	5.5	6.2	12.0	2.7	0.5	3.2	2.8	2.3	5.1
1990s	5.7	1.4	7.1	3.5	−3.5	−0.1	1.6	1.8	3.4
2000s	5.6	2.2	8.0	8.8	5.5	14.7	4.6	1.4	6.1
2010s	−2.7	4.1	1.3	4.0	0.9	4.9	2.2	0.2	2.4
All	5.6	1.9	7.7	4.3	0.7	5.1	3.2	2.1	5.3

Source Authors' calculation using data from FAOSTAT (2018) and DoAC&FW (2018a)

is risky for farmers and their profitability volatile. Interactions with farmers during field visit confirmed this trend. Hence, although the production has scaled up at the macro level, it is difficult for farmers, especially small and marginal farmers, to scale up cultivation of these crops because of market uncertainties.

In order to decompose the growth of tomato, onion and potato production into area and yield effects, we have used time-series data from FAOSTAT (from 1960 to 1990) and the Ministry of Agriculture (from 1991 onwards). Compound annual growth rates (CAGR) were calculated using the 'LOGEST[12]' function of MS Excel for area, production and yield for tomato, onion and potato over six decades starting 1960s.

It is clear from Table 3.13 that most of the growth in production has come from expansion in the area under cultivation and not growth in yield. The factors that have driven TOP production were the launch of the Integrated Development of Vegetables by Ministry of Agriculture, technology developed for micro irrigation systems, availability of quality seeds in adequate quantity and technology dissemination among farmers. Area expansion and production of TOP crops in non-traditional areas and in different seasons increased overall availability throughout the year.

We have compared the changing constituents of major TOP producing states in terms of acreage & production over a 10 year period in Figs. 3.30 and 3.31. While, Andhra Pradesh remained the largest tomato producing state in the last 10 years, Madhya Pradesh emerged as an important tomato producer. Karnataka has been overtaken by Madhya Pradesh as the second-largest onion producing state after Maharashtra. This is mainly due to the tremendous increases in onion yield in Madhya Pradesh. In fact, there has been a massive increase in horticultural crops, especially vegetables, in Madhya Pradesh in last 10 years. There is need to scale up vegetable production further in non-traditional areas to reduce regional concentration. There has been a tremendous increase in area and production of potato in Gujarat and

[12] LOGEST function gives the best fitted line for an exponential curve. This method was preferred over the general CAGR formula as the latter only gives the growth rates based on the initial and final values.

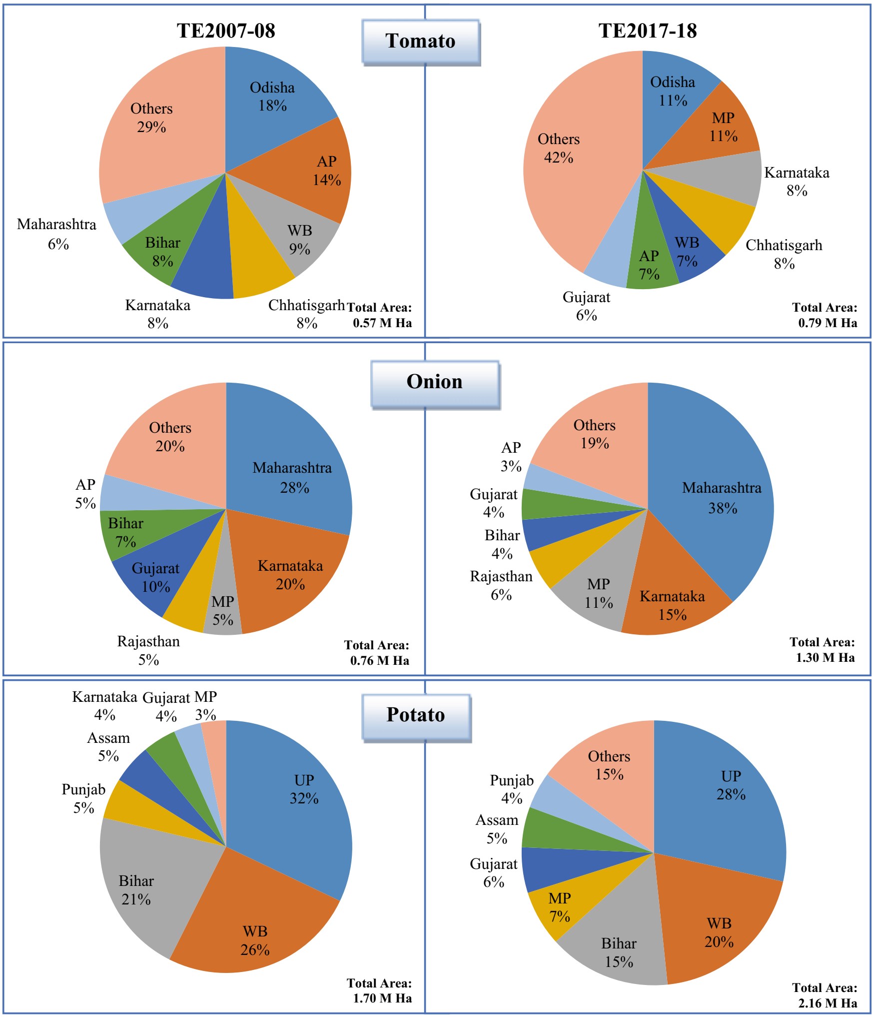

Fig. 3.30 Scalability in TOP acreage. *Source* NHB (2008–2010, 2017)

Madhya Pradesh. The Deesa region of Banaskantha is among the largest potato growing areas in India. Potatoes were always grown in this semi-arid region of Gujarat, but the yields have improved substantially with use of micro irrigation system. This region is the main potato supplying region for Balaji wafers and McCain processing units in Gujarat. Banaskantha district in Gujarat is now the largest potato producing district of India, followed by Agra. It is also the third-largest district in terms of area under potato after Muzaffarpur and Agra. There has been a considerable decline in the area and production of potato in Punjab between 2000 to 2010s. Once an important state for potato, Punjab at present does not even figure among the top

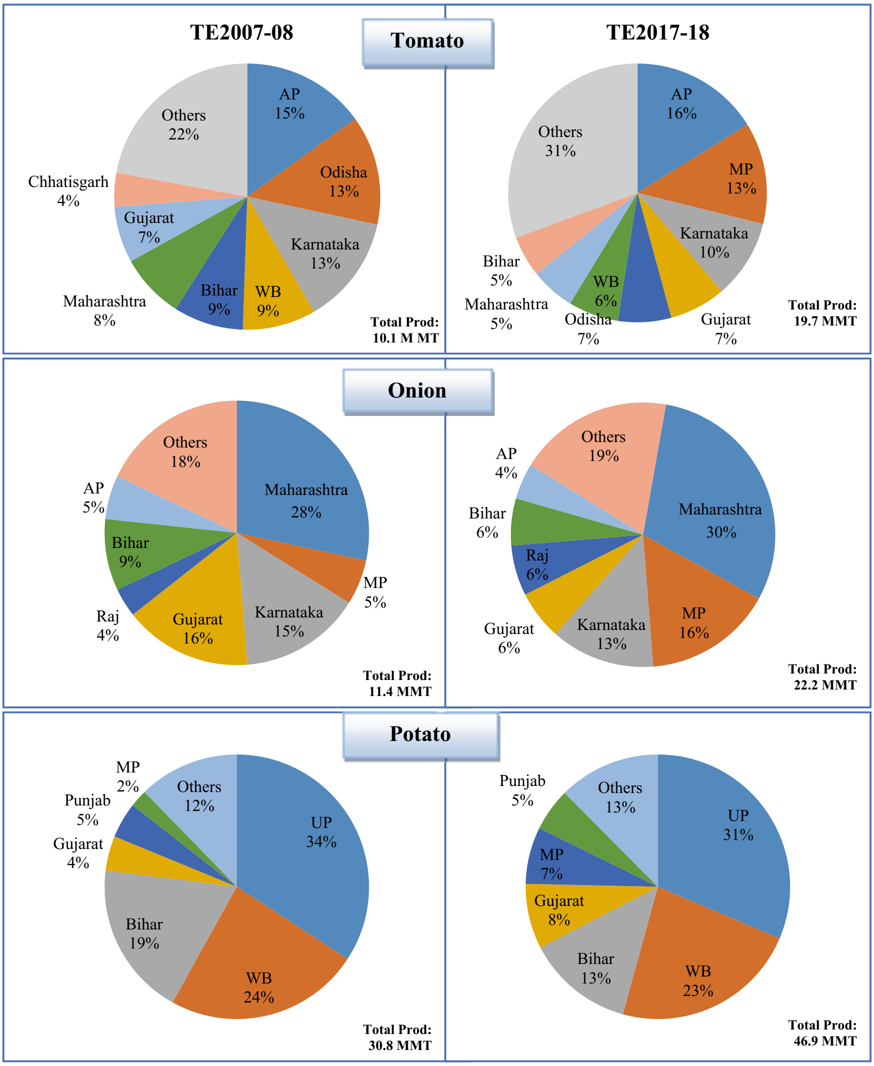

Fig. 3.31 Scalability in TOP production. *Source* NHB (2008, 2010, 2017)

five producing states. However, it has maintained its position as the largest supplier of potato seeds.

Scaling up of Cold Chain Network
Our analysis suggests that there is an immediate requirement for more cold storages for potato in India especially in states like Bihar. Even for onion, DOGR studies suggest that cold storages are capable of reducing losses to less than 5% for onions.

However, cold storages are not popular for storing onions because of the following reasons:

- Initial cost of setting up infrastructure and cost of operation are huge as compared to scientific *chals*
- It requires continuous supply of electricity
- There are bio chemical changes as soon as onions are taken out of the cold storages. Sprouting and rotting begins in onion bulbs within an hour of taking them out of the cold storage because of the difference in temperature.

However, to stop sprouting and rotting, onion bulbs may be treated with gamma irradiation rays before keeping them in the cold store and taken out in a controlled temperature from the cold store. If these steps are followed, sprouting and rotting will not take place. Since the losses will decline to less than 5%, the high construction and maintenance cost will be offset and ultimately it will be profitable. Hence, cold storage may be considered even for storing onions in metropolitan cities near irradiation plants.

3.5.2 Scalability of Exports

Despite being the second-largest fruits and vegetables producer in the world, India has a meagre share in global exports. In fact, just about (1–2)% of total production of fruits and vegetables are exported (Table 3.14). Also, exports are dominated by onions, mangoes and grapes.

Table 3.14 Fruits (F) and vegetables (V) exports as share of production

Year	Production (MMT)			Exports (MMT)			% Share of Exports to Production		
	V	F	F&V	V	F	F&V	V (%)	F (%)	F&V (%)
2010–11	147	75	221	1.7	0.4	2.1	1.1	0.6	1.0
2011–12	156	76	233	2.0	0.5	2.5	1.3	0.6	1.1
2012–13	162	81	243	2.3	0.5	2.9	1.4	0.7	1.2
2013–14	163	89	252	2.3	0.5	2.8	1.4	0.6	1.1
2014–15	167	90	256	2.0	0.5	2.5	1.2	0.5	1.0
2015–16	169	90	259	1.9	0.6	2.4	1.1	0.6	0.9
2016–17	178	93	271	3.6	0.8	4.4	2.0	0.9	1.6
2017–18	184	97	276	2.3	0.7	3.0	1.2	0.7	1.1
2018–19	186	99	284	2.9	0.7	3.7	1.6	0.7	1.3

Source Compiled using data from Horticulture Statistics and APEDA

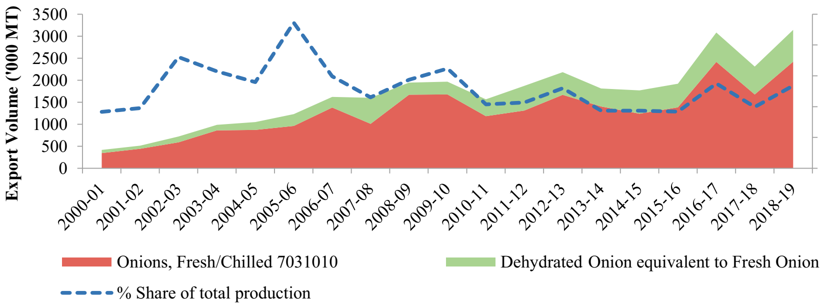

Fig. 3.32 Scalability of onion exports. *Source* Using data from Directorate General of Foreign Trade and Horticulture Statistics Division

Onions account for more than 50% of the total fruits and vegetables' export. However, despite a rising trend in onion production in the country, onion exports have not increased at the same pace (Fig. 3.32). This is because of the trade-distorting policies of the Indian government ranging from bans on exports to imposing minimum export prices, adversely affecting overall onion exports from the country.

The Agriculture Export Policy (AEP)[13] prepared by the Department of Commerce aims to double agricultural exports from USD 30 billion plus to USD 60 billion plus by 2022 and to USD 100 billion in a few years. It envisages an increase in present exports of dehydrated onion and other fresh and frozen vegetables from the level of USD 207 m to USD 400 m in the next three years. Even though the policy document discusses how trade policy instruments like export bans or imposition of MEPs are used for correcting short term inflationary conditions and affects India's image as a reliable exporter, it does not recommend complete removal of these policies for fresh onions and potatoes. Except for few processed agricultural products and organic products, exports of onions and potatoes will continue to be restricted as the need arises.

The policy has identified 50 export clusters that are unique product-specific districts that will be promoted for agricultural exports. For onion, the identified districts are Nashik in Maharashtra, and Indore, Sagar and Damoh in Madhya Pradesh. For the premium rose variety of onion, the two districts from Karnataka, Bangalore Rural and Chikkaballapura, have been identified. Similarly, the largest potato producing districts from Uttar Pradesh, Gujarat, Punjab and Madhya Pradesh will be developed for potato exports (DoC 2018). West Bengal and Bihar, which are second- and third-largest potato-growing states, have been excluded from the list of clusters. The policy, which seeks to develop an export-oriented value chain for several agricultural commodities including onions and potatoes, will go a long way in boosting the exports of high value agricultural products.

[13] http://commerce.gov.in/writereaddata/uploadedfile/MOC_636802088572767848_AGRI_EXPORT_POLICY.pdf.

Box: Scaling Up of SAFAL Model

Mother Dairy started its fresh fruits and vegetables operations through their SAFAL chain of outlets in 1988 in Delhi. Like 'Operation Green', the SAFAL model too was based on the success of Operation Flood. Although the milk marketing model of Mother Dairy was successful, it did not succeed as much in the case of fruits and vegetables.

Today, SAFAL has over 400 outlets in Delhi NCR and a few outlets in Bangalore (NCCD 2017). The share of SAFAL in total supply of fruits and vegetables in Delhi NCR is just about 4%. This share has been almost the same for the last many years. By contrast, the Mother Dairy milk chain, which it tried to emulate; accounts for 66% of the total branded milk supply in Delhi. A majority of Delhi households still rely on their local vendors for fruits and vegetables, which are subject to large scale intermediation.

The number of farmers who are supplying their produce to SAFAL is 8000, which is insubstantial. In over 30 years of SAFAL's existence, it has not succeeded in expanding to any city other than Bangalore. In Bangalore, SAFAL adopted an auction system with no direct retailing, which has not been as successful as planned. Over the years, SAFAL introduced a varied range of products from frozen peas, juices and other daily need items like cooking oil and pulses. Recent introductions like frozen jackfruit and dehydrated onion, however, have not been successful.

3.6 Access to Finance

Cost-effective, easy and inclusive access to finance is crucial for any efficient value chain to function. Value chain financing has been an issue of concern, particularly for small and marginal farmers. Farmers become indebted to money lenders, who charge exorbitant interest rates, throughout their life. While there has been some easing in terms of accessibility to finance, this has been confined to only medium or large farmers in well off states. Field visits undertaken during the study revealed vast variations in access to finance across the country.

3.6.1 Financing of Farmers

Tomato Farmers in Kolar, Karnataka

As crop-wise credit sources data for farmers are not readily available, data from interactions with stakeholders during field visits were used to analyze existing sources of credit for different stakeholders. Our field visit to Kolar suggested that 80% of small and marginal farmers source credit from the unorganized sector, comprising of commission agents, friends, relatives or through own sources. Large farmers or traders are an integral credit source for small and marginal farmers. This is because of mutual trust and understanding that has developed over the years. Getting credit for them is also easier and quicker as compared to taking loans from banks, which requires large amounts of paper work. Large farmers borrow only (30 to 35)% of the total cost of production. Of this, (60 to 70)% are borrowed from banks, less than 30% from relatives and none at all from commission agents.

In terms of schemes for farmers, government provides 90% subsidy on drip irrigation, the total cost of which is INR 25,000 per acre. However, the effective subsidy is just 70%; the 20% goes to middlemen. Farmers also get support in production technologies—precision farming, pest management, and drip irrigation. The government also provides subsidy for mulching, the practice of covering the soil with black polythene to protect the tomato crops.

Onion Farmers in Nashik, Maharashtra

In the comparatively developed region of Nashik in Maharashtra, farmers do have access to banking facilities and use Kisan Credit Cards (KCC). THE MSAMB implements a pledge loan scheme at 3% per annum against warehouse receipts through the APMCs for the benefit of farmers. District co-operative banks in every village is a major source of financing; however, (30–40)% of farmers have shifted towards nationalized banks as district co-operative banks are loss-making and many are shutting down. There is also a provision of a crop loan of INR 30,000 per acre for onions. This is the minimum amount; the amount increases over time if instalments are paid regularly. An interest rate of 7% is charged for crop loan up to INR 3 lakhs and there is a rebate of 2% for regular repayment. After the initial INR 3 lakhs crop loan, farmers get a cash credit loan at an interest rate of (10–11)% by nationalized banks and 12% by private banks.

During the field visit, APMC officials said that both in Lasalgaon and Pimpalgaon, there is no role for commission agents as money lenders. According to some farmers we spoke to, however, commission agents or other informal sources of financing are approached when it is not possible to get loans from banks due to non-payment of dues.

Onion Farmers in Mahuva, Gujarat

In Mahuva, banks provide loans at an interest rate of 7%. However, commission agents, who charge a monthly interest rate of around (2–3)%, are an important source of credit for farmers, Farmers, even if they have *kisan* credit cards, depend on commission agents for financing, at least, in part because they may have defaulted on bank loans. They are also discouraged by the long paper work required for availing bank credit.

Potato Farmers in Agra, Uttar Pradesh

The field visits to Agra threw up interesting insights about the financing of the potato value chain. We found that most farmers have a *kisan* credit card (KCC) but as most of them fail to repay loans on time, they end up paying higher and penal rates of interest (7% or more). The failure to repay can be attributed to farmers using crop loans for consumption purposes or to repay existing loans from informal sources. Even if farmers do not default, the loan amount received is often not enough for small farmers and they have to resort to some degree of informal borrowing. Due to a bumper crop, farmers received little return for their produce which has increased the dependence of many small and marginal farmers on *sahukars* (money lenders). The *sahukars*, many of them large farmers, charge a minimum of 2% per month (this could go as high as 5% per month in some cases). The transactions are based on and dictated by personal relationships.

Cold storage owners are another source of financing for farmers. They charge as much as the sahukars (around 2% per month). The cold storages, in turn, avail the overdraft facility given by banks to lend to farmers. This enables cold storage owners to earn arbitrage since the interest rate they charge from farmers is twice to five times higher than what they pay to the bank. Besides, the practice of not providing proper receipts to farmers for the potatoes stored makes it difficult for farmers to access other sources of credit. As Agra is home to a large number of cold storages for potato, a warehouse receipt system should be made compulsory to help farmers access low-cost finance.

Potato Farmers in Nalanda, Bihar

Nalanda in Bihar is a hub for vegetable farming; however, vegetable growers are not able to take loans, primarily because banks view vegetables as a high-risk activity and because of the high proportion of defaults by vegetable farmers. Besides, many farmers find it difficult to get a Land Possession Certificate (LPC), especially when land records are in names of fathers/grandfathers, making it difficult for them to avail bank loans. Hence, a very limited number of farmers who have proper land records are able to take formal loans. The interest rate charged by banks is 4% per annum if premiums are paid on time, but this could go up to (11–12)% per annum if there is a default. Interest rates of loans from non-institutional sources are as high as (2.5–3)% per month.

Because of the lengthy procedure involved in sanctioning farm loans, farmers find it difficult to avail loans from banks when they need it the most, which is just ahead of the sowing season. This forces many to approach non-institutional sources of loans. Besides, due to high incidence of loan defaults, banks are reluctant to lend to farmers. A possible solution is to provide credit through FPOs to minimize defaults. This is a plausible solution as there are large numbers of upcoming FPOs especially after the success of *Jeevika* led Women Farmer Producer Organizations in Bihar.

3.6.2 Financing of Infrastructure

As mentioned earlier, cold storages in Agra avail overdraft facility given by banks solely for onward lending to potato farmers in Uttar Pradesh are charged around 10–11% per annum by the banks.

Unlike potato farmers in Agra, onion farmers still use non-cold storage structures to store onions. DOGR and NHRDF have developed different kinds of low cost, improved storage structures using bamboos, asbestos, and other materials. While some structures are three sides open, some are open on all sides with ventilation provided at the bottom through a raised platform. Scientists at DOGR and NHRDF claim that these structures are able to reduce post-harvest losses to (15–20)% as compared to the (40–50)% when onions are stored in traditional structures. For the construction of these storage structures, the government provides a subsidy of 25% to farmers under the RKVY (*Rashtriya Krishi Vikas Yojana*) scheme. The scheme was entrusted to the Maharashtra State Agricultural Marketing Board (MSAMB), which administers it through the APMCs. The storage capacity ranged between 5 MT costing INR 30,000 to 50 MT costing INR 3,00,000.

Another government scheme provides 35% subsidy for the construction of cold storages as credit-linked back-ended subsidy, the cost of which comes to INR 3500 per MT. However, since storing onions in cold storages in Nashik is not yet popular, these are used to store other fruits and vegetables like tomato and grapes.

While existing cold storages are concentrated in few states and (80–90)% of available cold storages are used for potatoes, there is a dire need for cold storages in India. The Ministry of Food Processing Industry is building a National Cold Chain Grid in the country to connect major agricultural producing hubs to cold storage and processing industries. The Cold Chain and Value Addition Infrastructure scheme of MoFPI provides financial support to the tune of INR 10 crores for setting up of such facilities (NCCD 2018).

Onion traders in Nashik get cash credit from banks at an interest rate of 18% per annum. This is done by keeping land as security. Traders reported that the rate of interest charged to them is much higher than that charged to farmers.

As marketing is a key aspect for any value chain, infrastructural development of existing APMCs and setting up of private *mandis* becomes important. Visits to various APMC *mandis* during the course of the study revealed that the existing infrastructure of APMCs has run out of its capacity. For example, the largest tomato *mandi* in Kolar, which caters to more than 4 lakh MT of tomatoes a year, is spread over 20 acres and is overflowing. The *mandi* requires complete renovation of the existing infrastructure, as well as expansion of the market area.

3.6.3 Financing of Processors

The emergence of Mahuva as a dehydration hub can be attributed to the Gujarat Government's favourable policy regime. This includes subsidies to dehydration units. The Gujarat Government provides subsidy to cover 25% of the project cost up to INR 50 lakhs to set up such industries. Another interest subsidy of 7% on term loans for micro and small industries has helped in setting up dehydration units in Mahuva.

The Government of India's *SAMPADA* (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters) Yojana, which provides subsidy for setting up food processing units is another scheme which has boosted the food processing sector. It is an ongoing scheme for the food processing sector and has been renamed to Pradhan Mantri Kisan SAMPADA Yojana[14] with an allocation of INR 6000 crore for the period 2016–20. This scheme of Ministry of Food Processing Industries (MoFPI) provides a subsidy of 35% of the project cost up to INR 5 crores to set up food processing units. The scheme also covers the setting up of the following:

- Mega Food Parks
- Integrated Cold Chain and Value Addition Infrastructure
- Creation/Expansion of Food Processing and Preservation Capacities
- Infrastructure for Agro-processing Clusters
- Creation of Backward and Forward Linkages
- Food Safety and Quality Assurance Infrastructure
- Human Resources and Institutions.

According to MoFPI, PM Kisan SAMPADA Yojana was expected to leverage investment of INR 31,400 crore for handling of 334 lakh MT of agro-produce valued at INR 1,04,125 crore, benefiting 20 lakh farmers and generating 5,30,500 direct/indirect employment in the country by the year 2019–20" (MoFPI 2018).

3.7 Conclusion and Policy Recommendation

In this chapter, we highlight the fact that despite being the second-largest producer of TOP vegetables, we have stopped well short of securing a good deal for our farmers. During a bumper crop, farmers struggle to cover their cost of production. The primary reason for this is inefficient and fragmented value chains, which lead to low returns for farmers. Hence, to bring efficiency in the value chain of tomatoes, onions and potatoes, policy recommendations should address the challenges faced at each stage of the value chain from seeds to final consumption. In our analysis based on the CISS-F framework, we seek to highlight the difference marketing reforms can make on farm incomes.

First, we recommend some generic policy measures followed by recommendations specific to each of the TOP vegetables.

Generic Policy Recommendations for TOP

1. **Extension services:** The horticulture sector throughout the country suffers from serious gaps in extension services, which partly accounts for the uneven quality of produce and the abnormally high post-harvest losses. Government extension services are focused on cereal crops and private sector capacity has not grown

[14] http://mofpi.nic.in/Schemes/pradhan-mantri-kisan-sampada-yojana.

adequately. Yet, without massive effort to skill horticulture farmers, integrated value chains are unlikely to emerge to link producers to end markets. Operationalising a system of tax incentives to the private sector specifically to invest in extension services will help. While such a step should cover all sub-sectors of agriculture, it is most likely to attract private investment in the fast-growing areas of horticulture, poultry, livestock and dairy farming. Something like 150% tax deduction for eligible investments is likely to result in significant private interest in this area. At the same time, public extension services should also be revamped to focus on horticulture in general, and TOP crops in particular. This is an essential pre-requisite for the emergence of integrated value chains for these crops.

2. **Agriculture credit:** Agriculture credit for horticulture crops is another area which requires focused attention. Short-term crop credit is available only for crop husbandry, leaving horticulture farmers largely at the mercy of informal credit suppliers. This study has validated evidence from other sources that market intermediaries (or *mandi* agents) are one of the primary sources of credit for horticulture cultivation. This makes the cost of cultivation unsustainably high, as interest rates on informal credit range between (24–48)% per annum. Providing access to institutional credit through *kisan* credit cards (KCC), SHG-bank linkage, and channelizing credit through FPOs is the way forward to address this challenge.
3. **Mechanization:** The scope for mechanization to reduce production costs and wastage has not been adequately leveraged in horticulture. This is especially true of the TOP vegetables. From seeding to harvest and storage, mechanization is widely used even in our neighbourhood, especially in China. A focused policy on accelerating the scope of mechanisation in the TOP crops should be the forerunner for a sector-wide approach to increase farmers' access to hired mechanical aids. This is especially critical if we hope to break into export markets for these crops, where our competitors with a higher level of mechanization are able to meet the exacting demand of buyers.
4. **Farmer Collectives:** The typical vegetable farmer being small, the organization of producers into collectives such as farmer producer companies and co-operatives is vital to attract market players at the backend. The experience of the past few years shows that farmers' collectives have been successful in many instances in increasing the bargaining power of small producers in accessing capital, technology and markets. Current efforts to promote FPOs should be accelerated, with a cluster approach in the case of horticulture to attract processors, exporters, modern retail and others to source produce from the farm gate.
5. **Risk insurance:** To insure producers and exporters of TOP vegetables against risks, there is need for the creation of a formal advisory body that can assess the credit worthiness of all stakeholders within the value chain. This credit rating will help producers and exporters to identify traders to deal with, based on their credit worthiness. Insurance products that can help farmers in times of distress or adverse weather conditions should be promoted and these should be available

to farmers at affordable premium rates. Promotion of commodity derivatives and futures trading in TOP can be another way to hedge risks for farmers.

Tomato Value Chain

1. Private companies have done well in introducing different varieties of hybrid and disease-resistant seeds. However, in the absence of a strong intellectual property rights (IPR) regime, private companies find no incentive to further invest in seed research as copying of genetic material of seed developed after years of research by a company is very common in India. Hence, there is need to strengthen the IPR regime for tomato seeds.
2. Indian tomato yields are very low as compared to yields in European countries. There is a need for large scale adoption of polyhouses to enhance the yield of Indian tomatoes. This will help create a continuous cycle of tomato crop, and also help protect crop from pest attacks. Frequent spraying of pesticides makes Indian tomatoes unhealthy for domestic consumers, and non-tradable in the international market. As polyhouse construction is capital intensive, government can subsidise such investments for individual large and medium farmers, or small and marginal farmers through FPOs, who are willing to adopt this technology.
3. Tomato exports from India are very limited, despite India being the second-largest producer in the world. A high degree of pesticide residue in the vegetables makes it non-exportable in the world market and the exports remain limited to our neighbouring countries. Precision farming that allows farmers to improve their farming practices and harvest safe and quality produce, need to be encouraged and incentivized. Education and awareness about the negative impact of heavy usage of agro chemicals need to be stepped up through FPOs and organizations working directly with farmers.
4. FPOs can be encouraged to set up small-scale processing plants to produce tomato pulp and puree to supply to large-scale ketchup manufacturing plants. This will ensure surplus production is sold by farmers at remunerative prices and they benefit from direct marketing opportunities.
5. The monopoly of APMC can be tackled by allowing private *mandis* on PPP basis or by developing other marketing channels. The FPTC and FAPAFS Acts enacted by the Parliament in September 2020, will make it easier for private sector to set up *mandis*. This will give farmers a wider choice to sell their produce at remunerative prices as well as render APMC markets to become more competitive and improve their infrastructure and services.
6. Aggregation facilities for tomatoes should be done at farm-level itself with assaying, sorting and grading based on size, colour and texture and packaging with tinker proof bar codes for easy traceability.

Onion Value Chain

1. Even though cold storages are able to reduce post-harvest losses by 5%, these are not popular in India. There is need for dry storage on-or near the farm, preferably owned by farmers. Only Maharashtra has invested to some extent in this area. Hence, there is need to invest in the creation of scientific dry storages for onions, especially, in Madhya Pradesh, which has a huge infrastructure gap and has no policy to increase farm level storage.
2. An aggressive expansion of the area under onion with focus on states of Bihar, Odisha, Assam, and Chhattisgarh, will help cater to demand in east and north-east India, Nepal, and Bangladesh. It will reduce the need to transport onion at huge energy and financial costs across the country from Maharashtra, and create alternative crop choices for farmers in eastern India. But the foray into eastern India must be preceded by varietal trials to select the best varieties, extension, development of storage and supply chain infrastructure, and credit facilities. Leveraging private investment to expand onion value chains in new geographies, and strengthening processing and marketing segments within these value chains can provide diversified income opportunities for the farmers.
3. There is need for popularizing dehydrated onions among Indian consumers through ad campaigns. Dehydrated onions could be affordable substitute for fresh onions, when prices escalate very sharply. Also, with changing lifestyle and consumer preference, domestic market for dehydrated onions can take off. The dehydrating industry in Mahuva, Gujarat is quite large, but it mainly caters to the overseas market. Even when the quality of the product meets international standards, prices are not very remunerative because of oversupply and the business is not structured. Boosting domestic demand and creating an organized market will further promote the onion dehydration industry, benefit farmers in terms of assured remunerative prices, as well as potentially address the consumer inflation woes.
4. There should be an overhaul of India's onion trade policy. Instead of imposing minimum export price as and when onion price starts rising, government should instead allow imports. The minimum export price policy for onion not only affects India's image as a credible exporter, but also deprives onion farmers the benefit of higher prices in the international market.
5. For export purposes, India can cultivate foreign varieties of onion, which are bigger in size and less pungent and hence, less popular in the Indian market. These varieties could be grown to cater to the global market exclusively for export purposes through contract farming.
6. FPOs can play an effective role in promoting collective farming of onions marketed as fresh as well as dehydrated. Direct marketing linkages and/or contract farming will allow farmers to benefit from economies of scale and fair price realization. Existing government schemes and financial support can be made available to the farmers through such farmer collectives to promote onion farming as well as processing and marketing. There should be a mechanism where farmers can enter into contract farming with dehydration units so

that they are able to fetch a better price for their produce, which otherwise is too low.

Potato Value Chain

1. Inadequate investments in research of table and processing varieties of potato in India needs to be addressed to overcome the issues related to yield stagnation due to varietal reasons; threat of widespread viral and pest borne diseases; excessive use of agro chemicals; among others. While CPRI, Shimla has been leading the R&D in potato, there is scope for bringing in the private sector in R&D to end the monopoly of CPRI, Shimla.
2. Potato farmers' especially in Uttar Pradesh and Bihar can be organised into farmer producer organizations (FPOs), which can help them secure quality inputs at cheaper costs. During our field visits, farmers complained about their being fleeced by input traders dealing in seed, fertilizers, and other agro chemicals. FPOs can enable farmers to access organized markets for agri inputs as well as create awareness among them about the right farm practices. For instance, farmers can be linked to entities like Mahindra-HZPC,[15] which can provide access to high-quality seed. Finance can be made available to farmers through these FPOs, which can help farmers take care of their agri credit requirements and address issues related to default to a large extent. FPOs can also help farmers access custom hiring centres or other rental models to adopt mechanization on their farms. Large scale mechanization can help them improve farm efficiency as well as reduce cost of labour.
3. Cold storage plays an important role in the potato value chain. However, the cold storage infrastructure deficit and spatial mismatch needs to be corrected. For example, Bihar with a 14% share in potato production, accounts for only 4% of the total cold storage capacity in the country. There is urgent need to set up cold storage facilities in Nalanda, and other potato producing districts in the state. Financial incentives for setting up of energy-efficient, solar powered cold storages would help the cold storage owners reduce their operational costs and make cold storage more affordable for the farmers. Farmers' direct access to cold storage enables him to access institutional credit at affordable interest rates. It also saves the farmers from distress sale of his produce during peak arrival months. Cold storage units registered under the Warehouse Development and Regulatory Authority (WDRA) can issue negotiable warehouse receipts (NWRs) and eNWRs to the farmers, which can serve as a collateral for the banks and enable the farmer to meet his credit needs.
4. Efforts should be made to give potato processing in India a boost. The number of registered fruit and vegetable (F&V) processing units in the top potato producing states like Uttar Pradesh (42), West Bengal (58) and Bihar (7) are a small fraction of the total (1256) (ASI, 2020). Agra and Nalanda, two of the largest potato

[15] **Mahindra—HZPC (Dutch Company)** tie up seeks to bring high quality seed to Indian farmers, through the use of AERPONICS.

producing districts of India, do not have a single processing unit. India can benefit from increased potato processing, given that demand for processed potato products is set to increase. For example, India is a net importer of potato starch and could benefit from higher domestic production.

5. A robust export policy for potato needs to be developed. India exported a measly 0.37 million tonnes of a total production of 53 million tonnes in TE 2018–19. This is explained by high domestic consumption, and India's inability to project itself as a credible and consistent supplier of quality potatoes. The frequent imposition and removal of MEPs is testimony to this apathetic approach in promoting potato exports. Agriculture Export Policy announced in December 2018 to promote exports of agricultural commodities, highlights the potential of potato for exports.
6. Agricultural marketing reforms that promote contract farming, direct marketing, farmer markets, among others need to be adopted and implemented by the states, which have not done so far. The FPTC and FAPAFS laws provide the legal pathway to bring about these reforms that can benefit the farmers in terms of greater market access, fair price discovery and higher price realization.

Annexures

Annexure 3.1: Estimated Cost of Cultivation of Processing Variety Potato for McCain (Based on Discussions with McCain Officials and Contract Farmers)

S. No.	Operations	Details	Amount (INR/ha)
1	Land Rent for 6 months		27,170
2	Potato seed (processing variety)	~ 29.64 qtl@INR 2300/qtl	68,172
3	Land preparation		9880
4	Sowing/Planting		4940
5	Manures and fertilisers		37,050
6	Irrigation	2250 per year per acre per crop	5557.5
7	Motor maintenance	From the third year onwards, every year	4940
8	Plant protection		14,820

(continued)

(continued)

S. No.	Operations	Details	Amount (INR/ha)
9	Labour (including loading operations)		30,875
10	Bank Interest		6175
11	Supervision charges		3705
12	Total cost of potato cultivation		213,284.5
13	Average yield (q/ha)		321
14	Cost of production per quintal (INR)		664.44

Annexure 3.2: Markups Provided by MDFVPL for SAFAL Fruits and Vegetables

Components	Markups (%)
1. Price received by farmer	63.5
Local *Mandi* fees	0.3
Association handling charges (Avg)	0.2
Inward freight including loading/unloading	5.2
APMC fees (Delhi)	0.5
2. Total raw material cost (Incl. handling losses)	69.7
Packaging/Crates	0.4
Sorting/Grading/Ripening-labour charges at CDF	1.6
Consumables	0.5
Power and fuel	0.6
Cold storage charges & shifting to CDF	0.5
SAFAL contribution margin	15.5
Interest	0.5
Depreciation	0.7
Advertisement and promotion	1.0

(continued)

(continued)

Components	Markups (%)
3. Net sales realization of concessionaire	91.0
Concessionaire handling loss/Damage	5.0
Concessionaire margin	4.0
4. Price paid by consumers	100.0

Source MDFVPL

Annexure 3.3: Cost of Production of Onion in Maharashtra provided by NHRDF

S. No.	Operation/Item	Kharif onion (2016)	Rabi onion (2016–17)
1	Land rent for six months	12,000	12,000
2	Seed cost (kg)	7200	8000
3	Land preparation	17,370	17,370
4	Nursery raising	7040	7410
5	Manures and fertilisers	18,800	25,056
6	Transplanting	21,850	21,850
7	Weeding and hoeing	16,550	11,950
8	Plant protection	20,150	19,620
9	Irrigation	9900	15,000
10	Harvesting, curing, sorting, grading and packing	33,460	31,050
11	Transportation	12,000	15,000
12	Overhead charges	–	–
13	Supervisory charges	4500	4500
14	Total (INR)	180,820	188,806
15	Bank interest	9041	9440
16	Grand total cost (INR)	189,861	198,246
17	Average yield (q)	225	250
18	Final cost per quintal (INR/q)	844	793

Source NHRDF (2018)

Annexure 3.4: Item-Wise Cost of Production of Potato in Uttar Pradesh, 2016–17, Given by NHRDF (Adjusted for Yield)

S. No.	Operations	Details	Amount (INR/ha)
1	Land rent for 6 months	2500 per month	15,000
2	Potato seed	30 qtl @ 1500	45,000
3	Land preparation	03 no @ 1500	4500
4	Sowing/planting	25 no @ 150	3750
5	Manures and fertilisers	N 100 kg: P 100 kg: K 100 kg	8210
6	Irrigation	05 no @ 2400	12,000
7	Weeding hoeing and earthing	24 no @ 150	3600
8	Plant protection	Monocrotophos (Insecticide), Dicofol (Pesticide), Mancozeb (Fungicide), Metalaxyl formulation	6050
9	Harvesting, curing, sorting, grading and packing		20,400
10	Transportation		3770
11	Supervision charges		2500
12	Total cost of potato Production		124,780
13	Bank Interest		7440
14	Total		132,220
15	Average yield (q/ha)		240
16	Cost of production per quintal (INR/quintal)		551

Source NHRDF (2018)

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Chapter 4
Banana and Mango Value Chains

Harsh Wardhan, Sandip Das, and Ashok Gulati

4.1 Introduction

Fruits are high-value agricultural crops, mostly managed by individual farmers in India unlike in the West where large private corporations are involved in production and exports of fruit crops. India's fruits production increased significantly from 28.6 million metric tonnes (MMT) in 1991–92 to 96.8 MMT in 2018–19. Among fruits, mango and bananas are the most important crops with 50% share in fruits acreage as well as value dominated by mango (Fig. 4.1).

While Andhra Pradesh, Gujarat and Tamil Nadu are the largest banana-producing states in India, Uttar Pradesh, Andhra Pradesh and Bihar are the three largest mango-producing states. However, Maharashtra is an important producer and exporter for both. Despite being the largest producer of both bananas and mangoes, India's position in the trade of both these fruits is unremarkable. India exported around 103 thousand MT of bananas and another 46 thousand MT of mangoes during TE 2017–18, which is less than 1% of total production of the two crops. The processing capacity of these two crops is also limited in India. A significant volume of these fruit crops is wasted every year due to lack of proper post-harvest mechanisms. Banana and mango value chains did not witness the kind of success that was seen in grapes, which was led by Mahagrapes. Is it possible to develop banana and mango value chains on same lines as grapes model?

In order to answer this, the chapter strives to study and analyse banana and mango value chains in the CISS–F framework. The study identifies the challenges faced by the sector at each stage of the value chain from cultivation to marketing. It also discusses how policy reforms can strengthen these value chains to stabilise prices and ensuring fair share to farmers while guaranteeing healthy and affordable fruits to the consumers. It is expected that the results of this study and the policy recommendations suggested in the end would be useful for the policy planners formulating

H. Wardhan · S. Das · A. Gulati (✉)
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India

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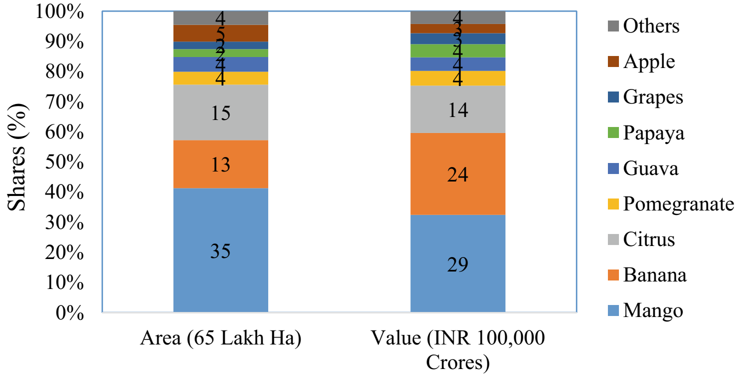

Fig. 4.1 Share of fruits in area and value. *Source* DoAC&FW and NAS (Various issues)

policies aimed at creating an efficient value chain models for banana and mango for India which then can be scaled up for other fruits.

4.2 Overview of Banana and Mango Economy

4.2.1 Banana

Global Overview of Banana

Banana is the most important fruit crop in the world in terms of acreage and production. Among all agricultural commodities, it is the seventh largest traded commodity in the world after wheat, maize, soybean, rice, barley and sugar. Being a tropical fruit with its origin in Asia, banana is a convenient fruit for people across the world as it is affordable, nutritious and available everywhere throughout the year. Bananas are eaten in ripened form as a fruit or dessert; and raw form (known as plantains) as a vegetable is used for cooking. Globally, around 5.5 million hectares was under banana crop in TE 2017, with India alone accounting for 15% of the total area. Other top countries with high banana acreage include Brazil, Tanzania and Philippines. In terms of production, India is the largest producer of bananas contributing to more than a quarter of global production of 114 MMT during TE 2017. Despite being a leading producer of most fruits and vegetables, China accounts for 10% of the total banana production, followed by Indonesia, Brazil, Ecuador and Philippines (Fig. 4.2).

While average world productivity of banana was 21 tonnes per hectare (tn/ha) during TE 2017, India (35 tn/ha) recorded a higher yield than most of the countries including Brazil (14 tn/ha), USA (15 tn/ha), China (28 tn/ha) and Mexico (29 n/ha). Countries that recorded higher yields than India also saw significant increases in their yields in the 10 year period between TE 2007 and TE 2017 (Fig. 4.3). For example,

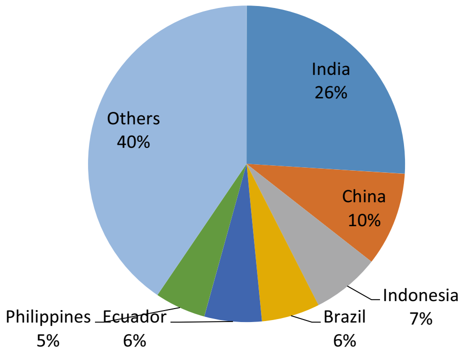

Fig. 4.2 Country-wise share of banana production (TE 2017). *Source* FAOSTAT (2019)

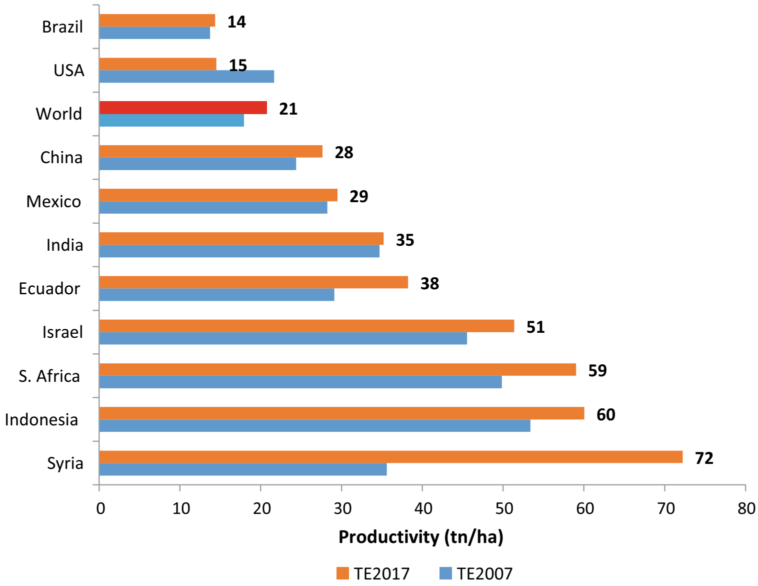

Fig. 4.3 Banana productivities in selected countries. *Source* FAOSTAT (2019)

Ecuador, which is the world's largest exporter of bananas, had much lower yields (29 tn/ha) than India whose yield levels have almost been stagnant.

Domestic Overview of Banana

Domestic production in India is dominated by Andhra Pradesh (16%), Gujarat (15%), Tamil Nadu (11%) and Maharashtra (12%) (TE 2018–19). Banana acreage is dominate by Karnataka (12%), Kerala (11%), Andhra Pradesh (10%) and Tamil Nadu

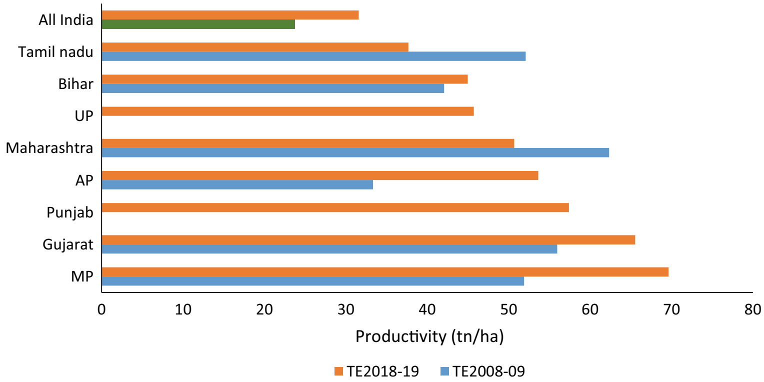

Fig. 4.4 Productivity of selected banana-producing states. *Source* DoAC&FW, NHB

(10%) (TE 2018–19). A decade back, traditional banana-producing states like Maharashtra and Tamil Nadu used to feed north, east and south India, respectively. Now due to area expansion and increase in productivity of bananas, states like UP, Bihar and Madhya Pradesh are also catering to domestic demand.

Western countries have large area under corporate plantations for bananas, and many big corporate players like Dole, Chiquita, Fyffes and Del Monte control more than 80% of the world's banana trade. However, in India, banana plantations are primarily smallholder venture. This has disabled any yield growth potential. India's banana yield recorded a positive growth during the decade of 1990s before falling for a brief period in early 2000s. The yield increase has been attributed to tissue culture technology and precision farming. While traditionally, bananas are grown using vegetative method which involves planting baby shoots growing near the stem of mother plant as seeds, in tissue culture method, a tissue of banana plant is grown artificially in a controlled environment and multiplied in laboratories before transplanting. This tissue culture method that penetrated the Indian banana cultivation practices resulted in disease free, uniform and short duration crops. The largest producing state, Andhra Pradesh, along with Gujarat and Madhya Pradesh witnessed large increases in yield levels. Madhya Pradesh (70 tn/ha) has the highest productivity for banana, followed by Gujarat, Punjab and Andhra Pradesh in TE 2018–19. Maharashtra and Tamil Nadu recorded a fall in their respective banana yields during TE 2018–19 compared to TE 2008–09 (Fig. 4.4).

Banana Trade Pattern

Banana is the largest trading fruit crop in the world with global demand of 20.6 MMT in TE 2017. However, the four largest banana-producing countries do not even feature in the top ten banana exporting countries list. Ecuador, the fifth largest banana producer, is the world leader in banana exports and accounts for 28% of global exports. India which produces more than a quarter of world banana production, exports a meagre 0.5% and ranks twentieth. Philippines, Guatemala and Costa Rica are other important banana exporting countries (Fig. 4.5). USA is the largest banana

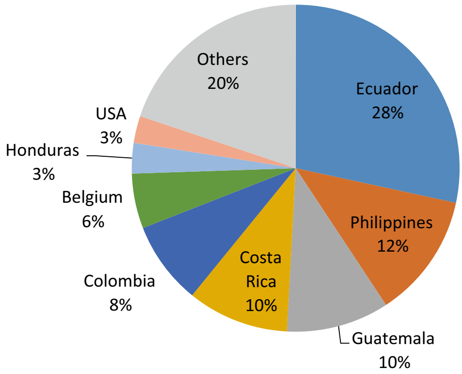

Fig. 4.5 Share in global banana exports (TE 2017). *Source* UN Comtrade Database (2019)

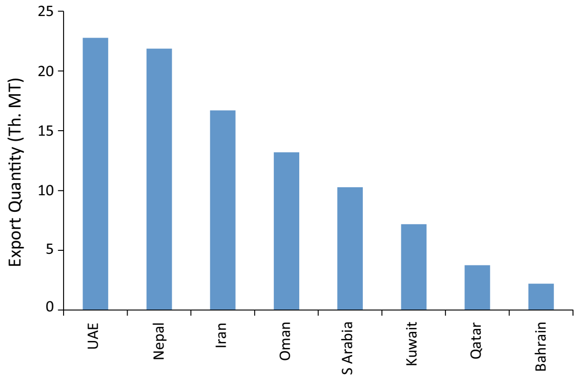

Fig. 4.6 Major export destinations for Indian bananas (TE 2017–18). *Source* APEDA (2018)

importing nation in the world with almost 42 lakhs MT of bananas imported during TE 2017, which is almost 22% of world banana imports. Other countries that import considerable quantities of banana include Germany, Russia, Belgium, UK, China and Japan, each importing (7–5%) of total banana imports (Fig. 4.6).

India exported 103,000 MT of bananas during TE 2017–18. Indian bananas are mostly exported to Middle Eastern countries and neighbouring countries like Nepal. UAE with around 23,000 MT is the largest importer of Indian bananas, followed by Nepal with 22,000 MT. While bananas are also exported to Pakistan in large numbers, the trade figures keep fluctuating because of political tensions. For example, Pakistan imported 21.7 MT of bananas in 2013–14, 7243 MT in 2014–18 and 32.4 MT in the following year. There were no imports in 2016–17, and 685.3 MT of bananas were imported in 2017–18.

Processing of Bananas

Like other fruits, bananas can be processed into a number of edible and non-edible products. Each part of a banana plant can be turned into a value-added product. Edible products that can be produced from the fruit include banana puree, paste, powder, candies, barfee, biscuits, juice and concentrate, wine, beer, chips, wafers, jams and jellies. Banana figs or dehydrated bananas are highly nutritious products which can be produced by small-scale industries. Inedible but useful products that can be produced from the pseudostem, scutcher and other parts include banana fibre, paper, bio fertilizer and vermi-compost.

Few pilot projects for banana figs ('Sustain' project by Bayer Material Science Company, Solar-dried Banana Fig by Thottiam Banana Producers Group, Tiruchirappalli and Madhur Fruits) have been started with the help of training and transfer of technology provided by National Research Centre for Banana (NRCB), an ICAR Institute in Trichy, Tamil Nadu. NRCB, along with Navsari Agricultural University, Gujarat, has also taken initiatives to utilize banana pseudostem waste for fibre extraction and production of yarn and textiles (NRCB). Anakaputhur Jute Weavers' Association (AJWA), 'Banana Star' of SSKJ Trading Pvt. Ltd., Trichy, and Tapti Valley Banana Cooperative Society, Jalgaon, have undertaken projects to utilize banana pseudostem for producing value-added products.

In India, bananas are mostly consumed as fresh fruit with very limited quantity available for value-added products. About (3 to 4)% of the total banana production is processed in India. Banana chips are the most popular form of value-added product, especially in the southern states of India. Nendran, Robusta and dwarf Cavendish varieties are the most suitable varieties for banana chips. While majority of banana chips are produced in the unorganized sector as local brands, organized sector comprises of well known brands like Haldiram's, MTR and Balaji. India has an excellent opportunity to cater to export demand for value added banana products.

4.2.2 Mango

Global Overview of Mango

The mango tree appears to have originated in Malaysia or the Indo-Burmese region (UNCTAD 2016) and reached Southeast Asia between the fifth and fourth centuries BC and then spread all over the world. There are at present more than 100 mango-producing countries with 1000's of varieties grown in different countries. Asian countries, especially India, Pakistan, Bangladesh, China, Indonesia and Thailand, account for 67% of the mango production (2017 data). India is the world's largest mango-producing country with a share of 38% of the global mango production (FAO) (Fig. 4.7).

India's mango yield at 9 tn/ha, is at par with global average (TE 2017). However, the productivity is lower than key growing countries such as Brazil (18 tn/ha) and Israel (23 tn/ha) (Fig. 4.8).

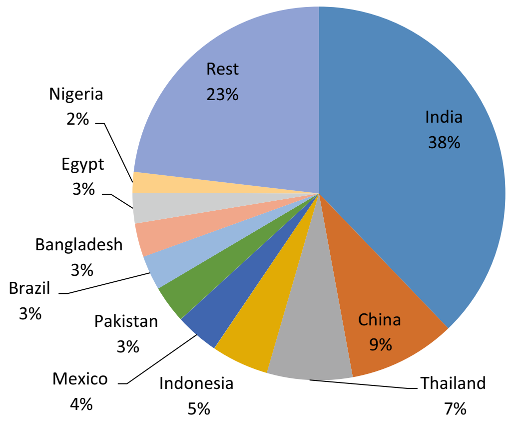

Fig. 4.7 Top mango-producing countries (2017). *Source* FAOSTAT (2019)

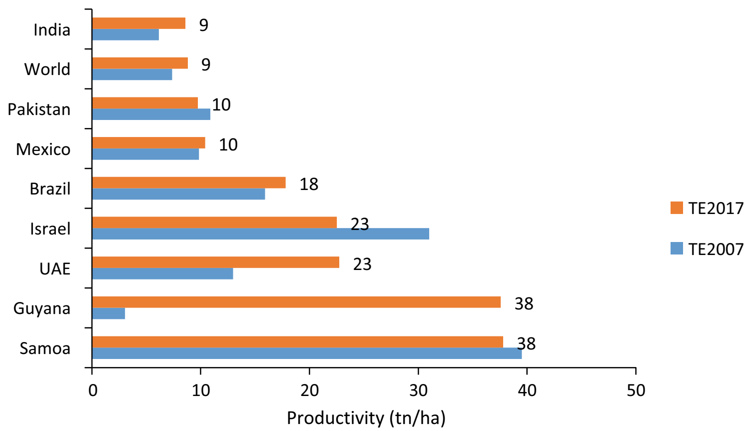

Fig. 4.8 Mango productivity in selected countries. *Source* FAOSTAT (2019)

Domestic Overview

Mango, also referred as 'king of fruit' owing to its taste and high nutritive value, is the most popular fruit in the country. Grown as both homestead and commercial farming, India has the largest variety of mango cultivars in the world. Although mangoes can grow in a wide variety of climate, it grows best in tropical and subtropical climatic conditions and needs a good amount of rain during the growth period and a dry spell during the flowering period. Table 4.1 presents the crop calendar for mangoes in different states. The peak season for mangoes in different states in India is between April to July.

Table 4.1 Harvesting pattern in the leading mango growing states

	February	March	April	May	June	July	August
AP / Telangana	•	•	✓	✓			
Gujarat			•	✓	✓	•	
Karnataka			•	✓	✓	•	
Maharashtra		•	✓	✓	•	•	
UP / Bihar				•	✓		•

✓ Peak season

• Lean season

Source: (NHB, 2017)

In terms of production, Uttar Pradesh is the largest mango producing state in India with a share of 22%, followed by Andhra Pradesh (19%), Bihar (10%), Karnataka (9%) and Telangana (6%). These top five mango producing states together contributed 66% of the total mango production in TE 2018–19 (Fig. 4.9).

However, there is a lot of variability in terms of productivity. Rajasthan has the highest yield of mangoes at 18.1 tn/ha even though it has one of the smallest area under mangoes. UP, being the largest mango producer, has second highest productivity levels at 17.1 tn/ha, followed by Punjab (16.9 tn/ha). Maharashtra, which is home to the famous Alphonso variety of mangoes, has one of the lowest yields at 3.7 tn/ha (Fig. 4.10).

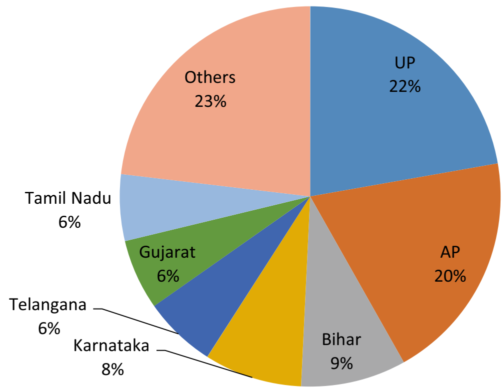

Fig. 4.9 Production (MMT) in top mango-producing states. *Source* DoAC&FW (2019)

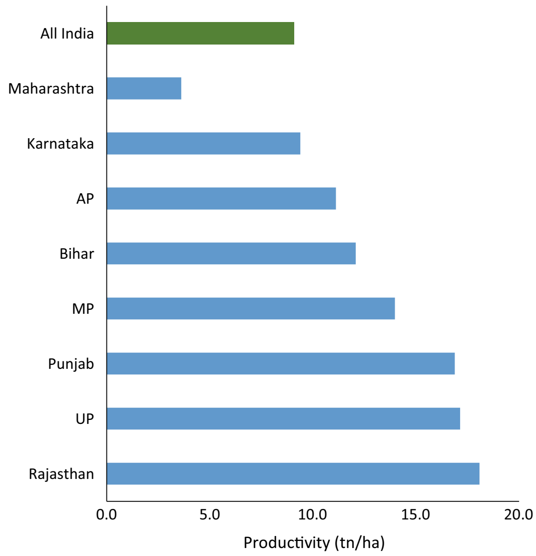

Fig. 4.10 Productivity of mango in selected states (TE 2018–19). *Source* DoAC&FW (2019)

Mango Trade Pattern

Global mango trade was virtually non-existent prior to 1960s. World demand for mango, especially in the USA, European Union (Netherlands, France, England, Portugal, Spain, Belgium, Denmark and Sweden), is increasing steadily. With the peak mango season being between April and July in India, the harvesting continues for 8–10 months in a year in Brazil, Columbia, Kenya and Venezuela. The season is also quite long in Burkina Faso, Costa Rica, Indonesia, Jamaica, Mexico, Nicaragua and Puerto Rico.

South American countries—Mexico, Puerto Rico, Dominican Republic, Brazil, etc., accounted for 39% of global trade (exports) in TE 2016. Asian countries—Thailand, Philippines, Pakistan and India accounted for 30% exports (Fig. 4.11).

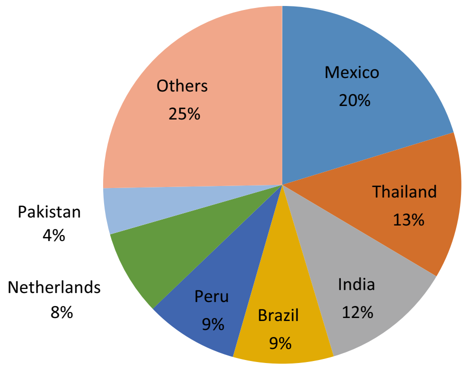

Fig. 4.11 Share in global exports (mangoes, mangosteen, guavas)—TE 2016. *Source* FAOSTAT (2019)

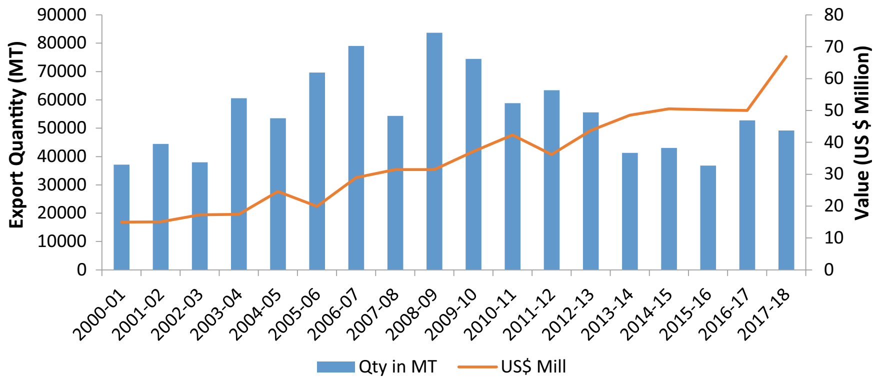

Fig. 4.12 India's mango exports (value and volume). *Source* APEDA (2018)

The USA, European Union, United Arab Emirates are the key mango-importing countries. Key globally traded mango varieties includes Tommy Atkins, Kent, Keitt, Palmer, Amélie, Irwin, Maya/Aya and Indian varieties, Alphonso, Kesar, Chausa and Totapuri.

India is also a prominent exporter of fresh mangoes and exported 46.4 thousand MT of fresh mangoes in TE 2017–18 (Fig. 4.12). Although mango exports constitute less than 1% of the total production indicating a high level of self-consumption, it has 12% share in global mango exports (TE 2016). According to Commerce Ministry officials, although variety-wise mango exports data is not available officially, the popular varieties exported are Alphonso (Maharashtra), Kesar (Gujarat and Maharashtra), Totapuri (Maharashtra, Tamil Nadu, West Bengal, Karnataka and Andhra Pradesh) and Banganapalli (AP, Maharashtra, Tamil Nadu and Karnataka). Indian mangoes are mostly exported to UAE, UK, Saudi Arabia, Qatar, Nepal and the USA.

Processing of Mangoes

Mango pulp is prepared from selected varieties like Totapuri and Kesar. Mango pulp or concentrate is used for making juices, jams, fruit cheese and various other kinds of beverages. It is used for puddings, bakery fillings and flavours for food industry. Mango puree/pulp is a smooth and thick product which is processed in such a way that the insoluble fibrous parts of the ripe mangoes are broken up. It retains all of the fruit juice and a huge portion of fibrous matter, which is found naturally in the raw fruit. Two main clusters of mango pulp industries are located in Chittoor, Andhra Pradesh, and Krishnagiri, Tamil Nadu. There are around 65 processing units with backward linkage facilities with farmers. Few processing units are located in Maharashtra and Gujarat. India is a major exporter of mango pulp, exporting to countries such as UAE, Europe, Singapore and Malaysia. India produced 3.5 LMT of mango pulp annually, around 50% of the estimated 7 LMT of global mango pulp production. India exported 1.2 LMT of pulp worth 108.3 million USD. Major players of mango pulp in India include Jain Irrigation Systems, ITC, Mother India Farms and ABC Fruits.

4.3 Competitiveness

India is the largest producer of both bananas and mangoes; however it is not a major banana exporter and has a limited presence in the global mango trade. Is it because the domestic consumption itself is high, there are quality issue or India is not competitive enough in the global market? This section will answer the above questions by analysing the competitiveness of Indian bananas and mangoes. There are two ways of looking at competitiveness—one at international level and the other at domestic level.

4.3.1 International Competitiveness

In this section, we will analyze international competitiveness for banana and mango value chains in India, by estimating Nominal Protection Coefficients (NPCs).

Banana Exports from India: Problems and Prospects

We have analysed India's position in global banana economy and compared it with other important nations in Table 4.2. It is clear that India has a dominant position in terms of both acreage and production of bananas, it even has a high productivity compared to other important banana producing countries; and it has a meagre presence in world trade of bananas. Ecuador which has around 20% of India's banana acreage is exporting almost 30% of world's banana exports. With global demand of bananas at 19 MMT worth USD 13.4 billion, India supplies only 0.4% and ranks 21 among all banana-exporting countries.

Table 4.2 Comparison of India with other banana countries (TE 2017)

	India	China	Ecuador	USA	World
Area (Th. ha)	841	396	175	0.3	5489
Rank	1	5	8	105	
Production (MMT)	30	11	7	0.004	114
Rank	1	2	5	98	
Productivity (tn/ha)	35	28	38	15	21
Rank	19	33	18	66	
Exports (Th. MT)	94	11	6153	579	22 MMT
Rank	21	50	1	8	
Imports (Th. MT)	0	1000	Neg	4195	19 MMT
Rank	–	6	131	1	

Source FAOSTAT (2019), UN Comtrade Database (2019)

A typical export chain for Indian bananas has been described in Fig. 4.13. India primarily exports Cavendish varieties of bananas via Nhava Sheva sea port, also known as JNPT (38%) and Nendran variety from Kerala via Cochin (13%), Trivandrum (12%) and Calicut (5%) airports as well as Tuticorin sea port (11%). A sizeable quantity of bananas is also exported to Nepal via land route from Nautanwa, Uttar Pradesh–Nepal border (Fig. 4.14). Banana exports to Pakistan is very volatile and are mostly traded through the barter system of trade, wherein Indian bananas are exchanged for Pakistani dry fruits.

While Europe, North America and China are major importers of bananas, their banana demand is met by Ecuador, Philippines and other major exporting countries. Europe does not prefer Indian bananas because of quality issues—heterogeneous size, black or brown spots and improper post-harvest handling. Quality issue, coupled with inadequate infrastructure like integrated pack houses for banana exports, has resulted in negligible participation of India in global banana trade. There are only three APEDA-recognized pack houses in India (APEDA 2017). The absence of sea protocol prevents India to export via sea to Europe. Since transportation through air freights make bananas costlier, India has a long way to go in exploring the promising banana markets of Europe.

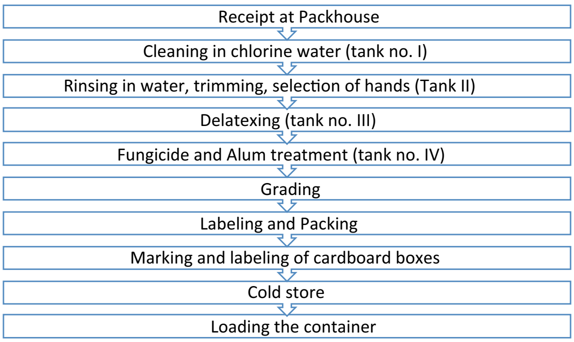

Fig. 4.13 Processes for banana exports. *Source* APEDA

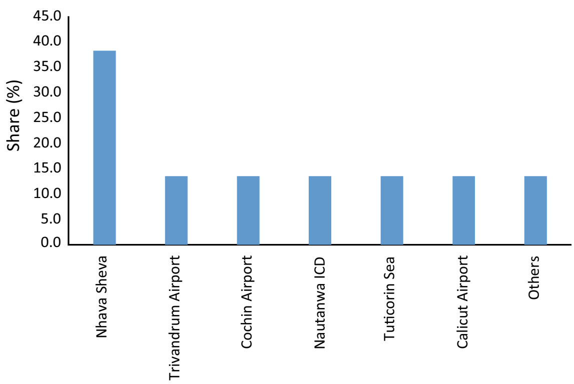

Fig. 4.14 Port-wise banana exports from India (TE 2017–18). *Source* APEDA (2018)

Nominal Protection Coefficients for Bananas

Competitiveness can be measured using Nominal Protection Coefficient (NPC), which is the ratio of average price received by the farmer and the adjusted border price. To calculate NPCs for Indian bananas, we have used the methodology adopted by (Saini and Gulati 2017) in their study on Price Distortions in Indian Agriculture, described in Sect. 1.2.

For domestic price estimation, weighted average wholesale prices for bananas have been taken from Agmarknet. Since, Cavendish variety of banana is the most traded variety in the world as well as from India, we have used wholesale prices of the states producing these varieties. We have not considered the *Nendran* variety of bananas from Kerala even though it is an important variety exported from India because they have higher prices and not comparable to Cavendish bananas in terms of price, size and quality. Unit value of banana exports from India has been taken as a proxy to the international fob prices.

Figure 4.15 shows that NPC values for banana have always remained well below 1, signifying exportability of bananas. This shows that Indian bananas have been competitive throughout the study period. In 2006–07, NPC value was very close to 1, and since then, NPC values have consistently declined. It implies that the export competitiveness of Indian bananas has been increasing. This is validated by the increasing export. Average NPC value for the entire period was 0.51 with a coefficient of variation (CV) of 0.41. Despite with a very comfortable value of NPC, India's true potential of banana exports could not be reached.

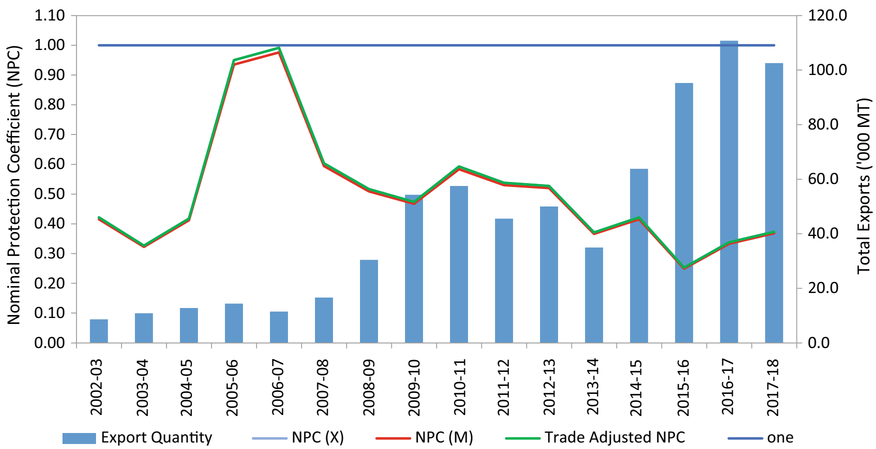

Fig. 4.15 Nominal protection coefficients for importable and exportable hypothesis for bananas. *Source* Authors' calculation using data from Agmarknet, NHB, DGFT and Field Visit

Trade Policy of Bananas

Although bananas are export competitive in the international market, Indian farmers are unable to reap benefits of this fact. They are largely small holding farms for whom access to export market are non-existent.

Whatever little exports India manages in bananas is because of steps taken by government agencies in terms of policies and infrastructural development.

India follows open export policy where banana exporters get an incentive of 7% of FOB value under the Merchandise Exports from India (MEIS) Scheme. Import duties on bananas at 30% helps control import and enables the farmers to cater to domestic demand. To promote banana exports, APEDA provides subsidies for creation of ripening chambers, reefer vehicles, pack houses and cable system of handling. There is also a provision for assistance in projects for quality development (certifications, handheld devices for traceability, water, soil and pesticides testers, laboratory upgradations) and market development (trial shipments and brand registrations).

Mango Exports from India: Problems and Prospects

India exports mangoes to around 60 countries. However, the major export destinations for Indian mangoes are United Arab Emirates, United Kingdom, Nepal, Saudi Arabia, Qatar and the USA. Japan and South Korea are new markets for Indian mangoes. Mango exports to the USA, Europe, Japan and South Korea are sourced from APEDA-approved pack houses. All consignments to EU, South Korea and Japan have to undergo hot-water treatment (HWT) or vapour heat treatment (VHT). South Korean government annually deputes Quarantine Inspectors to India for verification of mango consignments which undergo HWT or VHT.

As per norms agreed upon between India and USA, all the mangoes to be shipped have to undergo irradiation process at the Maharashtra State Agricultural Marketing Board facility at Vashi (Mumbai) and Lasalgaon. An official from USDA takes a sample of the mangoes for testing at the irradiation facility. Irradiation is mandatory for the mango exports to USA as the process eliminates pests like stone wheeler and fruit flies.

According to a leading exporter, Indian mangoes are mostly consumed by Asian origin population in the USA. The distinct feature of Indian mango is that it is ‘thin-skinned’ and has a flavour, while imported mangoes from Mexico and other countries are ‘thick-skinned’ without much flavour. During our interaction with exporters, we found out that Indian mangoes have a maximum shelf life of around 28 days, while it takes about 20 days to transport mangoes from India to USA through sea route. According to APEDA officials, sea protocol has not been formulated yet because of less shelf life of mangoes. As all the consignments of mangoes are transferred through air, air-freight costs are high compared to mangoes imported from South American countries to USA. For mango exports to Europe, mangoes are put through hot-water treatment and vapour treatment. For shipment to South Korea, its mandatory to conduct a pest risk analysis. APEDA has mandated the mango growers registered with it to adopt global Good Agricultural Practices (GAP) norms for ensuring quality produce. Increasingly, consumers across the globe are demanding food products sourced from GAP-affiliated farmers. GAP prescribes specific cultivation method for maintaining health of the fruit plant as well as ensures rational use of nutrients.

Nominal Protection Coefficients for Mangoes

Although Gujarat and Maharashtra has only 6.4% and 3.1% share in India's mango production, respectively (TE 2017–18), they are popular for the 'Alphonso' variety of mangoes, which is globally known for its taste, fragrance and vibrant colour. We have used prices of Alphonso mango from Ratnagiri (Maharashtra) and Navsari (Gujarat). Transportation cost from Ratnagiri and Navsari to JNPT have been calculated as a weighted average cost using production ratios. Trading margins, port handling charges and international reference prices (derived from unit value of exports), estimated under the exportable and importable hypotheses. Interaction with exporters and traders reveals that the trading or marketing margins are 10% of the domestic price because of perishable nature of the commodity as well as seasonality of the mango crop.

The NPC numbers in Fig. 4.16 clearly indicates that India's mango exports have been competitive only during five years between 2002–03 and 2017–18. EU in 2014 had banned Alphonso mangoes, brinjal, taro, bitter gourd and snake gourd imports from India as pests including fruit flies were found in some of the consignments. The ban was for the period from 1 May 2014 to December 2015. However, EU lifted the export ban on mangoes, earlier than planned.

The mangoes exported from India to the USA, European Union, Japan, etc., are sent through air route, thus making them costlier than mangoes sourced from countries like Mexico, Ecuador or Philippines. Often the cost of air freight is more than the farm gate price of mangoes. Thus, India cannot compete in USA and EU markets because of high air freight cost. However, India can promote mangoes in USA, EU, Japan and Korea where purchasing power of consumers is higher than

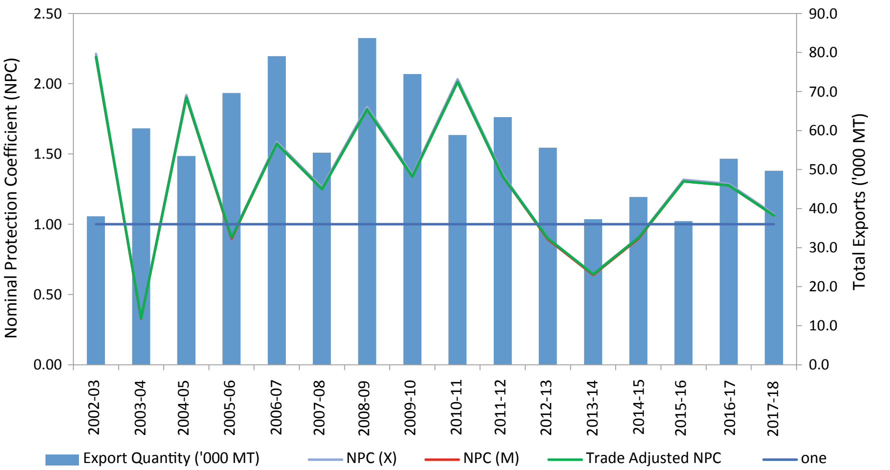

Fig. 4.16 Nominal protection coefficient for mangoes. *Source* Authors' calculations

Middle East countries to promote the unique flavour, colour and taste of Indian mangoes abroad.

4.3.2 *Domestic Price Formation*

Banana Domestic Value Chain
Bananas are produced in India throughout the year in almost all major states, unlike grapes and pomegranates that are concentrated only in Maharashtra. However, most of the produce is consumed well within India.

In India, Andhra Pradesh, Gujarat, Tamil Nadu and Maharashtra are the four largest banana-producing states that supply bananas all over India. For years, Maharashtra and Gujarat held a dominant position in banana trade, supplying most of the bananas to north India. A horticulture special train that started in 2012 used to transport bananas from Jalgaon to Azadpur *mandi* in Delhi. From there on, bananas were loaded on to trucks and supplied to various other states in north India.

The train however was suspended in 2016 because of changes in trading pattern, better road and highway connectivity, emergence of other major banana-producing regions (like Andhra Pradesh, Uttar Pradesh and Madhya Pradesh), and long duration and high costs associated with transporting via train. Further, there were hassles of transporting, loading and unloading bananas from truck to train and again from train to trucks during the arrival at the destination. Since other north Indian markets started receiving bananas via trucks directly from Jalgaon, Delhi market could not absorb the high arrivals, and hence, the train services stopped.

Jalgaon (part of the productive and irrigated region of Khandesh) supplies more than 50% of its bananas to Delhi. Rest are sent to other northern and western states of India like Himachal, Punjab, Uttar Pradesh, Madhya Pradesh and within Maharashtra. Jalgaon is also known as the ‘Banana city’ of India because of its large banana production, contributing about 50% of the total state production of Maharashtra. The presence of many small and major rivers from the Satpura range like Tapi has made Jalgaon very favourable for banana cultivation. Apart from this, Jain Irrigation (JISL) has developed and provided drip irrigation, sprinkler technologies and most importantly the tissue culture technology to the farmers that catalyzed a banana revolution in India.

Even though banana can be cultivated throughout the year, the peak harvesting months for bananas in Jalgaon has been observed to be June–July. During this time, prices are very low as mango arrivals are also at peak during this time.

Unlike vegetable marketing at *mandi* premises, bananas are traded directly from the farms by post-harvest contractors, commission agents or directly by traders. Sorting, weighing, washing and packing are all done at the farm level itself before loading on to trucks. Nowadays, box packing is preferred over traditional way of transporting loose bunches of bananas. This has considerably improved the quality of bananas and also reduced wastages. The price in Jalgaon is based on the prices displayed at Yawal APMC *mandi* board. The price for a day is decided the evening before at 5 pm based on price prevailing in nearby Burhanpur *mandi* of Madhya Pradesh (where open auction for bananas takes place), traders in big *mandies* like Delhi, Andhra, Karnataka and actual demand position of Jalgaon. Farmers in Jalgaon claimed that the price received by them is far less than the *mandi* price. A farmer's role in marketing ends once the bananas are sold at farm gates.

Efficiency of Domestic Banana Value Chain

For our analysis of farmer's share in consumer rupee, we have considered Jalgaon to be the production centre and Delhi as the consumption centre for bananas. During TE 2017–18, arrival of bananas at Azadpur *mandi* was around 75,000 MT. Delhi primarily sources its bananas from Maharashtra (Khandesh), Uttar Pradesh, Andhra Pradesh, Gujarat and Madhya Pradesh. According to Fig. 4.17, Uttar Pradesh is the main supplier during the months of September to November and Andhra Pradesh during February to April. Maharashtra is the major supplier of bananas to Delhi throughout the year except September and October.

For farmer's price, we have considered the average of wholesale prices prevailing in Jalgaon and Burhanpur for *Khandesh* variety of bananas from Agmarknet. The wholesale price for Delhi was also taken for *Khandesh* variety of bananas from Agmarknet. Retail price for Delhi was taken from National Horticulture Board (NHB). For all the above, average of 3 years prices have been taken (2015–16 to 2017–18). Data for costs of other intermediaries were collected during interactions at the time of field visit; details for which are in Annexure 4.1.

As shown in Fig. 4.18, farmer's share in consumer rupee is estimated at 35.5%. The mark-ups for other intermediaries are 29.6%, 16.3% and 18.6% for trader, wholesaler and retailer, respectively.

All intermediaries incurs their share of cost. While, trader has to pay transportation cost of bananas from Jalgaon to Delhi which is a major cost incurred, wholesaler has to bear the cost of labour, ripening and transportation from *mandi*. However, as bananas are sold by retailers to consumers mostly on carts, they face the cost of perishability. During festivals, due to high demand for bananas, prices tend to increase. However, this is not due to low supply, but rather an artificial increase in prices by retailers.

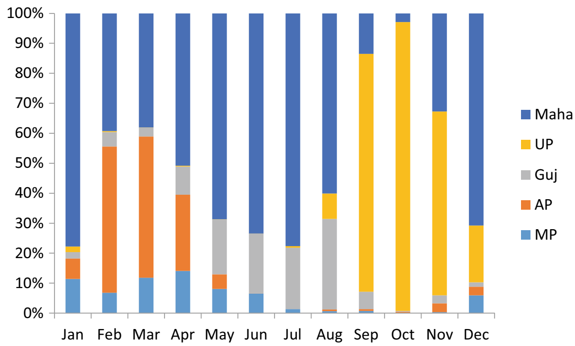

Fig. 4.17 Source-wise banana arrivals to Azadpur, Delhi (TE 2017–18). *Source* Authors' calculations using data from Azadpur APMC office

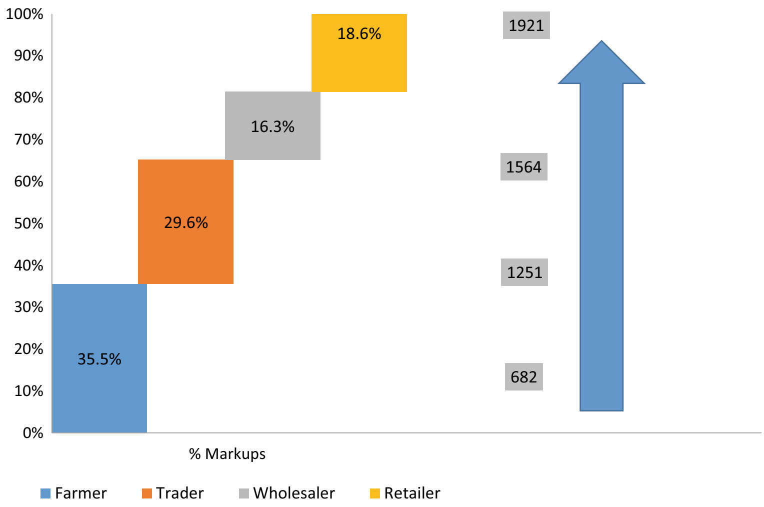

Fig. 4.18 Mark-ups for banana value chain (Jalgaon to Delhi). *Source* Authors' calculations using data from Agmarknet, NHB and Field visit

Banana Processing Value Chain

Bananas can be processed to banana puree, banana concentrates and banana puree-based ready-to-have beverages. While puree is prepared by mashing the banana pulp, without adding any additives, concentrate is prepared after evaporating the water from the puree. Concentrates are generally exported for B2B trade to reduce transportation cost.

In India, bananas are directly procured from traders or farmers at prevailing market rate. The following is the flow for banana processing:

$$
\begin{aligned}
&\text{Fresh fruit from fields} \rightarrow \text{Sorting}\\
&\quad \rightarrow \text{Ripening chamber}(4\text{ days}, 18\,^{\circ}\text{C}) \rightarrow \text{Wash}\\
&\quad \rightarrow \text{Peeling and Puree Extraction} \rightarrow \text{Final Product}
\end{aligned}
$$

Banana puree prices have declined over the years from USD 850/tonne in 1995 to USD 500/tonne, because of competition as bananas are now available at throw away prices. As per Jain Irrigation officials, processing of bananas is viable only when prices are less or equal to INR 6/kg. Beyond this price, bananas are not processed and the facilities at processing plants are used to process other fruits and vegetables.

Domestic Mango Value Chain

A typical mango value chain model is depicted in Fig. 4.19. The first stakeholder in the mango value chain is the pre-harvest contractor (PHC) who enters into a contract with a farmer around four months prior to the harvest season, based on the flowering of the trees. The PHC enters into contracts with several farmers for

Fig. 4.19 Traditional value chain for fresh mangoes

achieving economies of scale by being an aggregator. With this, farmers transfer their production and marketing risk to the PHC. During our interaction with farmers in Maharashtra as well as in Uttar Pradesh, it has been found that farmers do not market their products directly.

In the next step, PHC transports the harvested mangoes to the wholesale markets (APMCs) in big cities or consumption centres. These markets or *mandis* where commission agents are registered with APMCs buy the mango consignment from PHC. The commission agent also provides facilities for sorting and grading and overseeing of auctions. Lastly, retailers—small vendors or neighbourhood retailers sell the fruits to consumers after buying from the commission agents. Although small vendor and neighbourhood markets are still the main outlet for fruits and vegetables, there are several organized retailers or supermarkets which are expanding their base.

Mangoes going for exports do not follow this value chain. The exporters registered with APEDA purchase from the farmers and export after following requisite phytosanitary norms. The APMC *mandis* and PHCs are not involved as exporters directly purchase the mangoes from the farmers to ensure the quality standard.

Efficiency of Mango Value Chain

For studying the efficiency of the domestic value chain, we have considered Malihabad, Lucknow district, as key mango producing region and Delhi as a major consumption region. Uttar Pradesh is the country's biggest mango producer, and Lucknow is a key mango-growing region. We have taken the prices of 'Dasheri' variety of mango as it is the most popular variety consumed in the domestic market. The wholesale price of 'Dasheri' mango variety for Lucknow is sourced from Agmarknet, while the retail prices of Delhi are taken from National Horticulture Board. All the prices are taken for the peak mango season (April–June) for TE 2017–18. For arriving at mark-ups for all the stakeholders in the value chain, *mandi* fee and official commission charges have been taken from Malihabad as well as Azadpur *mandis*. Other expenses such as packing and loading charges, cost of transportation, wholesalers and retail margins are based on our interactions with *mandi* officials, traders as well as retailers in Uttar Pradesh and Delhi.

It clearly indicates that India's domestic mango value chain is inefficient as only about 20% of the consumer rupee spend on mangoes goes back to farmers (Fig. 4.20). The multiple retail channels including wholesalers as well as small vendors get a major share of consumer rupee. Mango being highly perishable, retailers take the risk of high wastage in the absence of adequate storage infrastructure.

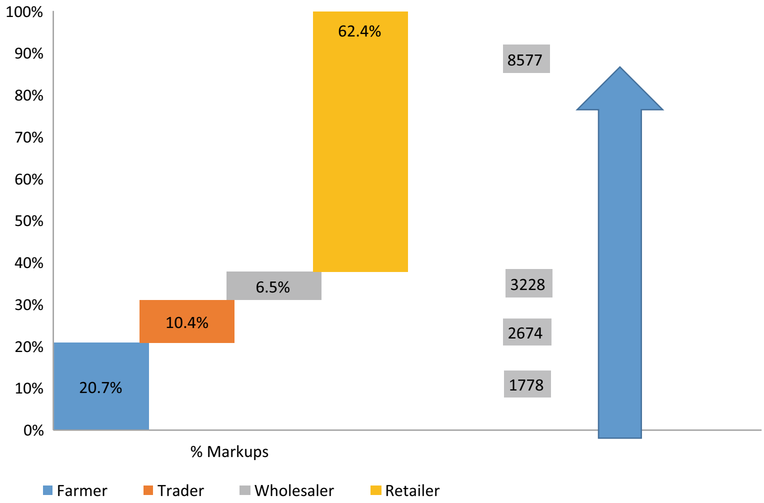

Fig. 4.20 Markups for mango value chain. *Source* Authors' calculations

4.4 Inclusiveness

This section examines the extent of small farmers' participation in the banana and mango value chain. The inclusiveness is measured in terms of farmers' participation in the production and marketing process.

4.4.1 Inclusiveness in Production

India is predominantly a smallholder economy as 86.1% of its farmers are small and marginal, operating on less than 2 hectares of land, according to the latest Agriculture Census Report 2015–16. While they hold just 46.9% of the total operated area in India, large farmers with just 0.6% share hold 9.1% of the land.

Horticulture production is mainly driven by small and marginal farmers, because of the short duration of the crop, high labour intensive operations, and higher profitability. According to Agriculture Census of 2015–16, a major share of farmers growing banana and mango in the country are 'small and marginal'. This implies that out of close to 20.4 lakhs banana growers and around 58 lakhs mango farmers, 86.2% and 93.5%, respectively, belong to 'small and marginal' category (Tables 4.3 and 4.4).

In Andhra Pradesh, which is the largest banana-producing state, 86.8% banana farmers are small and marginal and only 0.2% of them are large farmers. Maharashtra on the other hand, has 69.2% small and marginal farmers and another 21.4% semi-medium. Even the largest banana (Jalgaon) and mango (Chittoor)-growing districts

Table 4.3 Share of different farm sizes for banana

	Small and marginal	Semi-medium	Medium	Large	All classes
India	86.2	9.3	4.0	0.5	100
Tamil Nadu	87.2	9.1	3.3	0.4	100
Andhra Pradesh	86.8	10.0	3.0	0.2	100
Maharashtra	69.2	21.4	8.6	0.8	100
Jalgaon	69.4	22.0	7.8	0.3	100

Source: DoAC&FW (2020) Agricultural Census, 2015–16

Table 4.4 Share of different farm sizes for Mango

	Small and marginal	Semi-medium	Medium	Large	All classes
India	93.5	4.4	1.8	0.2	100
Uttar Pradesh	88.4	8.3	3.3	0.1	100
Andhra Pradesh	80.2	14.2	5.0	0.5	100
Maharashtra	68.9	18.0	10.9	2.2	100
Chittoor	78.6	16.2	4.8	0.4	100

Source DoAC&FW (2020) Agricultural Census, 2015–16

in the country have majority of farmers belonging to small and marginal category. This indicates that banana and mango cultivation is inclusive in nature.

While banana crop provides income throughout the year, mango is a seasonal crop with April–July as the peak season. Farmers continue to grow perishable fruits like banana and mango despite fluctuations in prices. Interaction with farmers as well as experts indicated, that small farmers still opt for horticultural crops as returns are far more than growing cereals. Increase in incomes, urbanization and rising consumption of fruits and vegetables have contributed to sustained demand for fruits and vegetables.

4.4.2 Inclusiveness in Marketing

Smallholders have inadequate farming and extension services and low level of technology adoption, and they lack capital and have poor business skills resulting in lower income. However, forming of farmer collectives like FPOs can be a good deal for small and marginal farmers. Not only cost of production can be reduced due to bulk procurement of necessary inputs, but also marketing cost can be reduced due to bulk transportation to markets. (NABARD 2017). NABARD supported creation of around 4000 FPOs across the country at the end of FY'18 of which over 2000 are registered entities actively doing business in agricultural activities. As many as 507 FPOs are engaged in bulk input procurement and distribution, while 223 FPOs are involved in aggregation and marketing of fruits and vegetables (NABARD press note, July 2018) NABARD provides grant support to existing FPOs towards capacity building, market linkages, etc., along with the credit support of business development. The central government also plans to create 10,000 FPOs by 2024.

Status of FPOs

According to NABARD, FPOs are farmers' collectives, with membership mainly comprising small or marginal farmers (around 70–80%). Majority of these FPOs are in the nascent stage of their operations with shareholder membership ranging from 100 to over 1000 farmers and require not only technical handholding support but also adequate capital and infrastructure facilities including market linkages for sustaining their business operations.

The Small Farmers' Agribusiness Consortium (SFAC), under MoAC&FW, also promotes formation of FPOs for ensuring that smallholders have stake in marketing of their produce. Out of the total 897 FPOs supported by SFAC, only 38 are related to banana and mango. These FPOs are located mostly in Karnataka, Tamil Nadu, Uttar Pradesh, West Bengal and Madhya Pradesh.[1]

During our field visits in Jalgaon, Maharashtra, we interacted with a number of FPOs who are engaged in marketing of banana and other agricultural produce. Out of total 41 FPOs in Jalgaon district as per records, only 14 FPOs were operational and only few of them were functioning with business plans. We identified three kinds of FPOs, *visionary FPOs,* which work like a proper company with a business plan in mind and not dependent on government subsidies and provide good-quality planting and fertigation to member farmers, ensuring quality produce; *non-visionary FPOs* which were established through Government of India or World Bank funds, facilities like ripening chambers with help of ATMA scheme, MIDH schemes and shares of member farmers. Then, there are *dysfunctional FPOs* most of which were established to avail government subsidies and are not functional any more.

For ensuring that smallholders have control over the marketing channels, agencies such as NABARD, SFAC and state governments must play a pro-active role in promoting FPOs and strengthening the dysfunctional FPOs. There is a huge opportunity for creation of FPOs dedicated to banana and mango plantation and the focus should be on imparting marketing skill so that FPOs are run professionally.

Currently, traders buy bananas directly from the farms. The bananas are sorted, weighed, washed, packed in cardboard boxes (16 kg) and loaded on trucks at the farm itself. Our interactions with agents who buy banana at the farm gate in Jalgaon as well as traders in Azadpur *mandi* in Delhi reveal that farmers' role in marketing ends once the produce (in this case banana and mango) is sold at the farm gates. This deprives the farmers in playing active role in price discovery.

In case of mangoes, there have been some attempts to create an electronic platform in Lucknow. The E-network platform, an online marketplace which connects consumer with farmer, removing middlemen, reducing farm-to-table time and most importantly, ensuring fresh produce reaches consumers (http://mangifera.res.in/e_market.php). However, our research reveals that such marketing networks have been

[1] http://www.sfacindia.com.

limited in their outreach so far. In case of mango trade, the pre-harvest contractor (PHC) continues to play critical role in marketing thus limiting farmers' direct interface with the markets.

Exporters of mangoes and bananas enter into buy back agreement prior to the harvesting season. However because of phyto-sanitary norms insisted by many importing countries, the exporters also provide agricultural inputs and advisory for ensuring quality produce. With majority of banana and mango growers being small and marginal, there is a minimal or often no post-harvest management infrastructure available at farm level. Small farmers find it expensive to access any post-harvest infrastructure facility, leading to high wastage and deterioration of quality, ultimately resulting in lower price yields. This necessitates expanding the role of farmer co-operatives or FPOs to create post-harvest infrastructure directly accessible to the farmers.

Producers Organizations Promoting Institutions (POPI)
NABARD has been encouraging formation of Farmer Producer Organizations promoted by Producers Organizations Promoting Institutions (POPI). Any legal entity such as an NGO, bank, government department, co-operative society, association or federation can become POPI. A POPI has to ensure that requisite technical and managerial capabilities are transferred to members of the FPOs so that they are able to work with an independent and sustainable business model.

Financial support is available to POPIs through SFAC and NABARD. NABARD provides financial support to the FPOs through Producers Organisation Development Fund based on project cost with a ceiling of 20% grant (NABKISAN).

4.4.3 Promotion of Small Scale Industries

A large number of value-added products can be manufactured from banana fruit, pseudostem and other waste products from banana cultivation in small-scale cottage industries. Setting up of these industries helps small farmers to get additional return for the waste or by products of banana tree. This also provides significant employment opportunities for landless agricultural labourers. The government must provide thrust on extending credit for setting up of these industries. Jalgaon has a large number of small units of banana chips, but the chips are not of a good quality. The traditional frying pans should be replaced with oil sprays like the ones used at big wafer making companies. Quality standardization with branding can help farmers and processors earn higher prices. Loans should be made available for machinery infrastructure and marketing of value added products.

4.5 Sustainability

In this section, we evaluate the financial and environmental sustainability of banana and mango value chain models.

4.5.1 Financial Sustainability

Financial sustainability is achieved when the net returns from a particular business is larger than the net costs. Similarly, farmers will be financially sustainable if the prices they receive for their produce are higher than the costs incurred, and they are compensated for the fixed as well as variable costs.

Financial Sustainability of Banana Value Chain

Banana being a cash crop because of its high value has been a lucrative option for farmers. This is especially true for Jalgaon, which is a hub for banana production because of the climate and geographical location. With advancement in technology, especially tissue culture and precision farming, banana farmers have been able to increase the yield levels significantly. While the national average of banana yield is 35 tn/ha, Jalgaon farmers grow 80 tonnes of bananas in one hectare. The presence of Jain Irrigation Systems Limited (JISL), which pioneered banana tissue culture in India along with their drip irrigation technology proved to be a boon for banana farmers of Jalgaon.

Tissue culture technology has helped reduce the planting to harvesting period from about 18 months to (9.5–11) months as the roots get developed in the laboratory and sent for primary and secondary hardening in nurseries in a controlled environment (greenhouses). Over time, as JISL tissue culture plants started spreading to other parts of the country, and with better road connectivity, Jalgaon's monopoly started diminishing. Jalgaon is now facing a stiff competition from other major banana-producing regions.

In order to be competitive, there have been several changes in the way bananas are cultivated and traded. Banana cultivation is done under high density with 6ft x 5ft spacing between each plant on a raised bed. Raising the bed helps in better utilization of water, fertilizer and helps in draining excess water. Mulching helps in avoiding excess water reaching the roots, especially during rainy season. Farmer receive 50% subsidy for drip irrigation technologies as well as rotavators. To make things more mechanized, there are mobile apps for controlling the timing of drip. A sapling of tissue culture banana is sold for INR 14, of which INR 4 needs to be paid at the time of purchase, and the rest INR 10 is paid after planting.

Unlike vegetables, especially tomatoes, onions and potatoes (TOP), where price stability has been a major concern and farmers are forced to throw their produce on roads, banana farmers have not faced such a situation.

Benefit–cost ratio has been evaluated for banana farmers in Jalgaon. For this, cost of cultivation data for Grand Nain variety was used from a study done by Banana

Table 4.5 Cost and returns for Jalgaon banana farmers (TE 2018–19)

S. No	Item	Cost/Price
1	Cost of production of grand nain (INR/ha)	262,532
2	Yield of grand nain at Jalgaon (q/ha)	800
3	Cost of production (INR/q)	328
4	Overhead Cost (INR/q)	100
5	Total Cost incurred by the farmer (1 + 2) (INR/q)	428
6	Price received by farmer (INR./q)	682
7	Returns earned by the farmer (INR/q)	254
8	Benefit–cost ratio (B:C Ratio)	1.6

Source Shaikh et al. (2016), Agmarknet, Field Visit

Research Centre at Jalgaon, which is INR 2,62,531 per hectare. Now using yield level of 80 tn/ha for Grand Nain variety in Jalgaon and average price data for TE 2018–19 for peak harvesting months from Agmarknet, we calculate the net returns of farmers. Farmers on an average earned about INR 254 per quintal. The benefit–cost ratio comes out to 1.6, indicating banana cultivation is profitable (Table 4.5).

Financial Sustainability of Mango Value Chain

In this section, we calculate the cost of the cultivation of mango to assess the financial sustainability of the value chain.

Usually, farmers take up planting of orchards after early monsoon rains in late June or early July, as trees planted during this season sustain well with higher survival rates. On an average, around 100 trees are accommodated in a hectare, using traditional spacing practice. Mango tree starts giving fruit from 5th year onwards. Following our interaction with mango growers in Maharashtra and officers at Indian Institute of Horticultural Research (IIHR), affiliated to Indian Council for Agricultural Research (ICAR), we calculated the cost of production and return accrued to farmers.

Table 4.6 clearly indicates that if mango orchard is well maintained and the grower undertakes self-marketing, mango cultivation is highly economical and viable. The study by IIHR states that on an average, commercial cultivation of mango yields an annual return of 2.38 on investments in orchards (Sudha Mysore 2016). The cost of cultivation has been estimated for orchard growing Totapuri variety of mango, which is widely used in the processing industry.

As the mango trees start giving fruits after five years of plantation, the farmers incur various costs including physical establishment of orchard, planting of sapling, land preparation, manure application, farm yard manure, inter-cropping operations, etc., for four years. For inter-cropping purposes, farmers take up leguminous crops like gram, cereals like wheat or oilseeds like mustard or sesame or groundnut, etc.

Kesar is a premium variety of mango whose demand has been rising globally as well as in the domestic market. Table 4.7 indicates that commercial cultivation of Kesar fetched 2.25 returns on investment, thus making it a highly profitable proposition. The estimates were arrived at after extensive interactions with farmers and

Table 4.6 Average annual returns on mango orchard (INR/ha), Karnataka

Cultivation cost	Value (INR/ha)	Per cent of total cost
Material inputs: farm yard manure, fertilizer, pesticides	15,325	39.02
Labour	6240	15.89
Total operating cost	21,565	54.37
10% interest on working capital	2156	5.43
Total cultivation cost	23,721	59.80
Marketing cost: transportation (avg. distance of 100 km) and commission at INR 0.3/kg	6580	16.59
Rent on land	8000	20.17
Establishment cost	1361	3.43
Total cost of production	39,662	100
Average yield	12,600	
Average price (INR/kg)[a]	7.5	
Gross returns (INR)	94,500	
Net return (INR)	54,838	
Cost-benefit ratio	2.38	

[a]Totapuri variety, orchard age is in the range of 10–12 years. Orchard is self-maintained and marketed
Source Authors' calculation using data from field visit and (Sudha Mysore 2016)

Table 4.7 Cost of cultivation and returns for Maharashtra mango (Kesar) farmers INR/quintal

Item	Cost/Price (INR/q)
Cost of production	3630
Overhead cost	1250
Total cost	4880
Price received by farmer	11,000
Returns earned by the farmer	6120
Benefit cost ratio (B:C Ratio)	2.25

Source Based on interaction with farmers from Jalna district, Maharashtra and district agriculture officials, all data are from 2018 when farmers got around INR 110 per kg for Kesar mango

officials of the agriculture department in Jalna, Maharashtra. However, mango cultivation is seasonal activity as India's peak mango season is during April–June. Thus, the farmers need to have robust inter-cropping system for ensuring sustained income from agriculture.

4.5.2 Environmental Sustainability

Water Usage

Banana is a water-loving crop and needs timely irrigation, almost 70 to 75 times with per annum water intake estimated to be 1800–2000 mm. Irrigation has to be provided every 7 to 8 days during winter, every 4–5 days during summer and as required during the rainy season (NHB). As banana crops have shallow roots, they cannot hold water. Hence, in addition to irrigation, banana crops also need a proper drainage system. If banana is cultivated using drip irrigation technology, it will not only increase productivity by about 52%, but will also save up to 45% water (NHB, 2017). An efficient irrigation system along with sustainable use of fertilizers enables fertigation technique to be used.

Almost entire Jalgaon region is under drip irrigation for banana cultivation. JISL-developed drip irrigation and sprinklers are greatly benefitting banana plants, especially tissue-cultured plants. Jalgaon itself is not a drought prone area as it has many small and major rivers like Tapi. There is also no report of any water table depletion in the area.

For efficient use of water, drip irrigation is a must. If done on a raised bed, it will further help in draining out the excess water and in better utilization of fertilizers.

In case of mango, which can be grown under various climatic conditions, the fruit is well adapted to tropical and subtropical climate. The mango plantation needs adequate quantity of rain during their growth period (June to October) and a dry spell during the flowering period (November). Mango grows well in the region when there is rainfall of 750–2500 mm during June to September followed by eight months of dry season. In zones receiving less than 750 mm per year, the orchards must be irrigated (UNCTAD 2016). In India, majority of mango plantation is rain fed with conventional spacing of 10 m × 10 m (Gunjate 2006). However, High Density Planting (HDP) is being adopted for new plantings with use of drip irrigation. HDP is a method of mango cultivation which involves planting of tree densely, allowing small or dwarf trees with modified canopy for better light interception and distribution and ease of mechanized field operations. HDP gives higher yield as well as better financial returns.

Under conventional irrigation systems, weekly irrigation is essential (Table 4.8). With micro irrigation, the requirement is restricted to one-third of the water required for conventional method. Fertigation (application of fertilizers with drip irrigation)

Table 4.8 Irrigation requirement for mango plant

Age of the plant (in years)	Irrigation
1	Interval of 2–3 days during dry season
2–5	Interval of 4–5 days
5–8/Fruit set to maturity	Every 10–15 days
Full bearing stage	2–3 irrigations after fruiting

Source NHB

in mango is being promoted to get higher nutrient and irrigation use efficiency. The number of irrigation varies according to soil, age of mango tree and climatic factors such as rainfall and its distribution. During monsoon months, no irrigation is needed.

Mango plants are irrigated using basin irrigation. Use of drip technology, however, reduces considerable water and also helps in fertigation of root zones of the plants.

Fertilizers and Pesticides Usage

Few decades back, banana was the only fruit which did not require any pesticide. Banana is still one of the safest fruits for consumption. However, according to Banana Link, since Cavendish is the single most traded variety in the world, it has become prone to pests, fungi and diseases. Due to this, large quantities of insecticides and pesticides have to be sprayed on the plants. Given that Cavendish bananas are thick-skinned, higher number of sprays are required. There is a great danger when the pests and disease become resistant to chemicals requiring stronger and more harmful pesticides.

High dosage of fertilizers and pesticides has adverse impact on the environment affecting the soil, water, animals and human all at the same time. Farmers should avoid using banned pesticides and only use permitted pesticides that too in a time-bound manner and as per the dosage recommended. Pesticides are usually applied a month after harvesting is done.

Mango, since last many decades has been grown as a crop with least management efforts and without inputs like irrigation, fertigation, etc., resulting in low productivity. As it is a seasonal fruit, farmers' focus has been other crops like pulses and oilseeds. There are several insects which also impact the mango plants such as shoot borer, stem borer, stone weevil, leaf webber, etc. As stated earlier, because of inter-cropping system, mango trees are not hugely impacted by pest attack. Farmers in Maharashtra use fungicides (only twice in a season) prior to fruit bearing stage, if required.

Organic Waste Management for Banana Pseudostem

There is a very high potential for converting waste material of bananapseudo stem into value-added products. The amount of waste produced by banana cultivation is very high compared to other fruit crops, as the stems of banana plant have to be removed before next or alternate year planting. Approximately, 70–80 MT per hectare of waste is generated from this stem removal. Farmers usually throw away these wastes and burn them when dry. This not only pollutes the environment, but also poses additional costs to the farmers without any gain.

If these pseudostems are converted to value-added products, it is not only economically beneficial for the farmer, but also benefits the economy as a whole. A pseudostem has three parts: central core, fibre and waste (Fig. 4.21). Various edible items like candies, pickles, vegetables, soft drinks can be produced from the central core. The juice from the central core is rich in Vitamin A and Vitamin B6. Waste part

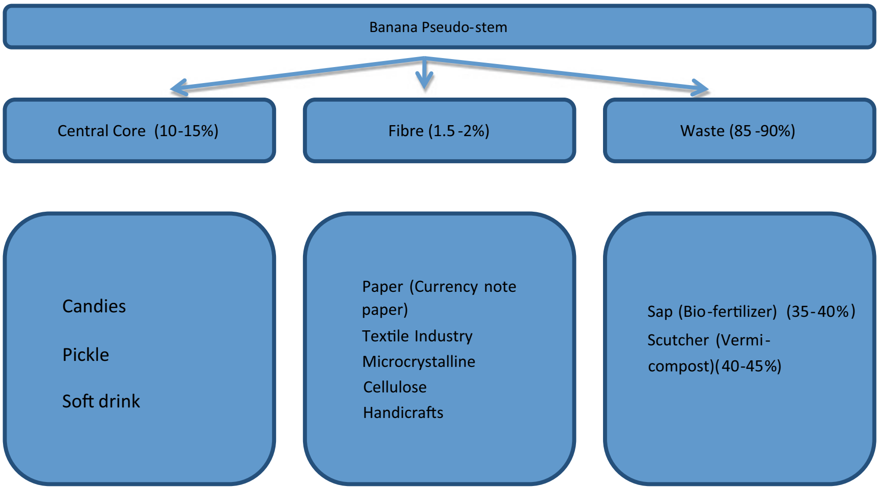

Fig. 4.21 List of value-added products from banana pseudo stem. *Source* Field visit to Tapti Valley Banana Co-operative Society and (RKVY)

which is about 85–90% of the pseudostem can be converted to useful fertilizers and manures. While bio-fertilizers can be prepared from the liquid sap that is extracted from the waste, vermi-compost can be prepared using scutcher. The most important by-product of this waste is fibre which can be used for making paper currency, textile and handicrafts. In fact, textile industry can benefit to a great extent from banana fibre as unlike other natural fibres these are prepared from a complete waste product and can substitute highly water intensive cotton. This way, each and every part of the pseudostem is well utilized.

4.6 Scalability

There has been a tremendous increase in production of horticulture crops in India including fruits. Driven by increase in incomes, a large middle-class population and greater availability of different varieties, fruits demand has risen in India. Responding to this increase in demand, India's fruits production has increased from 29 MMT in 1991–92 to 97 MMT in 2018–19, more than three times. Out of this, banana and mango together accounts for 50% of the total production. In this section, we will evaluate the scalability of banana and mango value chains.

4.6.1 *Scalability in Area and Production*

Area and Production of Bananas

India is the world leader in the production of bananas. India's banana production quadrupled from 10 MMT during TE 1993–94 to more than 30.6 MMT during TE 2018–19 (Fig. 4.22). Even though the overall increase is positive, there have been instances when the production declined due to decrease in area cultivated. For example, banana production declined in 2000–01, then again in 2011–12 and the following years. As farmers are free to choose what they want to cultivate, they tend to decrease their acreage due to many external factors, like previous year's profit or, peer farmers' cropping decisions, etc. There is no real-time acreage data available which can predict supply in the following season, which could have helped farmers take better farming decisions.

As bananas have proved to be a profitable crop for farmers over the years, they have shown keen interest in newer technologies that have a positive effect on banana yield. There appears to be a structural break in the production of bananas in 2003–04, after which the trajectory of production increase changed its course. Introduction of tissue culture cultivars especially Grand Nain variety of Cavendish bananas resulted in the increase in production. Grand Nain is an Israeli variety, introduced by Jain Irrigation (JISL). They developed a Hi-tech model for banana cultivation with proper pre- and post-harvest management for export variety of bananas. They used poly-house instead of shade net for nursery raising with mulching to protect the roots. This resulted in disease free saplings, as there is no scope of disease in a controlled environment of a nursery. The model took years to be developed and was ready for adoption in early 2000s. According to our interactions with JISL scientists, banana yields in India increased from 35 tn/ha in 1994 to almost 110 tn/ha in 2017–18, for hi-tech model in Jalgaon, and for normal model, it is 70 tn/ha. Price also increased

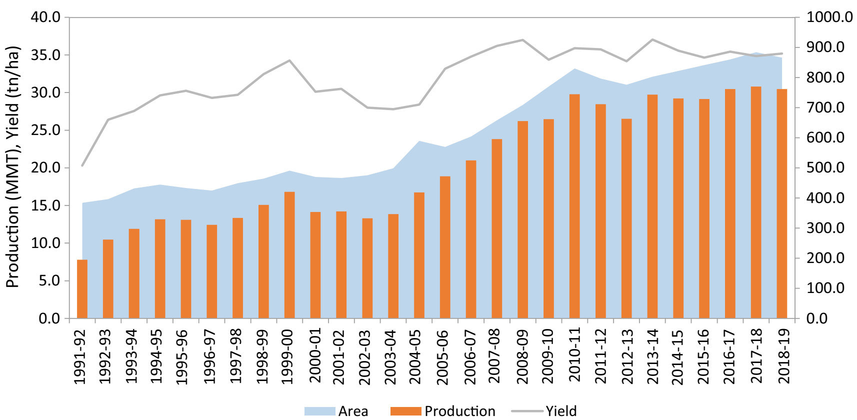

Fig. 4.22 Banana area, production and yield—All India. *Source* DoAC&FW, NHB

during this time; twice for normal variety and 4 times for hi-tech variety. Hence, there has been prosperity among banana growers in Jalgaon during these two decades.

Other reasons that triggered this quantum jump in banana production were adoption of drip irrigation technology, precision farming and high density planting. Precision farming ensures maximum output with minimum resource use, and this technology has been used for banana cultivation in many parts of the country. It was adopted by farmers in Theni district of Tamil Nadu way back in 2007–08, where (80–85)% of the area is covered under Grand Nain variety (Balaganesh et al. 2016).

It is clear from Table 4.9 that most of the growth in production (5.1%) was due to area growth (2.9%). However, growth in yield (2.1%) was also significant. Banana acreage increased substantially in Kerala, while it declined in Tamil Nadu from 17% in TE 2008–09 to 10% in TE 2018–19 and in Maharashtra from 12% to 9% during the same period. In one decade, the shares of different states in banana production also changed. For example, Andhra Pradesh became the largest producer of bananas from 11% during TE 2008–09 to 16% during TE 2018–19, even though during TE 2018–19 Andhra Pradesh lost Telangana share. It is interesting to note that around 46% of bananas in India were produced in Tamil Nadu and Maharashtra, which has now declined to half, i.e. 23% (Fig. 4.23). This change in cropping pattern is due to expansion of banana production in newer regions and decline in the dominance of Tamil Nadu and Maharashtra.

Table 4.9 Compound annual growth rates for area, production and yield of bananas in India

Variable	Banana CAGR (%)						
	1960s	1970s	1980s	1990s	2000s	2010s	All
Area	2.4	3.5	3.9	2.3	6.7	1.8	2.9
Yield	0.3	1.3	2.2	3.8	3.1	−0.4	2.1
Prod	2.7	4.8	6.2	6.2	10.1	1.4	5.1

Source Authors' calculation using data from D/o A&FW and FAOSTAT

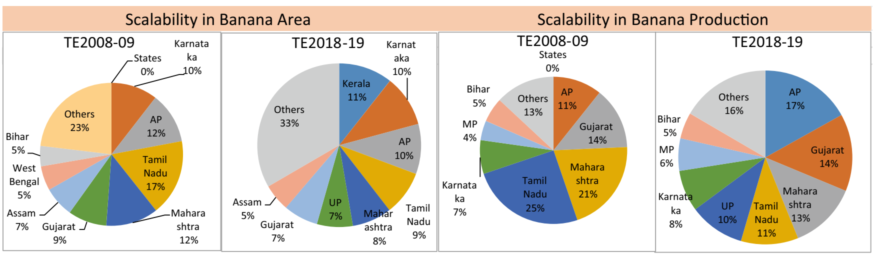

Fig. 4.23 Scalability in area and production of bananas in India. *Source* Authors' calculation using data from D/o A&FW

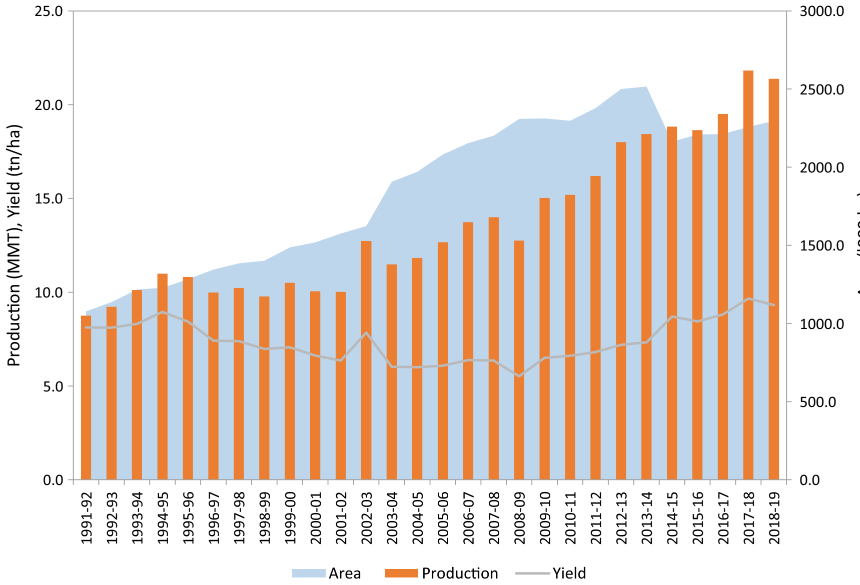

Fig. 4.24 Mango area, production and yield—All India. *Source* DoAC&FW, NHB

Area and Production of Mangoes

Figure 4.24 indicates that the increase in mango productivity since 1990s has been rather slow. Mango production has increased from 9.4 MMT in TE 1993–94 to 20.9 MMT in TE 2018–19, at an annual average growth rate of 3.6%. The area under mango cultivation increased from 1.1 million hectares to 2.3 million hectares during the same period, at an annual average growth rate of 3%. The increase in productivity has been rather slow. There has been not much change in the production pattern in the key producing states.

According to a statement in Lok Sabha, MoAC&FW stated that Indian Council of Agricultural Research (ICAR) institutes like Central Institute for Subtropical Horticulture (CISH), Lucknow and Indian Institute of Horticultural Research (IIHR), Bengaluru, are engaged in development of new technologies and varieties which has resulted in innovative mango cultivation like High Density Plantation (HDP). For enhancing productivity and cost effectiveness of mango cultivation, technologies for canopy management and cultivation of climate tolerance varieties are being promoted under Mission for Integrated Development of Horticulture (MIDH) and Rashtriya Krishi Vikas Yojana (RKVY) (Lok Sabha Questions 2019).

On the new varietal development front, there has not been major breakthrough in the decade starting 2010. The last mango variety developed by CISH was Arunika back in 2008. Without varietal developmental, scalability of mango value chain remains an area of concern. There is a need for development of long shelf life mango varieties without compromising on the taste or flavour. Due to short shelf life of mango, exports are not often viable.

Table 4.10 Funds allocated to states under MIDH (INR/crore)

Funds allocated to states under MIDH (INR/crore)			
2015–16	2016–17	2017–18	2018–19
1379	1238	1397	1846

Source Lok Sabha, 12 February, 2019

During our interaction with farmers and exporters, it was learnt that lack of standardization of production technology and poor extension of technical knowledge to the farmers resulted in slow adoption of HDP technology in mango plantation in the country. High initial establishment cost has been a deterrent for technology adoption (Table 4.10).

Another key concern regarding mango value chain is that there is hardly any advance production information available, like cereal crops. This puts farmers at the mercy of traders for determining the prices, which has gone against scaling up mango trade in the country. In 2019, IIHR-Bengaluru and Indian Space Research Organisation (ISRO) had commenced work on a pilot project to provide mango production advisory to the Karnataka government. Such advisory services need to be expanded to other key mango-producing states. ISRO advisory can give information ranging from flowering of the crop to the estimated crop size during the season concerned. This would equip the state government in estimating the crop size, and hence provide advance information about prices to the farmers.

Role of ICAR Institutions

Indian Council for Agricultural Research (ICAR) affiliated institutions such as National Research Centre for Banana (NRCB), Trichy, and Central Institute of Subtropical Horticulture (CISH), Lucknow, have made contribution towards varietal development of bananas and mangoes, respectively, over the last decades.

The ICAR-National Research Centre for Banana has significantly contributed towards banana research and development. The centre has developed many new technologies related to production, protection and post-harvest management and value addition in banana. ICAR-NRCB has disseminated its new technologies to the farmers and entrepreneurs, which have been adopted widely by the farming community (NRCB 2015). The centre is one of Asia's largest genebanks with 361 indigenous accessions. The centre has released three high-yielding varieties, namely—Udhayam, Saba and Bangrier, which are known for leaf spot resistance, tolerant to drought and salt stress and short duration, respectively.

The centre has been instrumental in developing high density planting with fertigation, organic cultivation of banana, pre- and post-harvest management techniques and development of various value-added products like juices, figs, bars, jams. Some of the popular banana varieties developed by NRCB includes Namwa Khom, Popoulou, Manoranjitham selection with high yield and a fragrant variant.

Similarly, CISH has developed the High Density Planting (HDP) for improving mango productivity as well as higher economic returns per unit area. This has ensured maximum utilization of land, water, nutrients and solar energy. The conventional mango plantation was in area of 10 m × 10 m (around 100 trees per hectare), while HDP can accommodate 400 trees per hectare (5 m × 5 m). With the integration of fertigation technology, productivity level as high as 14–15 tonnes could be achieved as against 7–8 tonne under conventional system (CISH).

According to CISH, 40% of mango orchards in northern India are more than 40 years old, over-crowded, reduced productivity and hence turning out to be less remunerative (CISH 2013). It has also noted inadequate supply of genuine and quality planting materials and lack of improved package of practices of mango cultivation being adopted by orchardists. Hence, its production, productivity and fruit quality have remained low. The CISH perspective plan suggested medium–high density planting system to be adopted extensively in view of the shrinking land resources in the country. It also suggested that cool chains need to be made more popular amongst the mango growers. Precision Farming Development Centre of the institute is in the forefront of developing and popularizing micro irrigation modules in different crops.

4.6.2 *Scalability in Exports*

Bananas have higher production tonnage than all fruits and vegetables (except potatoes). Yet India manages to export just 0.4% of total bananas produced, although it exports a substantial amount of mangoes, grapes and onions. Analysis of NPCs computed in this study reveals how India has been export competitive in bananas. Hence, even though exports share in production is very meagre; there is a potential to increase banana exports further from India, as validated by NPC numbers and also the increasing exports to production shares (Fig. 4.25). Share of export to production increased considerably after 2007–08, and then again after 2013–14.

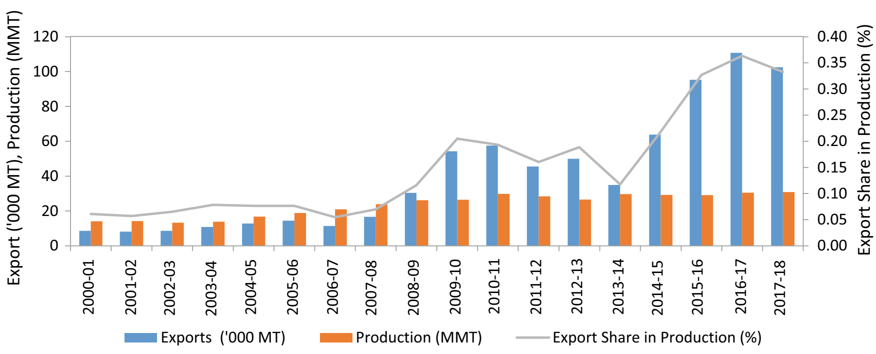

Fig. 4.25 Banana exports as share of production. *Source* DGFT, D/oA&FW

Table 4.11 Mango exports from Maharashtra

Volume in MT. (Value in INR crores in parenthesis)			
	2015–16	2016–17	2017–18
Maharashtra	24,243 (INR 259 cr)	37,180 (INR 368 cr)	33,347 (INR 281 cr)
India	36,329 (INR 317 cr)	53,177 (INR 446 cr)	46,147 (INR 344 cr)

Source Maharashtra Economic Survey 2017–18

Department of Commerce prepared an **Agriculture Export Policy (AEP)**[2] and noted that bananas have very high potential for export from India along with several other agricultural commodities. The policy document identified 50 export clusters which are unique product-specific districts that will be promoted for agri exports. For bananas, 2 western states and 3 southern states have been chosen. In Maharashtra, the clusters are Jalgaon, Kolhapur and Sholapur, and in Gujarat, Bharuch, Narmada and Surat. In Kerala, Andhra Pradesh and Tamil Nadu, important banana growing regions have been included. Uttar Pradesh, one of the major suppliers to Delhi and the fifth largest banana-producing state, has been completely left out. For mangoes, AEP has identified 15 districts of Maharashtra (2), Gujarat (4), UP (3), Telangana (3), AP (3) as clusters for mango exports. Maharashtra which has a major share in mango exports has also identified several districts including Aurangabad and Jalna to be developed as export hubs.

Banana value chain does not face any production or price related issues, but face issues related to post-harvest management and export. There is a need to scale up exports as well as processing capacities for banana.

For mango, Maharashtra has taken active role in promoting exports in collaboration with APEDA through Maharashtra State Agricultural Marketing Board. Measures have been taken in promoting exports of Alphonso, Kesar and other varieties of mangoes. Other key mango growing states such as Uttar Pradesh, Andhra Pradesh, Telangana and others must give thrust on promoting mango exports. This would scale up the mango trade in the country (Table 4.11).

4.7 Access to Finance

Key to any successful value chain model is the availability of timely and affordable credit. Typically, small farmers engaged in cultivation of bananas and mangoes find it difficult to access affordable formal credit facilities. In this section, we have studied the existing financing mechanism for key stakeholders—farmers, exporters, and retailers in the mango and banana value chains. Through field visits, interactions with stakeholders and available data in the public domain, this section examines the key financing channels available in the existing value chains and possible areas of intervention to strengthen access to finance.

[2] http://commerce.gov.in/writereaddata/uploadedfile/MOC_636802088572767848_AGRI_EXPORT_POLICY.pdf.

4.7.1 Financing Mechanism for Farmers

The following institutional sources for credit are available for farmers:

- District cooperative banks finance several *Kisan* societies which further finance farmers. In Jalgaon, Jalgaon District Cooperative Society (JDCC) provides credit facilities.
- Central Banks mainly through *Kisan* Credit Cards provide loans to farmers at 7% interest per annum. If the premiums are paid on time, 3% is credited back to farmers in about two years.
- Some successful Farmer Producer Organisation (FPOs) also provide loans to farmers at about 12% per annum. However, a very small number of FPOs are actually helping farmers to avail credit as most of the FPOs are either in dysfunctional state or operating at the mercy of government subsidies.

Among institutional sources, farmers have access to crop loans mainly through Kisan Credit Cards (KCCs) availed through district cooperatives societies, provided there is no default on repayment of loans. While large mango farmers who constitute a small group, have access to credit from the banks, most of the small and marginal farmers depend on self-financing mode for carrying out mango plantation. Most of the small farmers who grow mango as well as banana also grow several other crops. Mango farmers need credit only for few months of a year.

Non-institutional Sources

Despite the presence of banking facilities, small and marginal farmers are heavily dependent on non-institutional sources. This is because either the farmers are defaulters, who have not paid back previously borrowed money from banks or they simply do not want to go through the cumbersome paper work and land ownership certificates that have to be submitted. Besides, the processing time taken by banks for granting loans to farmers are high and farmers prefer known commission agents, *sahukars*, friends or relatives who provide instant credit. However, the interest charged by these entities is as high as (2–2.5)% per month and can go up to even 5%.

4.7.2 Government Schemes for Horticulture Sector Development, and Processing

The public sector banks provide loans for development of fruit orchards like mango, chikoo, grapes, pomegranate, apple, etc., as well as short-term crops like banana, pineapple, flower in open and greenhouses and vegetable crops. However, the credit is available to those farmers who have cultivable lands, thus leaving out those farmers who carry out tenancy farming without any land holdings (Table 4.12).

The loan repayment starts after the completion of the gestation period varying from 4 to 7 years for different crops. Repayment commences from the time the crop gives economic yield and is linked to the income generation of each crop every year and varies between 7 and 12 years.

Table 4.12 Loans for farmers

Loan amount	Loan available	Hypothecation
Up to INR 1 Lakh	100% of the cost of the project	Hypothecation of asset created
Above INR 1 Lakh	75–80% of the cost of the project	Hypothecation of asset along with mortgage of land

Besides this, Government of India's SAMAPDA (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters) Yojana provides subsidy for setting up of food processing industry and has boosted the food processing sector. Renamed as Pradhan Mantri Kisan SAMPADA Yojana,[3] with an allocation of INR 60 billion for 2016 to 2020, the scheme provides subsidy of 35% of the project cost up to INR 5 crores for setting up of food processing units. This scheme will not only help in setting up of food processing units but will also include food parks, integrated cold chains, creation of backward and forward linkages, food safety and quality and other infrastructures. (MoFPI 2018).

Government of Maharashtra tied up with World Bank for $300 million project, known as Maharashtra's Agri-business and Rural Transformation Program (SMART) Project (World Bank 2018). The project aimed to develop inclusive and competitive agriculture value chains, focusing on smallholders and agri-entrepreneurs in Maharashtra with active participation from private sector. The scheme includes several agricultural commodities for value chain development including bananas and mangoes.

4.7.3 Development of Export Infrastructure

To facilitate exports of mangoes by refrigerated vans, Agricultural & Processed Food Products Export Development Authority (APEDA), under the Infrastructure Development component of its export promotion scheme, provides financial assistance for purchase of insulated/reefer transport/mobile pre-cooling units up to 40% of the cost subject to ceiling of INR 100 lakhs. Assistance is available for the establishment of post-harvest infrastructure for fresh horticulture produce like integrated pack house, cable handling system for banana, mango and other similar requirements for other crops, purchase of insulated and, reefer transport/mobile pre-cooling units. APEDA provides financial assistance to exporters for setting up post-harvest infrastructure facilities, purchase of laboratory equipment, implementing quality management system and transport assistance for non-traditional markets (Table 4.13).

To meet the quarantine concerns of importing countries, APEDA has extended financial assistance to state government agencies to establish vapour heat treatment

[3] http://mofpi.nic.in/Schemes/pradhan-mantri-kisan-sampada-yojana.

Table 4.13 APEDA assistances for mango and banana exporters

Components	Scope	Assistance
Integrated pack house	Improve compliance of phyto-sanitary requirements	Up to 40% of the total cost subject to a ceiling of INR One crore for each of the activities
Purchasing insulated, reefer transport/mobile pre-cooling units	Cold chain strengthening	
Cable handling system for banana and other crops	Quality improvement	
Processing facilities	Enhancing productivity, efficiency and quality for value-added products	

Source APEDA

facilities in Andhra Pradesh, Uttar Pradesh and Maharashtra and for irradiation facility in Maharashtra and Gujarat.

Assistance for reefer transport vehicles is also available under Mission for Integrated Development of Horticulture (MIDH), a Centrally Sponsored Scheme implemented by Ministry of Agriculture & Farmers' Welfare. Under MIDH, credit linked assistance is provided for establishment of cold storage, ripening chambers and reefer transport vehicles for perishable horticulture crops, including mango. The component is demand and entrepreneur-driven, and funds under MIDH are allocated to states on the basis of Annual Action Plans.

4.8 Conclusion and Policy Recommendations

While India has favourable geographic and climatic factors for growing both banana and mango, the potential it holds for catering to world's demand of fresh fruits has remained untapped. These value chain suffer from improper post-harvest management, fragmented and small farm sizes, and weak linkages to the global markets, especially, in the case of banana. The sustained efforts by APEDA and state governments of Maharashtra and Gujarat helped boost mango exports. Indian mango varieties such as Alphonso, Kesar and others are exported to UAE, USA, UK, and other European countries. There is a significant opportunity to scale up mango exports focusing on the uniqueness of Indian mangoes in terms of appearance, flavour and taste.

Hence, to bring efficiency in the value chain of bananas and mangoes, policy recommendations should address the challenges faced at each stage of the value chain from origin of planting material to the final consumption of the product. The establishment of traceability and certification will help ensure stronger export markets for Indian bananas, and mangoes. Farmers need good quality inputs such as seeds, fertigation, robust extension services, and affordable credit facilities. Based on our analysis of the value chains on the CISS-F framework, we put forth certain important policy recommendations that will further strengthen these value chains.

4.8.1 Generic Policy Recommendations for Fruit Crops

1. **Alternative markets for perishables**: Despite delisting of fruits and vegetables from APMC by several states, much of the marketing of these commodities is still channeled through APMC markets. Traditional APMC markets are plagued with issues related to high cost of intermediation, opaque price discovery controlled by commission agents and traders, poor infrastructure facilities and services that cannot handle perishable commodities. As a result, farmers suffer from high marketing costs and lower price realization, adversely impacting their income levels. Agricultural marketing reforms are targeted towards streamlining marketing operations, upgrading existing markets as well as broadening the spectrum of markets to include private markets, digital markets, farmers' market, and other direct marketing channels. The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act enacted by the Parliament in September 2020 will be instrumental in setting up of these kind of alternate markets and lending greater access to the farmers. Incentives for private sector participation in agricultural markets and investments in building advanced value chains will improve both domestic and export marketability of these commodities.
2. **Farmer collectives**: Farmer Producer Organizations (FPOs) can be effective in providing pre and post-harvest infrastructure and services to the farmers. Government schemes aimed at extending financial support towards building these fruit value chains can be leveraged to the benefit of the farmers. FPOs can also facilitate direct market linkages with organized wholesalers, retailers, processors, and exporters, ensuring farmers the remunerative prices, and assured market access. The recent Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services or the FAPAFS Act enacted by the Parliament in September 2020 is an attempt by the government to legalize contract farming. Examples of Mahagrapes (grapes) and Sahyadri Farmer Producer Company Limited (fruits and vegetables) show how farmers can benefit from farmer-market linkages facilitated through such institutions, and important lessons can be drawn.
3. **Value Chain Financing**: Horticulture farmers mostly access finance from informal credit sources comprising of market intermediaries (commission agents/*arhatiyas*), traders and/or self-finance. The rate of interest charged by the intermediaries range between (2–2.5)% and can go up to 5% per month. Banana and mango farmers, especially small and marginal, need affordable and timely access to institutional credit for buying planting material, automated fertigation,

pipelines, tractors, etc. Such credit requirements can be made available through Kisan Credit Cards (KCC) or through FPOs.
Given the widespread retail marketing of fruits and vegetables, in this case bananas and mangoes, access to affordable institutional finance can enable small retailers scale up and upgrade their business models. Being highly perishable, storage facilities at the retail level can help extend the shelf life of the commodities and allow retailers to avoid wastage and earn better incomes.

4.8.2 Banana Value Chain

1. Giving bunch treatment to banana plants before harvesting using bunching bags improves the quality of the fruit. This can be done by covering the banana bunches using bunching bags to avoid the spread of thrift pests, which scrap banana juice, leading to brown spots on banana. The resultant spotless bananas will further expand banana exports to promising markets, like the European union.
2. Indian bananas have negligible presence in the global export market. This is because bananas from India are not of the desired quality, are not homogeneously sized, and there is no standardized protocol for handling bananas during harvest. Development of a sea protocol for banana exports which includes the number of days of maturity, size parameters, and pesticide residue range will enable expansion of banana exports via sea route to distant markets.
3. Mechanization of banana transplanting and harvesting should be explored to reduce production costs and wastages. Scaling up pilot projects on cable system for handling bananas, can be the starting point. Mechanization of banana value chain will help reduce labour costs, undertake better cultivation practices that have a favorable impact on quality, thereby making banana cultivation profitable for the farmers.
4. As bananas are water loving plants and its roots cannot hold water for long, it needs efficient irrigation and drainage facilities. With drip irrigation in place, 45% water can be saved and banana yields can also increase by 52%. While Maharashtra has adopted drip irrigation for banana cultivation to a large extent, other banana growing states should adopt drip irrigation facilities to make banana cultivation environmentally sustainable.
5. Banana fibre is a great alternative to other natural fibres, like cotton as the former is prepared from pseudo banana stem, which is a waste product in the banana value chain. In India, 70–80 tn/ha of banana pseudo stem is wasted, which has the potential to be converted into a number of value-added products including paper, handicrafts, fibre, bio-fertilizer, vermin compost, candies and pickle. Hence, it is not only an environmentally sustainable option, but also financially lucrative for farmers as well as the entire banana economy. While a few pilot projects have been started in Jalgaon and Trichy in India, the operations have to be scaled up in other banana growing regions to acquire the desired scale.

4.8.3 Mango Value Chain

1. As mango cultivation is mostly carried out by small and marginal farmers and it is a seasonal fruit, inter-cropping could be encouraged, keeping in mind the nature of soil as well as availability of water or irrigation. The role of ICAR affiliate institutes is critical in developing a sustainable mango cultivation system which is remunerative for the farmers as well as environmentally sustainable.
2. There has been a slow increase in output, productivity, and area under mango cultivation across states, in the last few decades. The last mango variety was developed by CISH (Arunika) in 2008, and since then mango has not seen any significant breakthrough in varietal development. Development of long shelf life mango varieties without compromising on the taste or flavour, will ensure scalability of mango production in India.
3. There is a large asymmetry in post-harvest and export oriented infrastructure facilities across states. While Maharashtra State Agricultural Marketing Board runs irradiation facilities in Vashi and Lasalgaon and several Vapour Heat Treatment (VHT) facilities are located in mango-growing regions in Maharashtra, other states lack such facilities. In the absence of such facilities, mango exporters from Uttar Pradesh bring in their produce to Vashi or Lasalgaon (Maharashtra) for these treatments, which is a mandatory requirement to cater to export markets in many countries. Setting up such infrastructure in Uttar Pradesh, which is the largest producer of mango, would help farmers in cutting cost of transportation, and ensure quicker shipments. All consignments to EU, South Korea, and Japan have to undergo hot water treatment (HWT) or VHT. Irradiation is mandatory for the mango consignment sent to the USA. Hence, ramping up such facilities in other states, such that exporters can avail them easily will have a positive impact on export.
4. Logistics including cold chains, ripening chambers, reefer trucks, etc for perishable commodities and in this context, mangoes, need to be developed and made accessible to the stakeholders in the value chain. Such logistics support will help improve the shelf life and quality of the fresh produce, reduce wastage, and enhance the marketability of the produce. Farmers can benefit from greater demand for mangoes as a result of robust value chain.

Annexures

Annexure 4.1: Banana Value Chain Markups

Components	INR/q	Share in consumer rupee (%)
1. Price received by farmer (From Agmarknet)	682	35.5
a. *Mandi* fees (INR 300/truck of 15–25 MT capacity)	1.5	
b. Packing and loading charges (INR 15000/truck of 15 MT capacity)	100.0	
c. Transportation cost	400.0	
2. Total traders cost (a to c)	502	26.1
3. Traders margin (4-2-1)	67	3.5
4. Delhi wholesale price	1251	
a. *Mandi* fees (1%)	12.5	
b. Official commission charges (6%)	75.1	
c. Cost for transportation, labour, ripening and wastages	100.0	
5. Semi-wholesaler total cost (a to c)	188	9.8
6. Semi-wholesaler margin (10%)	125	6.5
7. Price to retailer	1564	
8. Retailer cost	50	2.6
9. Retailers margin (10-7-8)	307	16.0
10. Price paid by consumers (Delhi retail price)	1921	100.0

Annexure 4.2: Mango Value Chain Markups

Components	INR per quintal	Share in consumer rupee (%)
1. Price received by farmer (From Agmarknet)	1778	20.7
a. *Mandi* fees	53.3	
b. Packing and loading charges	250.0	
c. Transportation cost	500.0	
2. Total traders cost (a to c)	803.3	9.4
3. Traders margin (4-2-1)	92.4	1.1
4. Delhi wholesale price	2674	
a. *Mandi* fees (1%)	26.7	
b. Official commission charges (6%)	160.4	
c. Cost for transportation, labour, ripening and wastages	100	
5. Semi-wholesaler total cost (a to c)	287	3.3
6. Semi-wholesaler margin (10%)	267	3.1
7. Price to retailer	3228	
8. Retailer cost	50	0.6
9. Retailers margin (10-7-8)	5298	61.8
10. Price paid by consumers (Delhi retail price)	8577	100.0

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Chapter 5
Grapes and Pomegranate Value Chains

Manasi Phadke, Bhushana Karandikar, and Ashok Gulati

5.1 Introduction

Horticulture has grown in size and importance within the agriculture landscape of the country. Horticulture production doubled from 191 million tonnes in 2006–07 to nearly 300 million tonnes in 2016–17. In fact, by 2015–16, production of horticulture crops was higher than that of food grains. Further, production of fruit crops as a proportion of horticulture crops increased from 29.5% in 2001–02 to 31.5% in 2015–16 (Fig. 5.1).

Within horticulture crops, grapes and pomegranates are very high-value fruit crops. Grape cultivation in the world, as also in India, is distinct from other horticulture crops in the sense that grape is a super-speciality science crop. The entire production protocol of grapes, right from plantation to pruning to spraying and harvesting, has been decoded scientifically. Grape farmers across the globe follow region-specific protocols for cultivating particular varieties of grapes. India cultivates table grapes which are consumed as fresh grapes. In India, grape cultivation is largely practised in Maharashtra, Karnataka, Andhra Pradesh and Telangana. However, in terms of acreage, production as well as exports, the contribution of Maharashtra is indomitable. Around 76% of acreage and 80% of the production of grapes are concentrated in Maharashtra, making it the definitive vineyard of India.

M. Phadke
Former Senior External Consultant, Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

B. Karandikar
Former Senior External Consultant, Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

A. Gulati (✉)
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

A. Gulati et al. (eds.), *Agricultural Value Chains in India*, India Studies in Business and Economics, https://doi.org/10.1007/978-981-33-4268-2_5

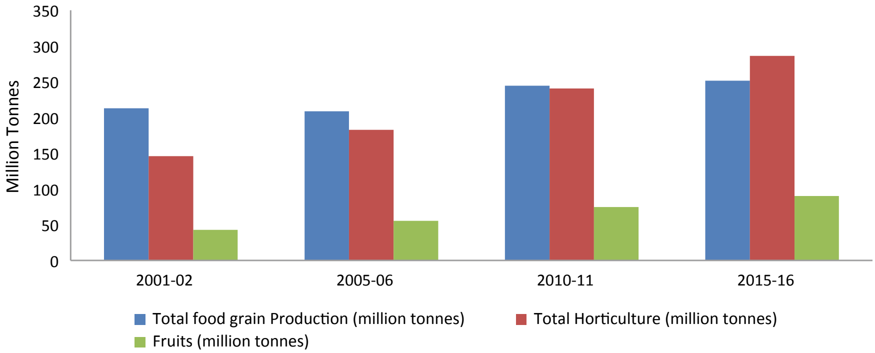


Fig. 5.1 Production of food grains, horticulture crops and fruits in India for selected years. *Source* NHB (2018a, b)

While climatic and soil conditions partly explain why Maharashtra dominates in grape production, there is also an underlying socio-economic story that potentially explains why grape cultivation flourished in Maharashtra the way it did. The *Maharashtra Rajya Draksha Bagayatdar Sangh (MRDBS)* or the Grape Growers Association of Maharashtra State, which was formed in 1958, did much of the ground work in terms of creating an information network among scientific minded farmers. Later, another organization 'Mahagrapes', set up in 1991 in partnership between grape farmer co-operatives and the Government of Maharashtra became the post-harvest and export management arm of the grape farmers (Nikam et al. 2014). The proactive presence of Mahagrapes led to evolution of grape value chains, linking the science-driven grape cultivation in Maharashtra to business-driven retail chain models throughout the world (NCPAH, n.d.).

The story of the pomegranate is slightly different. After the drought of 1972 in Maharashtra, farmers tried experimenting with different drought-resistant crops. Recognizing its potential to utilize wastelands and to augment the income of small and marginal farmers in water scarce areas, the Government of Maharashtra created incentive schemes for pomegranate farming. In 1981–82, the state government declared the Capital Subsidy Scheme for several horticulture crops. In 1991, the Employment Guarantee Scheme (EGS) was linked with horticulture. Pomegranates were covered under both the schemes, given the immense potential of the shrub to grow in coarse, poor-quality soil and with limited water resources.

In response to the schemes, acreage under pomegranates in Maharashtra increased multi-fold. Today, around 65% of the total area under pomegranates and 70% of the production are concentrated in Maharashtra.

Among the top 5 fruits of Maharashtra, 36% and 12% of the value is accounted for by grapes and pomegranates, respectively (Fig. 5.2).

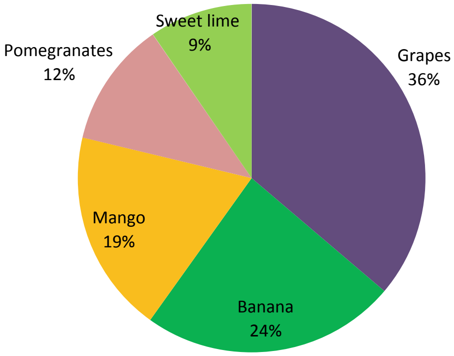


Fig. 5.2 Share of grapes and pomegranates in the value of top 5 fruits in Maharashtra (2013–14). *Source* NHB (2018a, b)

In this study, we analyze various aspects of the grape value chain (GVC henceforth) and the pomegranate value chain (PVC henceforth). Given the dominant position of Maharashtra in production of both the crops, the study focuses on the development of the value chains from Maharashtra. The analysis of the value chains is presented in terms of competitiveness, inclusiveness, scalability, sustainability and access to finance (CISS-F).

5.2 Overview of Grape and Pomegranate Economy

5.2.1 Grape

Global Overview

Viticulture is globally recognized as high-value agriculture (HVA) (Fig. 5.3). Grapes are consumed fresh (table grapes), dried (raisins) or in the form of pressed products (wine, juice, jellies, etc.). Value chains for table grapes, raisins and wine grapes are extremely different from each other.

Together with China and Turkey, India is one of the biggest producers of table grapes in the world (Fig. 5.4).

Global production of table grapes almost doubled from 15 million MT in 2000 to 27 million MT in 2014 (FAO-OIV Focus 2016). Notable increments in production of table grapes were observed in China, India, Turkey, Egypt, Uzbekistan, Brazil and Peru. Global consumption of table grapes has also doubled between 2000 to 2014, mostly led by a consumption boom in the Asian economies (Fig. 5.5).

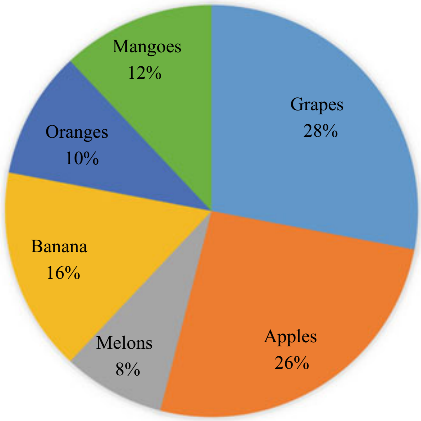


Fig. 5.3 Share (%) of grapes in value of top 6 globally traded fruits in 2018. *Source* Compiled from FAOSTAT (2018a)

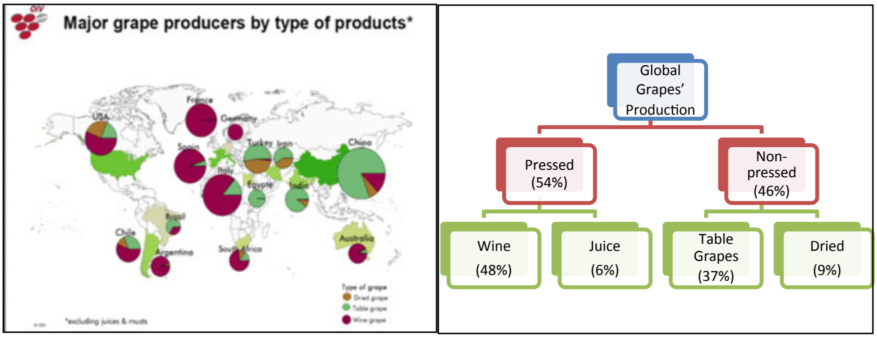


Fig. 5.4 Major grape producers in the world and share of table grapes, wine grapes and raisins in the total global production of grapes. *Source* OIV (2016)

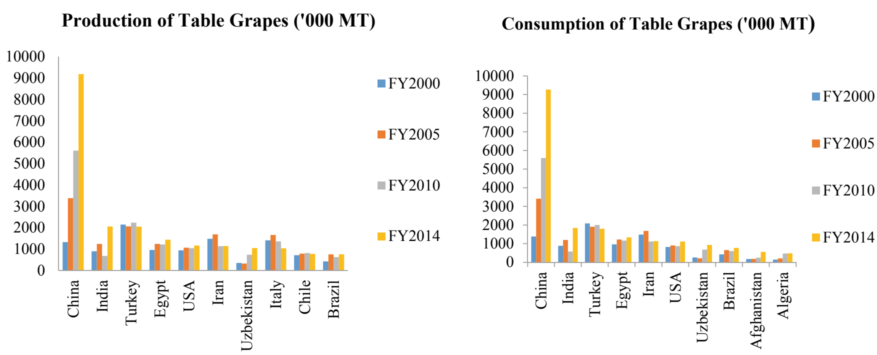


Fig. 5.5 Bi-decadal snapshot of production and consumption of table grapes in select countries ('000 MT). *Source* Compiled from FAO—OIV (2016)

Domestic Overview

India is the second largest producer of table grapes in the world. Within India, around 77% of the production consists of table grapes (Fig. 5.6a).

Thompson Seedless is the most popularly sown variety in India, followed by Bangalore Blue and Anab-e-Shahi (Fig. 5.6b).

In India, grapes are cultivated in Maharashtra, Karnataka, Punjab, Tamil Nadu and Andhra Pradesh. Acreage under vines in India has more than tripled from 45,000 hectares (ha) in 2000–01 to 140,000 ha in 2017–18. In the same time period, production of grapes in India increased from 1.06 MMT to 2.91 MMT in 2017–18 (Fig. 5.7).

2009 and 2010 have been the crisis years for Indian grapes. Based on steady growth in the past seven years, farmers increased acreage under grapes in 2009. However, as monsoons failed in the 2009 kharif season, drought affected the crop substantially. Further, downy mildew affected the crop and production of grapes fell drastically in that year in Maharashtra. Later, unseasonal rains destroyed much of the crop in November 2010. According to the FAO-OIV Focus (2016), the productivity of Indian grapes at about 30 MT per hectare has been consistently one of the highest in the world.

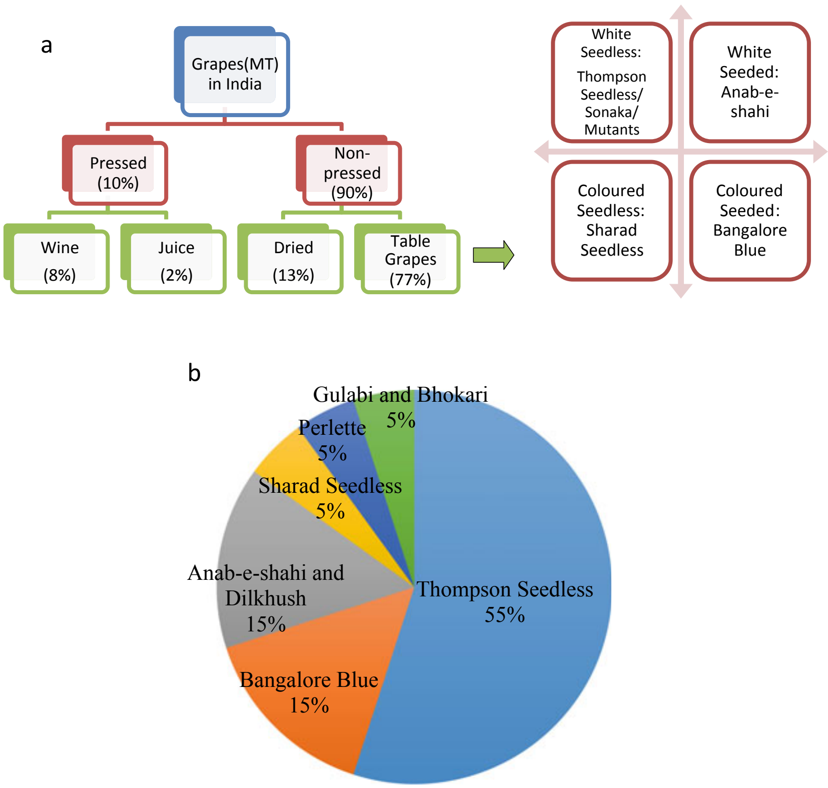


Fig. 5.6 **a** Share of table grapes, wine grapes and raisins to the total production of grapes in India (2014) and major grape varieties in India. *Source* KIIs with Grape Growers Association; indicative figures. **b** Distribution of area under dominant grape varieties in India. *Source* Hindu (2020)

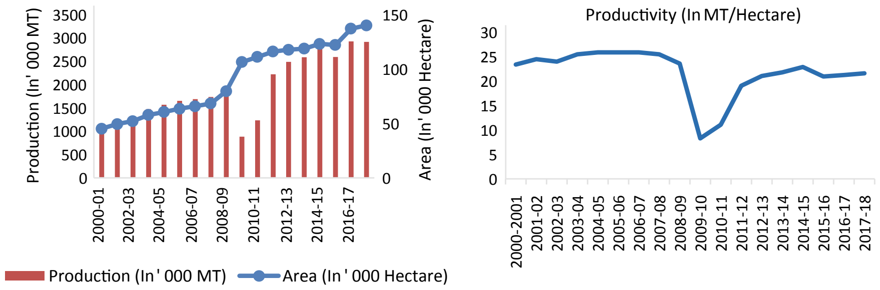


Fig. 5.7 Area ('000 ha) and production ('000 MT) of table grapes in India from 2000–01 to 2017–18. *Source* NHB (2018a, b)

Trade Pattern of Grapes

The doubling of production and consumption globally from 2000 to 2014, has not been matched by a doubling of exports. This is largely due to the fact that table grapes are mostly consumed at source countries. However, due to rapid strides in technology adoption in harvesting, packaging, storage and quicker transportation, exports of table grapes increased from 2.9 million MT to about 4.2 million MT, i.e. by around 50% during the above period. It is interesting to note that the biggest producers of table grapes do not feature among the biggest exporters of the commodity (Table 5.1).

China, India and Egypt normally consume a majority part of the produce domestically. On the other hand, producer countries such as Chile, Peru and South Africa export nearly the entire produce. The export–production ratio for Chile is as high as 94% (Fig. 5.8).

India emerged as one of the top 10 exporters of grapes in value terms in calendar year 2016. In 2006–07, India exported 85,000 MT of grapes, whereas in 2017–18, Indian exports of grapes had risen nearly 2.5 times and stood at 260,000 MT. From 2006–07 to 2017–18, the value of exports of table grapes from India had risen 4 times from 73 million USD to 302 million USD (Fig. 5.9).

In calendar year 2016, the major importers of grapes from India were Netherlands, UK, Russian Federation, UAE, Germany, Saudi Arabia, Thailand and Bangladesh (Fig. 5.10).

Chile, Peru and South Africa compete for market space with India in similar destinations from January to April. While they produce coloured varieties, they are also exporters of Thompson Seedless variety of grapes. These countries are the toughest export competitors for the grape exporters from India.

Table 5.1 Top producers, consumers, exporters and importers of table grapes (2014)

Producers	Consumers	Exporters	Importers
•China •India •Turkey •Egypt •USA	•China •India •Turkey •Egypt •Iran	•Chile •Italy •USA •Netherlands •Peru •South Africa	•USA •Netherlands •Germany •Russian Federation •UK

Source FAO-OIV (2016)

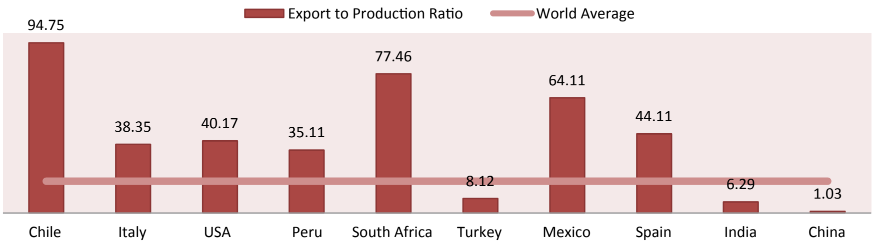


Fig. 5.8 Export-to-production ratio for table grapes for top 10 table grape-producing countries (2014). *Source* Compiled from FAO—OIV (2016)

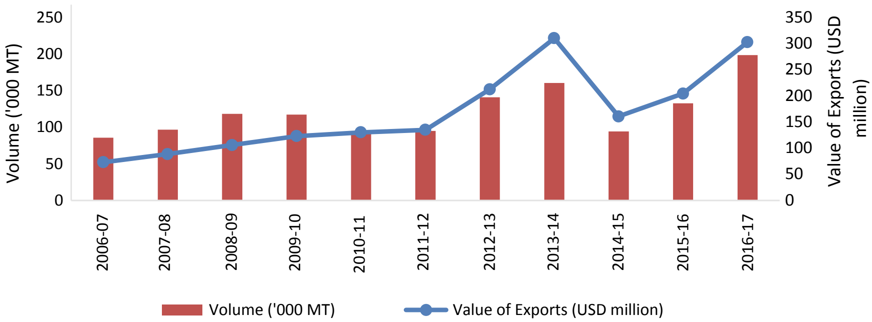
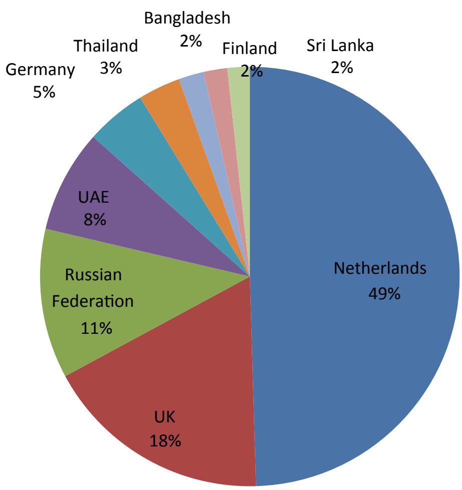


Fig. 5.9 Exports of grapes ('000 MT) from India from 2006–07 to 2016–17. *Source* NHB (2018a, b)

Fig. 5.10 Share of value on grape exports from India in 2016. *Source* FAOSTAT (2018b)



Export Crisis in 2010–11 and 2011–12

Grape exports (MT) showed a sharp dip in the year 2010–11 and in 2011–12 before rising in 2012–13. From March to May 2010, supermarket chains in EU rejected Indian grape exports citing residues of chlormequat chloride (lihocin), a growth regulator, in excess of the prescribed maximum residue limits (MRLs) (Jamwal 2015). Even as landed grape exports from India were randomly tested for the presence of the said chemical, grape prices received by Indian exporters dropped massively. Many traders had to sell grapes to agents in Rotterdam at throwaway prices. Exporting firms experienced a huge reduction in their margins; some firms claim that they moved into negative margins for that year. Farmers, who had extended credit to such firms in turn, faced the problem of non-receipt of outstanding payment at their end. Informal estimates suggest that at least 20% of the total loss was borne by the farmers, whereas 80% was borne by the exporting firms. Thus, FY 2010 was a catastrophic year for the entire value chain.

5.2.2 Pomegranate

Global Overview

Pomegranate cultivation traditionally belongs to Central Asia, but is now practised throughout the world (Fig. 5.11).

The biggest producers of pomegranates are India, Iran, China, Israel, Afghanistan, Iraq, Turkey, Egypt, Morocco, Tunisia, Uzbekistan, Azerbaijan, Spain and the

Fig. 5.11 Map of pomegranate-producing countries in the world. *Source* https://geology.com/world/world-map.shtml indicative map constructed by authors

Table 5.2 Production of pomegranates ('000 MT) in major producing countries (2014)

Country	Production ('000 MT)
India	1345
Iran	790
Turkey	320
Spain	45

Source Compiled from NHB (2018a, b), Ebrahimi (2015), Ikinci et al. (2018), Bartual et al. (2015)

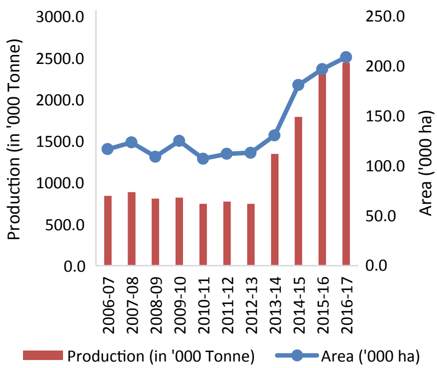
USA (Table 5.2). Pomegranate production also commenced in Brazil, Peru, Argentina and South Africa during the last decade.

Domestic Overview

Traditional states for pomegranate cultivation are Maharashtra, Karnataka, Andhra Pradesh and Gujarat, though cultivation is also practised in Himachal Pradesh, Rajasthan and Madhya Pradesh. The main cultivars produced in India are Bhagwa, Ganesh, Arakta and Ruby. Of these, Bhagwa is seen to be the most stable variety for Indian conditions and has become the biggest commercially produced and exported variety from India.

The acreage under pomegranates increased from 120,000 hectares in 2006–07 to 224,000 hectares in 2017–18. In the same time period, the production increased from 0.84 MMT to 2.6 MMT (Fig. 5.12).

While the area under pomegranates has less than doubled in the past decade, the production has nearly tripled in the same time. This tells us about the encouraging increase in productivity of Indian pomegranates between 2006–07 and 2017–18 from about 7.2 MT per hectare to about 12 MT per hectare. However, the yields in Maharashtra, and especially those in Nashik, are much higher at about 17 tonnes per



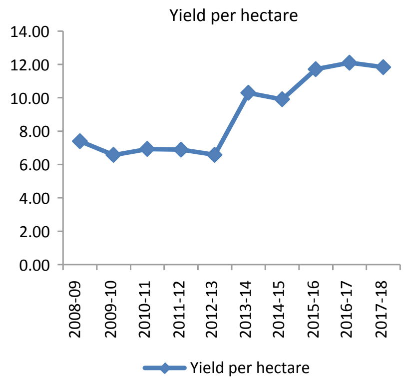


Fig. 5.12 Area ('000 ha) and production ('000 MT) of pomegranates in India (2006–07 to 2016–17). *Source* NHB (2018a, b)

hectare. According to KIIs, the yields from precision farming techniques tend to be as high as 25 MT per hectare in Maharashtra.

Trade Pattern of Pomegranate

As in the case of grapes, producer countries such as India and Iran are not the largest exporters and export just about 3.8% and 1.8% of their production, respectively (Fig. 5.13).

Turkey is heavily export-oriented and exports more than half of its production. South Africa, Peru and Chile too have a sharp export focus and are already making their mark in the lucrative European markets (Salgado 2017). The major importers of pomegranates are Europe, Middle East, Russia and Asian regions. In particular, the European Union (EU), which offers highest average prices for pomegranates, is perceived to be a lucrative market for pomegranates.

In the northern hemisphere, pomegranates are cultivated from September to January, whereas the southern hemisphere season extends from March to May (Fig. 5.14). There is a supply gap in the months between these seasons. Indian

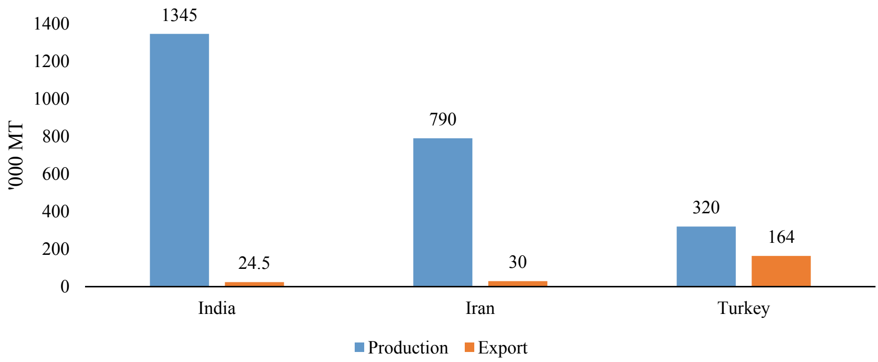


Fig. 5.13 Export and production of pomegranates from India, Iran and Turkey (2014). *Source* NHB (2018a, b), Ebrahimi (2015), Ikinci et al. (2018)

	J	F	M	A	M	J	J	A	S	O	N	D
Turkey												
Iran												
India												
Chile												
Egypt												
Spain												
Israel												
Peru												
Argentina												

Fig. 5.14 Export window for pomegranates from different countries. *Source* Compiled from NHB (2018a, b), Ebrahimi (2015), Ikinci et al. (2018), Bartual et al. (2015), CBI n.d

pomegranates are exported in the perfect window from January to March, when there is no competition from other countries.

Exports of pomegranates from India show a steady increase. The volume of pomegranate exports has more than doubled in the past decade from 21,670 MT in 2006–07 to nearly 50,000 MT in 2016–17. In the same time frame, the value of Indian pomegranate exports to all destinations has quadrupled from USD 18 million to USD 74 million (Fig. 5.15).

About 43% of Indian pomegranates (volume terms) are sold to the UAE, whereas only 4% of pomegranate volumes are sold to the EU. However, in value terms, UAE is the top export destination, accounting for 57% of the value of export.

Bangladesh, which is the second largest destination for Indian pomegranates in volume terms, is the fourth largest destination in value terms (Fig. 5.16). This again indicates that exports to Bangladesh are not highly remunerative.

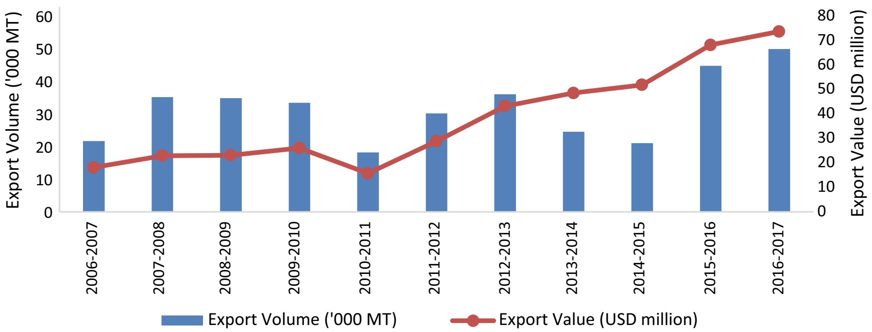


Fig. 5.15 Exports of pomegranates (volume '000 MT and value USD million) from India from 2006–07 to 2016–17. *Source* APEDA (2018a)

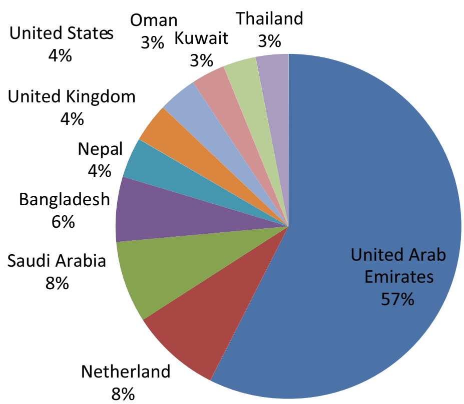


Fig. 5.16 Major export destinations for Indian pomegranates in value terms (TE 2018–19). *Source* APEDA (2018a)

5.3 Competitiveness

One of the central themes of the study is to evaluate whether the grapes and pomegranate value chains are competitive, which is assessed at two levels:

- International competitiveness using nominal protection coefficient (NPC)
- Domestic competitiveness by estimating what percentage of the consumer's rupee actually reaches the farmer.

5.3.1 *International Competitiveness*

Processes in the Export Value Chains of Grapes and Pomegranates
Processes in the export value chain can be broadly classified as quality check, movement of produce, shipping to export destination and final settlement of payments (Fig. 5.17).

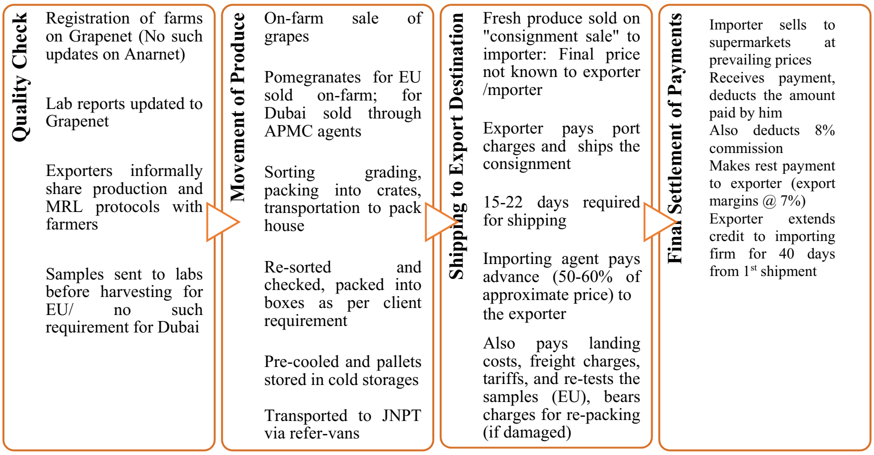


Fig. 5.17 Major processes in the export value chains. *Source* Authors' illustration

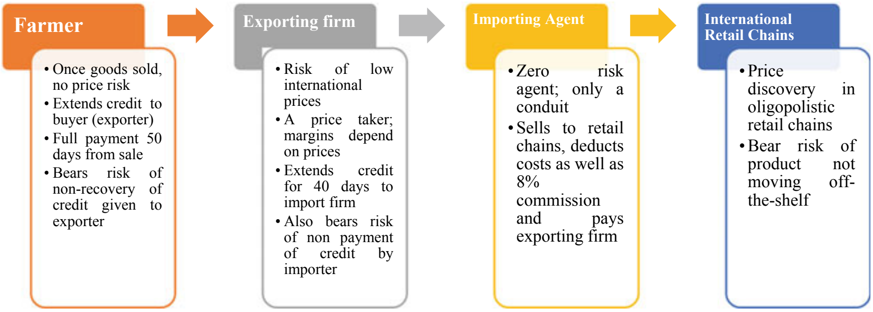


Fig. 5.18 Price-Risk interaction between major actants in the value chain. *Source* Authors' illustration

Figure 5.18 summarizes the price risk interaction between major actants in the value chain. Since the farmers get a fixed price for the produce, they do not bear a price risk. But since exporters enter a consignment sale vis-a-vis importer, they bear a price risk. While the farmer is technically free from price risk, he may still experience some risk due to the procedure of the financial transaction between him and the exporting firm. For grapes, the farmer receives 60% down payment from the exporter and gives 40% credit to the exporter. For pomegranates, he may receive only 50% or lesser down payment. Thus, the farmer carries the risk of non-payment by the exporter firm. The exporter carries price risk as well as risk of non-payment by importer.

Nominal Protection Coefficients (NPCs) for Grapes

Table 5.3 shows that India has a dominant position in production, but the export volumes are very restricted. The export performance of relatively new producers such as Peru is impressive due to the export of niche varieties. India specializes only in the production of white Thompson Seedless grapes. However, the world demands coloured varieties. Aggressive research in order to support stable, coloured varieties in India is needed, which could then increase our export prices as well as the volume of grape exports.

Table 5.3 Comparison of production and exports of table grapes in India and other grape-producing countries

Variables and ranks (2014)	China	India	Turkey	Egypt	USA	Italy	Chile	Peru	South Africa
Production ('000 MT)	9187	2059	2056	1442	1166	1038	776	330	280
Rank	1	2	3	4	5	7	8	10	11
Exports ('000 MT)	126	137	258	114	445	448	732	266	263
Rank	12	11	6	14	3	2	1	4	5

Source OIV-FAO (2016)

We next examine competitiveness of Indian grapes through the NPCs, for which we construct a series on international reference price for Indian grapes and domestic price of the grapes based on the paper by Saini and Gulati (2017). Unit values (UVs henceforth) of grapes are used as a proxy for fob prices. The UVs for grape export were calculated for every year (2006–07 to 2016–17) using the export data maintained by Agriculture and Processed Food Products Export Development Authority (APEDA).

The UVs so calculated were next adjusted for port handling charges, trader margins, transport costs (Jawaharlal Nehru Port Trust (JNPT) to Nashik), packaging costs, labour costs and quality differential to work out the adjusted border prices at the level of the wholesale market. While the data on port handling charges was sourced from JNPT, the estimates for other adjustments were developed through primary interviews with traders. The trader bears the costs of packaging, pre-cooling, transporting and marketing the produce which is equal to around 30% of the farm gate price (FGP). The present design of the grape value chain is such that traders normally derive around (7–8)% of (FGP + costs) as their margin.

We consider the average wholesale prices prevailing at Nashik during the harvest months (January to March) as a proxy for domestic prices of grapes. Using the domestic prices and adjusted border prices, the NPCs for Indian grape exports under the exportable hypothesis have been worked out between 2006–07 and 2016–17 (Annexure 5.1). An NPC value of less than 1 signifies exportability of the commodity.

Grapes have been export competitive in the period between 2006–07 and 2016–17. Indian grape exports have become more competitive in the period after 2011–12, as indicated by a structural break in 2011–12 (Fig. 5.19).

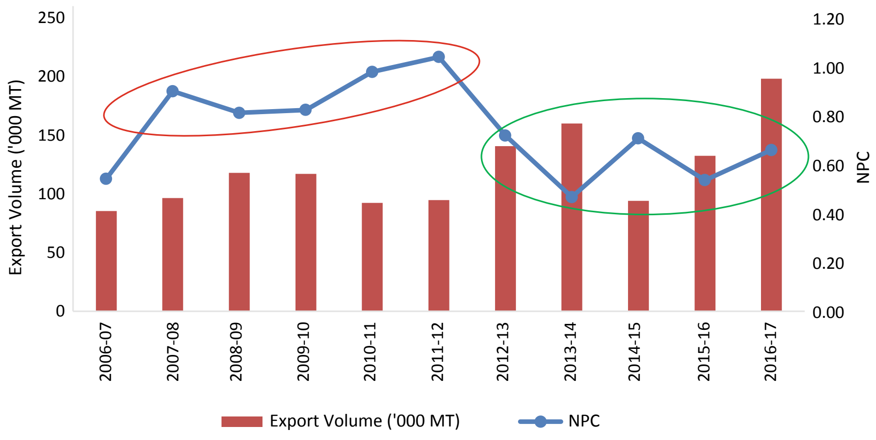


Fig. 5.19 NPC for Indian grapes and exports (‘000 MT) from 2006–07 to 2016–17. *Source* APEDA (2018a), NHB (2018a, b) and authors’ compilations

Explaining the Structural Break

In 2010–11, supermarkets in EU rejected consignments of Indian grapes and Indian exporters sold grapes at distress prices. In the same year, domestic inflation implied that the prices of all agricultural commodities including grapes rose sharply. The NPC increased from 0.82 in 2009–10 to 0.98 in 2010–11. Some of the produce was diverted to local domestic markets, and hence the export volumes fell.

The pessimism continued well into 2011–12. European markets remained edgy. Higher costs of compliance and fear of rejection prevailed. The NPC breached the value 1 and rose to a record level of 1.04. Export volumes remained low. It is only in 2012–13 that the recovery started. New technologies were adopted in Maharashtra. Traceability and MRL management from GrapeNet further increased the competitiveness of grapes from India. Food inflation also reduced domestically in the same financial year, and the NPC fell to a comfortable value of 0.66, indicating higher export competitiveness.

Grapes Export Value Chain: Price Escalation in Grapes from Farm gate to Consumer

What share of the international retail value does the farmer in Nashik earn? We construct an indicative cost chart for the export value chain for grapes from farmer–exporter–importer–supermarket–consumer to identify the same.

The export GVC in India is compressed and fairly efficient. The farmer gets 70% of the fob prices in India and 51% of the retail prices abroad (Fig. 5.20).

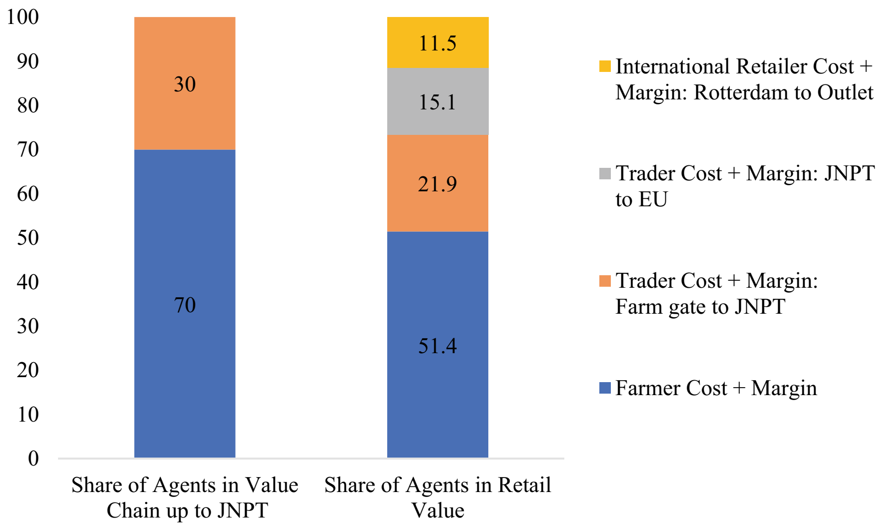


Fig. 5.20 Comparison of share of agents in value chain up to JNPT and value chain up to international retail consumer. *Source* KIIs, authors' compilation

Nominal Protection Coefficient for Pomegranates

Pomegranates are sold on consignment sale and not on fixed prices. This implies that the final value of the transaction is not fully determined when the pomegranates are exported. The exporter gets 50% advance of the expected value of the consignment; rest is paid after the retailer makes the final payment. According to the All-India Pomegranate Growers' Federation, APEDA data underestimates the UVs since it records only the advance value of the consignment. The final consignment value feeds into the Bank Realization Certificate (BRC) of the exporter. The BRCs are then submitted to the DGCIS in a hard copy format. To the extent that BRC data is not integrated with the data submitted by the exporter at the time of shipping, there is underestimation of the actual export value of Indian pomegranates.

The extent of underestimation in value of exports as per APEDA data is severe up to 2012–13. Hence, we carry out the analysis of international competitiveness of Indian pomegranates from 2013–14 to 2016–17 only (Fig. 5.21). The calculations show that pomegranates, with an average NPC value of 0.92, have been export competitive from 2013–14 to 2016–17 (Annexure 5.2).

We next construct an indicative cost chart for the export PVC from farmer–exporter–importer–supermarket–consumer to identify the share of farmers in the export value chain.

Not only are Indian pomegranates competitive, but the farmers are well integrated in the PVC. The farmer gets 80% of the fob prices in India and 54.6% of the retail prices abroad (Fig. 5.22). The export PVC demonstrated above has only 5 players, viz. farmer, exporter, importer, supermarket and consumer in the EU. Thus, it is compressed and fairly efficient. However, higher share of pomegranates (43% of volumes) is exported to Dubai. Importing firms in Dubai also sell the produce to other local agents, thereby increasing the number of players in the value chain. More are the number of players, less compressed is the value chain and the farmer gets lesser share in the retail value of the produce.

The prices of pomegranates in the EU normally exceed the prices in Dubai by at least 40%. Further, Indian exports to the EU are normally to supermarket agents and are fairly compressed. Hence, it is logical to conclude that the pomegranate farmer in India would stand to get a higher share of the value in the exports to the EU.

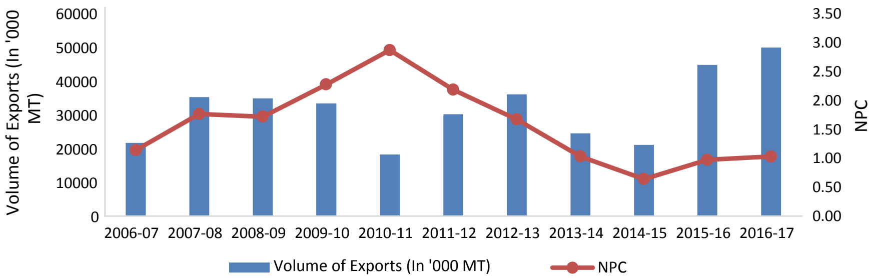


Fig. 5.21 NPC for Indian pomegranates and exports ('000 MT) from 2006–07 to 2016–17. *Source* APEDA (2018a), authors' calculations

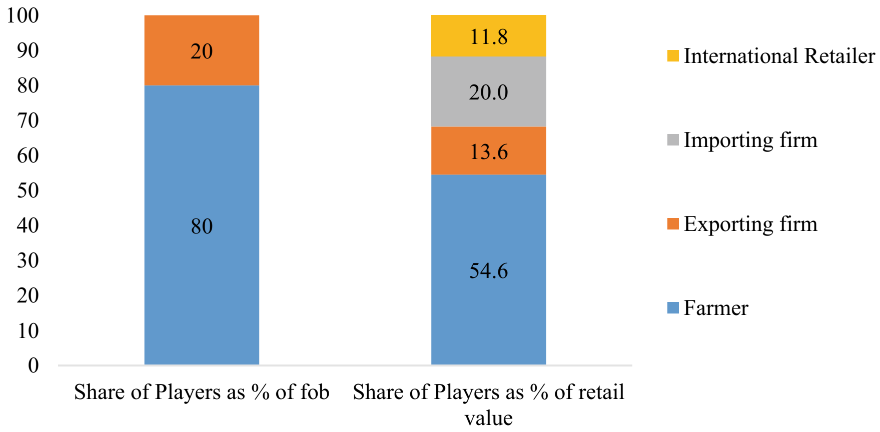


Fig. 5.22 Comparison of share of agents in value chain up to JNPT and value chain up to international retail consumer. *Source* KIIs

5.3.2 *Domestic Price Formation*

Processes in the Domestic Value Chains

Nashik and Solapur districts are traditional hubs of grapes and pomegranates production in Maharashtra. Whereas grapes are mostly sold on farm, pomegranates are auctioned by the local *arthiyas* or commission agents to traders and agents from North India. Figure 5.23 depicts the domestic value chains from Maharashtra to other parts of India.

Of the grapes and pomegranates that are available for the domestic market, the best produce is normally purchased by traders from Kolkata. Once the produce reaches Kolkata, it is then re-packed and exported to Bangladesh and Nepal. Thus, part of the domestic demand for fresh produce is actually demand for exports to neighbouring

Fig. 5.23 Domestic value chain of grapes and pomegranates. *Source* Indicative map constructed using qgis

countries in the north and east from Kolkata. KIIs with farmers in Nashik revealed that within domestic trade, around 15% of the grapes and pomegranates are purchased by traders from Kolkata (most of these are best quality fruits), whereas traders from Delhi and Bihar purchase 15% and 60% of the produce, respectively. The produce sold to Delhi and Bihar markets is of a mixed quality. The rest 10% of the produce is sold to markets in Mumbai and Pune.

Efficiency of Grape Value Chain

Figure 5.24 explains the domestic movement of grapes and pomegranates from Nashik to the northern markets in India. Here is an indicative cost chart to understand how the price of grapes escalates from the farm at Nashik to the retail customer in New Delhi.

The domestic GVC is a non-compressed value chain. Price escalations from the farm gate to the retail consumer are driven by the number of traders and markets involved in the value chain. Despite the non-compressed nature of the domestic GVC, it is observed that the farmer gets 56% of the wholesale price and 43% of the final consumer's rupee (Fig. 5.25).

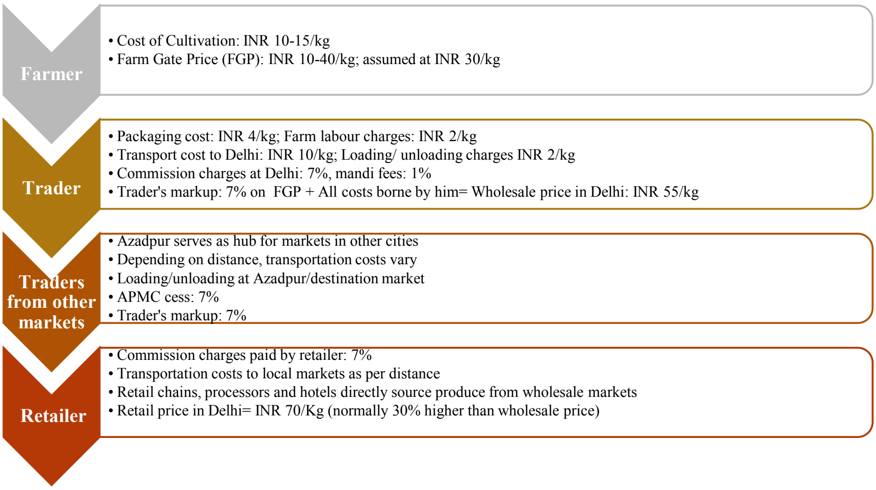


Fig. 5.24 Indicative cost chart of domestic value chain (Nashik to Azadpur *Mandi*, New Delhi) for grapes for 2015–16. *Source* KIIs

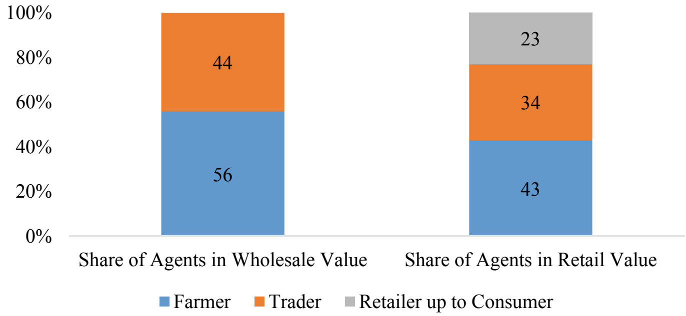


Fig. 5.25 Share of actants in wholesale and retail value in domestic grape value chain. *Source* KIIs

Efficiency of Pomegranate Value Chain

Here is an indicative cost chart to understand how the price of pomegranates escalates from the farm in Nashik to the retail consumer in New Delhi (Figs. 5.26 and 5.27).

Within the PVC, it is seen that the farmer gets about 45% of the final consumer's rupee.

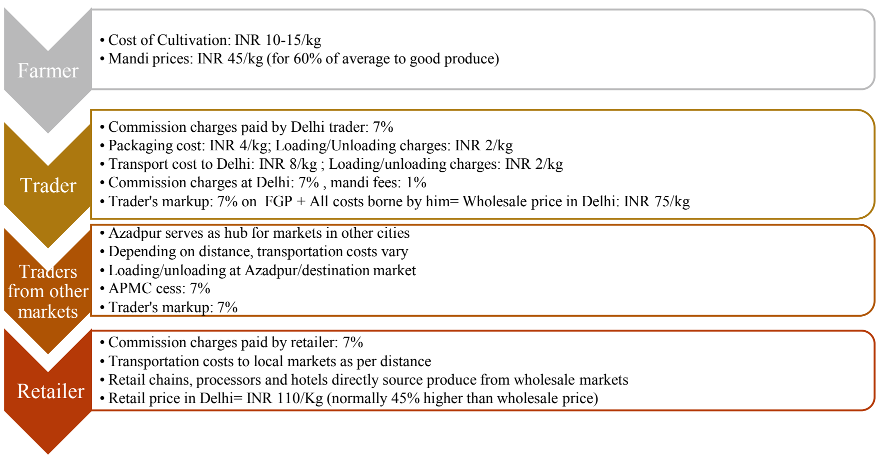


Fig. 5.26 Indicative cost chart of domestic value chain (Nashik to Azadpur *Mandi*, New Delhi) for pomegranates for 2015–16. *Source* KIIs

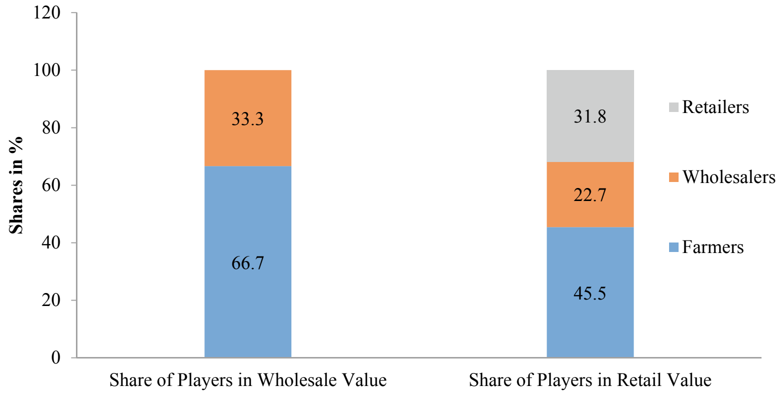


Fig. 5.27 Share of actants in wholesale and retail value in domestic pomegranate value chain. *Source* KIIs

5.4 Inclusiveness

5.4.1 Inclusiveness of Small Farmers in Production and Marketing

Do small farmers participate in the production and marketing of grapes and pomegranates in India? Do the value chains show the presence of small exporters, agents and traders, or is it dominated only by big players? These issues are examined in this section.

It is a known fact in Indian viticulture that high yields of table variety grapes are associated with small farms. This is because of the micromanagement that grapes demand as a crop. Every production activity from pruning, spraying, thinning, application of fertilizers and harvesting has to be done in a specific manner within a specific time frame. In that sense, grape is a handcrafted commodity. Farmers, together with their family and trusted aides, have to personally look into the production protocols, without which the success rate is doomed. Hence, there is a natural deterrent to expand beyond a certain limit and one finds predominance of small grape farmers in Maharashtra. Data suggests that about 67.8% of grape farmers are small and marginal owning less than 2 hectares of land (Agriculture Census 2015–16) (Fig. 5.28).

- The MRDBS created production protocols for farms even as small as 1 acre onwards. Most importantly, it created confidence among small farmers through peer group interactions and through knowledge sharing platforms.
- The MRDBS encouraged the small farmers to visit various *mandis* to see which grape varieties have demand in various markets. Gradually, farmers started getting much more aware about which varieties could sell at what prices, across the country. One finds that domestic agents/traders visit small and big farmers alike for sourcing grapes and that the small farmer negotiates a price which is equal to the big farmer.

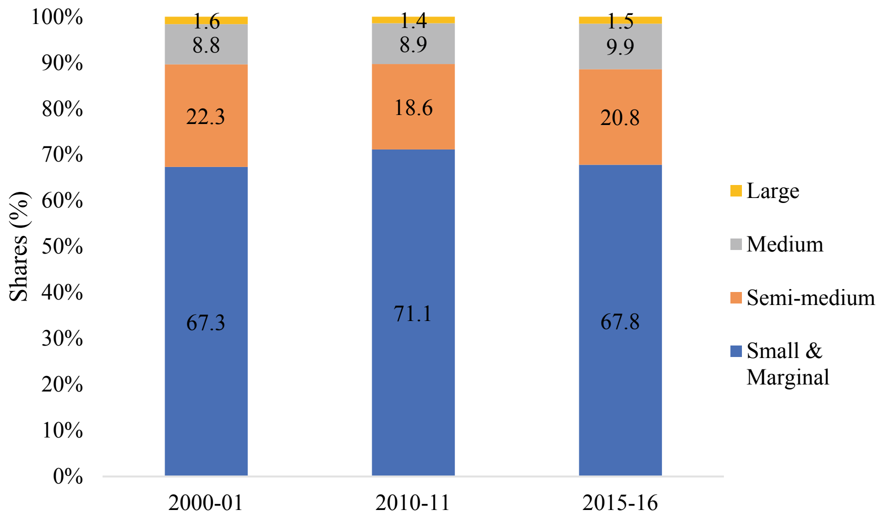


Fig. 5.28 Percentage of marginal and small, semi-medium, medium and large farmers in grape cultivation. *Source* Agriculture census, various issues

- The institutional support in Nashik has ensured that even small farmers are bold, market savvy and tech savvy. They are aware that it is their penchant for precision farming that leads to low rejections and high prices in the EU. Thus, they confidently negotiate the prices even in the export GVC.

Like grapes, pomegranate farming in Maharashtra is dominated by small and marginal land holdings. Nearly 69.2% of pomegranate farmers were marginal and small in 2015–16, which is slightly lower than 70.9% in 2010–11 and much higher than 57.4% in 2000–01 (Fig. 5.29).

The following factors have created a huge opportunity for small farmers to participate in pomegranate production in Maharashtra.

- Pomegranate farming has become quite popular among the smallholders of Maharashtra due to the low resource demands of this commodity. As compared to grapes, it is less intensive in terms of consumption of inputs and has the potential of giving fairly high returns, just like the grape crop. Hence, pomegranates are referred to as the poor man's grapes in Maharashtra.
- Since the pomegranate shrubs are spaced apart in the farm, it also allows the possibility of intercropping, adding to the overall income and importantly to cash flow of farmers across the year.
- The Government of Maharashtra linked the Employment Guarantee Scheme (EGS) with pomegranate farming in 1991. This move helped many small farmers to reduce costs and resolve the issue of farm labour.
- Pomegranates, once harvested, are taken to the APMC markets, from where they are auctioned by the local *arthiyas*. Selling pomegranates in the APMC markets has two benefits from the small farmers' perspective; one, the farmer sells the produce to a known agent and gets immediate payment, and two, the farmer

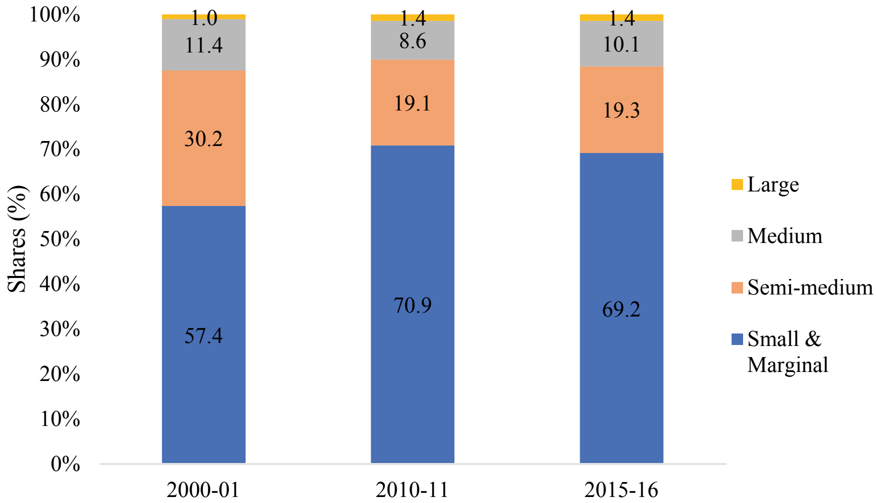


Fig. 5.29 Percentage of marginal and small, semi-medium, medium and large holdings in pomegranate cultivation. *Source* Agriculture census, various issues

himself witnesses the price discovery process for the produce. Thus, the marketing chain for pomegranates is fairly inclusive for the small farmer. However, certain issues do seem to affect the fairness of the marketing process in the PVC.

- The Maharashtra Government waived off the commission (6%) and market fees (1%) for the farmers vide Ordinance no. 15 dated 5 July 2016 (DoM 2016). The *arthiya*, who facilitates the market transaction between the farmer and the trader, now charges 6% commission to the trader and not to the farmer. The 1% market fee is also charged to the trader and not to the farmer. This apparently farmer-friendly reform has created issues in its wake, as is explained below.
- Since the traders now have to pay the price as well as the commission and market fees to the *arthiya*, they have cartelized to lower the prices for the produce. Thus, the gross amount that they pay to the *arthiya* has remained more or less the same, whereas the prices received by the farmers have fallen.
- Secondly, the *arthiyas* also charge INR 20 per crate as labour and calling out/auctioning charges to the farmers. The farmers have no bargaining power to protest against this charge and pay INR 20 per crate to the *arthiyas*. A full crate typically weighs 22 kg. The farmer receives payment only for 19 kg; the weight of the empty crate is 2 kg, and it is assumed that 1 kg per crate will be damaged. Now, the problem is that whether the pomegranates are sold at INR 80 per kg or whether they are sold at INR 10 per kg, the farmer necessarily has to bear a fixed cost of INR 20 per crate. Since the farmer pays a fixed charge and not an ad valorem rate per crate, the payment has become a regressive tax on the farmer.

5.4.2 Inclusiveness in Post-harvest Management

Small export firms dominate both the GVC and PVC (Fig. 5.30). Most of the export firms are proprietary concerns, partnership concerns or private limited firms. KIIs reveal that there was a huge influx of corporate players such as ITC, Kalyani Agro Exports, Deepak Fertilisers and Petrochemicals Corporation Ltd., Mahindra Shubh-labh Services Ltd. (MSSL) and Seven Star Fruits Pvt. Ltd. (Subsidiary of Mahyco) in exports of fresh grapes in the 1990s and 2000s. Some of them eventually diversified into pomegranates. However, many of these could not sustain their business.

There were two major issues which led to the exit of corporate firms between 2010 and 2017. The first issue was that of creating a network vis-a-vis farmer who would be able to supply export quality pomegranates. The companies used to hire salaried agents with know-how in the local markets of Nashik and Solapur, but these turned out to be high-cost resources. The second issue is that quick decision-making and agility in marketing decisions is needed to keep pace with highly volatile markets for fresh produce. The hierarchical structures in corporate bodies do not allow for that kind of agility, and hence, it became difficult to sustain the revenues.

The small export firms typically try to reduce their fixed costs. Thus, many of them do not own pack houses, cold storages and refer vans, but rather lease in these facilities on rent. The cold storages in Nashik are also mostly owned by farmers and small proprietary concerns or private limited companies. In that sense, this part of the value chain too is quite inclusive.

Of course, the market is dynamic. Many of the firms that started out with very small businesses have increased their turnover and employment over a period of time. Several companies have expanded and now have their own pack houses and cold storage facilities. Thus, consolidation of capacities has commenced within the value chains.

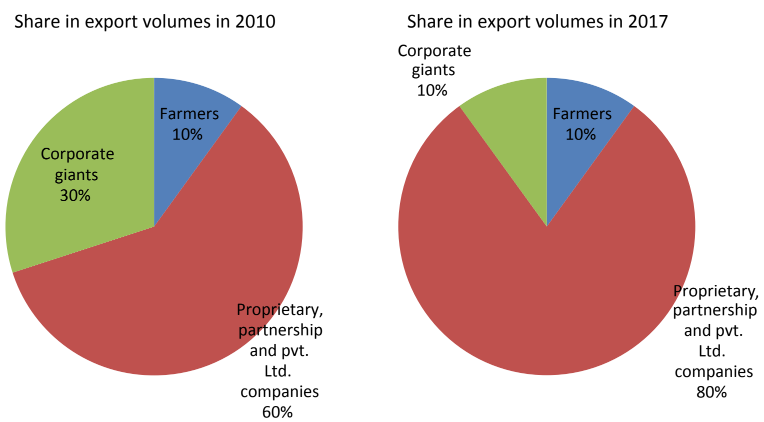


Fig. 5.30 Share of grapes and pomegranates exported by Farmers Private Ltd. Companies and corporate entities in 2010 and 2017. *Source* KIIs

5.5 Sustainability

It is observed that both GVC and PVC are efficient; i.e. farmers get a fairly high share in the respective retail prices. In addition to being competitive and inclusive, it is important to ensure that value chains are both financially and environmentally sustainable in order to achieve the desired scale effect.

5.5.1 Financial Sustainability

Under a set of assumptions regarding price levels, yields and costs (Annexures 5.3 and 5.4), we calculate the net returns accruing to the export-oriented and domestically oriented grape and pomegranate farmers. Accounting rates of return measure the profits or the returns over initial costs. The internal rate of return (IRR) is the compound rate of return for the investment annualized over the life of the project. Returns calculated under the business as usual (BAU) scenario are given in Table 5.4.

IRRs for export-oriented vineyards and orchards are much higher than the IRRs from domestic value chains. There is a zero internal rate of return associated with domestically oriented pomegranate farming, once the imputed costs of family labour and other costs are included. Clearly, the positive accounting rates of returns are a mirage.

Table 5.4 Rates of return accruing to export-oriented and domestically oriented grape and pomegranate farmers under BAU

S. No.	Rates of return	Export-oriented grape farmer (%)	Domestically oriented grape farmer (%)	Export-oriented pomegranate farmer (%)	Domestically oriented pomegranate farmer (%)
I	Accounting rate of return (per annum over recurring costs)	159	215	207	84
II	Internal rate of return of project (over A2)	70	51	144	55
III	Internal rate of return of project (over A2 + FL)	45	25	77	0
IV	Internal rate of return of project (over C2)	30	6	40	0

Source KIIs and authors' calculations

Export value chains for both crops are highly remunerative. However, there are challenges that do not allow the players in the value chains to reach full potential.

- Export firms normally give an advance payment of (50–60)% to the farmers. Farmers carry the risk of exporters not paying the outstanding balance. In fact, this has been a pinching issue for most farmers in Nashik.
- Lack of new and coloured varieties has led to Indian grapes receiving low prices in international markets.
- Pomegranate farming is mostly practised in the drought-prone areas of Maharashtra. Pomegranates are drought resistant, but they need water at specific growth stages such as flowering and fruit bearing. Climate change has brought about higher incidence of droughts in Maharashtra, and this has caused the economics of pomegranate farming to change.

We examine the sensitivity of accounting rates of returns of grape and pomegranate exporting farmers to various challenges mentioned above (Tables 5.5 and 5.6).

- The analysis indicates that farmers are highly vulnerable to the risk of default by exporters. This highlights the need for credit guarantee or risk mitigation mechanism, which is explained in the section on policy suggestions.
- Grape-exporting farmers from India have decoded production of Thompson Seedless perfectly and boast some of the highest yields in the world too. According to FAO-OIV Focus (2016), Indian grapes had a productivity of 21.23 MT/ha, which was the third highest in the world. However, expertise and efficiency have not translated into high prices. This is because the global demand has moved to coloured varieties and India lacks the research base with which to cultivate these. It is quite evident that for the GVC to be sustainable and grow in future, a switch to new varieties is imperative.
- Climate change is here to stay, and it affects the economics of horticulture fairly significantly. Yet, it is observed that insurance products such as those under the

Table 5.5 Accounting rate of returns to export-oriented grape farmers under various sensitivity scenarios

S. No.	Scenarios	Description	ARR (%)	Inference
1	BAU	Yield @ 10 tonnes; 60% sold at INR 70; 30% sold at INR 50; 10% yield is damaged	159	ARR indicates high lucrative business
2	Exporters give down payment of 60% and do not pay the rest amount	Most commonly encountered issue within the GVC	**55**	Reduces profit sharply: need for credit guarantee
3	New variety	Assuming INR 250,000 cost per acre	171	New varieties can change the game completely

Source Authors' calculations

Table 5.6 Indicative revenues, costs and rate of returns to export-oriented pomegranate farmers under various sensitivity scenarios

S. No.	Scenarios	Description	ARR (%)	Inference
1	BAU	Yield @ 8 tonnes; 60% sold at INR 60; 30% tonnes sold at INR 40; 10% yield is damaged	207	Highly remunerative and lucrative business
2	Risk of non-return	50% credit extended to exporter is not recovered	**54**	Profits reduce to a fourth of BAU: need for credit guarantee
3	Drought: water supplied by tankers	Yield maintained @ 8 MT; 40% sold at INR 60; 50% MT sold at INR 40; 10% yield is damaged	**76**	Indicates vulnerability of pomegranate farming to availability of water

Source Authors' calculations

Weather Based Crop Insurance Scheme (WBCIS) that can provide some risk mitigation to high-value horticulture are still in a nascent stage.

5.5.2 Environmental Sustainability

Water

Water and sunshine are the two key ingredients that make Indian grapes and pomegranates sweet. From the perspective of water, grapes are environmentally sustainable. Almost all the vineyards are on drip irrigation systems, which ensure efficient use of water. Pomegranates too are water-friendly crops and can be cultivated in drought-prone areas quite successfully. This is because pomegranates survive dry spells without water up to 3–4 weeks quite well. The pomegranate shrub is fairly hardy and has a high level of adaptability to high heat. It is a climate-resilient crop and is extremely suitable for cultivators in the drought-prone districts of Maharashtra. As per estimates of NRC, grapes and pomegranates require 200 L and 180 L of water per kg of crop, respectively. The world average for rice is 4000 L per kg of crop.

However, there are specific times when grapes and pomegranates are very sensitive to availability of water. For example, once the flowering phase of the shrub starts in pomegranates, regular irrigation is a key to fruition and to large size of fruits. If the water is not available at that time of the plant growth cycle, it can destroy the crop completely. See Table 5.6 for financial sensitivity of pomegranate farming to droughts.

Fertilizers and Pesticides

Grape vine in tropical area needs intense inputs as well as precise timing of the application of fertilizers, pesticides and growth hormones. As per APEDA guidelines, grape exports were sensitive to MRLs for 97 chemicals (as in 2006). By 2017, growers had to watch MRL for 200 chemicals. Even though grapes require heavy but regulated usage of chemical molecules, these are never used indiscriminately. This is because of the potential impact it can cause on MRL levels contributing to increased possibility of rejection of exports. The culture of MRL sensitivity in the export chain has had a positive effect on the domestic grape production as well.

However, there is indiscriminate use of chemical molecules in pomegranate farming. Though hardy, pomegranates are susceptible to various diseases and pests such as bacterial blight leaf spots, i.e. oily spot (*Telya*) and nodal blight, Cercospora leaf spots, alternaria leaf spots, Phytophthora blight, wilt, sucking pests such as thrips and root knot nematode. Various fertilizers and pesticides are recommended by the ICAR for different stages of growth of the orchard. However, excessive usage of both is found among the pomegranate cultivators. One factor that contributes to the issue is genuine lack of education among the pomegranate growers. The other factor is that pomegranates are mostly sold domestically or to residue non-sensitive export markets such as Dubai and Bangladesh. Thus, the culture of MRL sensitivity has not yet set in the PVC.

5.6 Scalability

Cultivation of grapes as well as pomegranates is a capital decision since the orchards have a life of 10 to 15 years. Grape vines and pomegranate orchards require substantial infrastructure in terms of trellises, drip irrigation systems, etc. Scaling up needs ability and willingness of family members and trusted aides working on the farm.

These factors indicate that grapes and pomegranates are inherently not very scalable. Nevertheless, acreage, production and exports of grapes have increased tremendously in the past 10 years.

5.6.1 Scalability Within GVC

Production of grapes in India increased from 1.06 million MT in 2000–01 to 2.9 million MT in 2017–18, thereby exhibiting an average growth rate of about 5% per annum (Fig. 5.31). In India, the yield of table grapes is already very high and there is limited scope for further increase. Thus, the increment in production has been driven by increment in acreage.

Although the highly lucrative GVC is scalable, it is not replicable across other Indian states. Thus, the scalability in grape acreage has remained restricted to Maharashtra and, to a lesser extent, Karnataka. Even within Maharashtra, the increase in acreage has been mostly confined to Nashik (Fig. 5.32). Thus, the GVC has not witnessed any replicability even within Maharashtra.

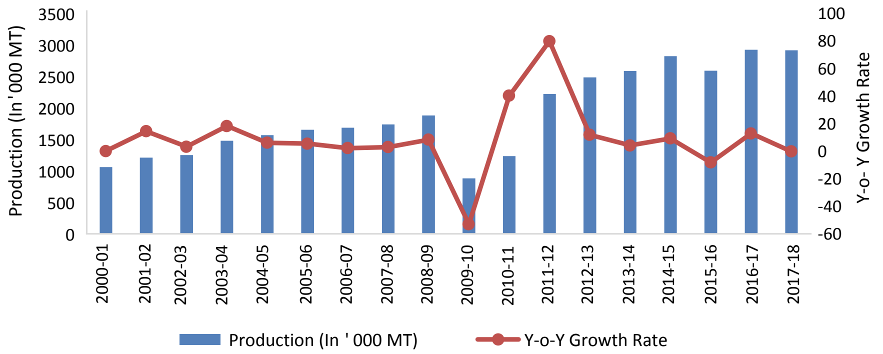
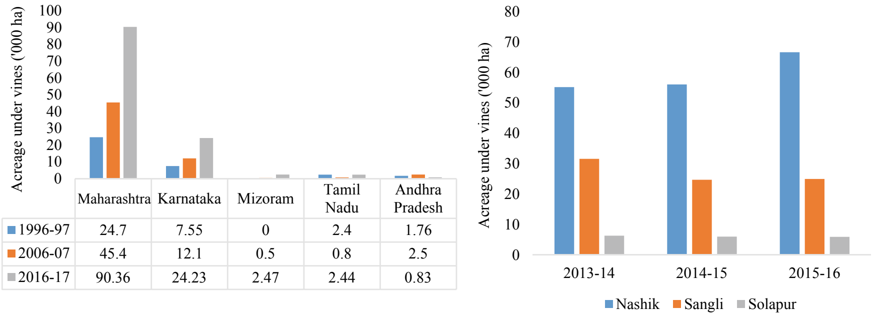


Fig. 5.31 Production of grapes ('000 MT) and Y-o-Y growth rate of production in India from 2000–01 to 2017–18. *Source* NHB (2018a, b)



	Maharashtra	Karnataka	Mizoram	Tamil Nadu	Andhra Pradesh
1996-97	24.7	7.55	0	2.4	1.76
2006-07	45.4	12.1	0.5	0.8	2.5
2016-17	90.36	24.23	2.47	2.44	0.83

Fig. 5.32 Area under grapes ('000 ha) in select States and in select Districts in Maharashtra. *Source* NHB (2018a, b). *Note* *AP data in 2016–17 compiled as the summation of acres under grapes in AP and Telangana

5.6.2 Scalability Within PVC

Both area and production of pomegranate production were stagnating between 2006–07 and 2012–13 and showed significant increase from 2013–14 onwards explained by a number of factors (Fig. 5.33).

- Though the scale-up in area and production was seen only after 2012–13, the story of why pomegranates emerged as a popular horticulture crop in India starts earlier. Before 2012–13, 80% of the pomegranate production was concentrated in Maharashtra. Pomegranate prices witnessed a continuous rise from 2007 to 2008 onwards. Drought conditions in Maharashtra together with the notorious oily spot bacterial blight created a huge supply shock in 2009 and 2010. At the same time, rise in incomes created huge demand for fresh fruits and vegetables, driving prices higher.

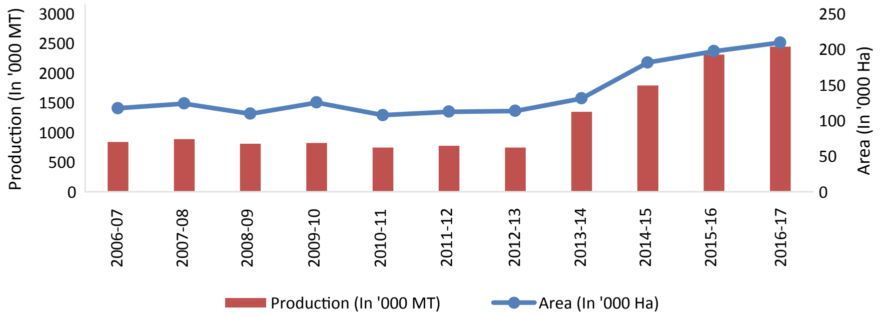


Fig. 5.33 Area ('000 ha) and production ('000 MT) of pomegranates in India (2006–07 to 2016–17). *Source* NHB (2018a, b)

- High domestic prices created renewed interest in the potential of pomegranates. Acreage under pomegranates started increasing in Gujarat, which had already started experimenting with pomegranate cultivation.
- Perhaps, an important breakthrough in the story came from Jain Irrigation, which started offering sturdier pomegranate cultivation options with the planting material being supported by tissue culture (Fig. 5.34). New development of tissue culture helped standardization of the production protocols, leading to higher output after 2012–13. Apart from planting material, Jain Irrigation also offered support products and services such as drip, pruning technology and fertigation that led to assured yields and profits. Almost all states started offering increased subsidies on drip irrigation systems, which further incentivized cultivation of the crop.
- This technical breakthrough from Jain Irrigation facilitated new expansion, especially in Gujarat. Rajasthan, which hosts ideal climatic and soil conditions for pomegranates, but had never ventured into pomegranates before, started experimenting with pomegranate production. Thus, the increase in acreage after 2012–13 was very rapid in states outside Maharashtra.

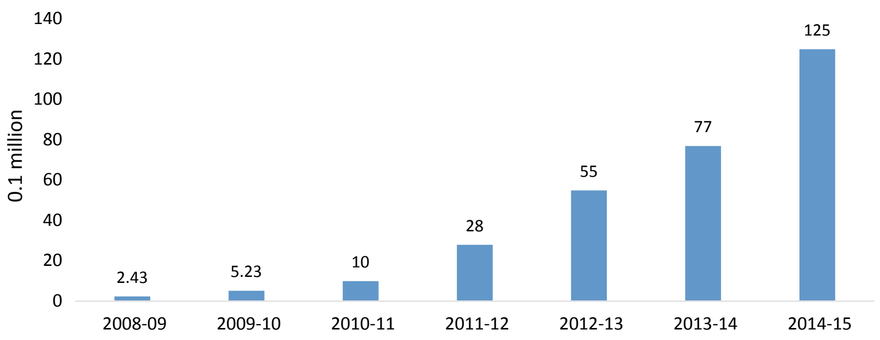


Fig. 5.34 Tissue Culture based Pomegranate Plants sold by Jain Irrigation (0.1 millions) from 2008–09 to 2014–15. *Source* Jain Irrigation, n.d.

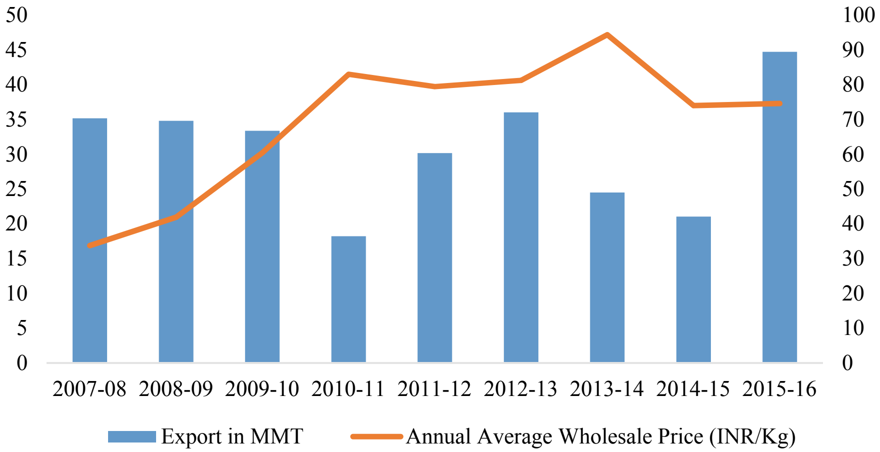


Fig. 5.35 Annual average wholesale price and export volumes of pomegranates in India: 2007–08 to 2015–16. *Source* NHB (2018a, b), APEDA (2018a)

The scalability in pomegranate exports is evident from the increase in volume as well as value of exports from India. Figure 5.35 indicates that pomegranate exports fell sharply in 2010. The oily spot, which manifests itself as a black spot on the skin of the pomegranate, reduced exportability of Indian pomegranates. Indian grapes were rejected in the EU markets citing non-compliance with pesticide residue levels. This caused a domino effect on the pomegranate export market as well and led to a reduction in pomegranate exports. The domestic price inflation between 2009 and 2011 implied higher prices for pomegranates, which further reduced export volumes. In general, there is a negative correlation coefficient between domestic prices and export volumes of Indian pomegranates (Fig. 5.35).

India is one of the most lucrative markets for pomegranates, and pomegranates fetch a highly remunerative price, domestically. Thus, any increase in domestic prices affects export volumes very sharply as the producers simply prefer to sell in the domestic markets. In fact, Indian prices are a key determinant of export volumes of pomegranates.

5.6.3 *Scalability and Product Diversification: Experiments with Raisins and Arils*

The theories expounding firm behaviour often refer to economies of scale and economies of scope. Scale economies refer to reducing average costs by producing higher volumes of a particular product. Economies of scope refer to a reduction in costs by producing a greater number of related products. The firm sells multiple related products to the consumer and thus exploits maximum mileage from spending

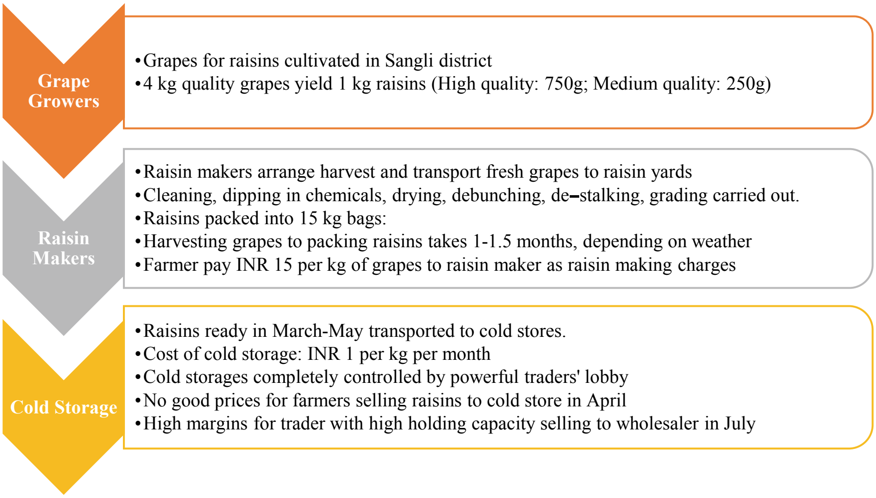


Fig. 5.36 Process map from grape to raisin. *Source* KII

a rupee in reaching out to consumers. It also exploits economies in terms of know-how, credit, raw materials and manpower. In other words, economies of scope allow the firm to scale up horizontally across different related products.

Raisins

The grape economy is a sector where one witnesses economies of scope, plentifully. Globally, 9%, and in India, around 13% of the grape production is processed into raisins. Raisins are a high-value, non-perishable product and hence an attractive business proposition to most grape growers.

In India, Sangli district, with its unique geography, is the major production hub of raisins. The grape season starts early in the region, due to which the raisin making process gets a head start. Hot weather with hot and dry winds from mid-March offers ideal conditions to dry table grapes with 22-degree brix into raisins. The grape to raisin value chain in Sangli is summarized in Fig. 5.36.

When the raisins are ready by March, farmers are in need of money. However, both the demand and price of raisins increase closer to the festive season in August (Fig. 5.37).[1] Farmers do not have holding capacity to await payments for another 3 months. Also, storing the raisins without cold storages is risky since raisins are susceptible to moulds. Cold storages in Nashik are owned by the strong trader lobbies. Very often, farmers enter into a distress sale of raisins at low prices in April itself. Thus, the farmers unfortunately do not partake in the value added in the raisin value chain in a big way.

[1] We created a price index for raisins to understand the movements in prices compared to March, for which value of index = 100. The index was created based on wholesale price data on raisins for 2016–17 and 2017–18.

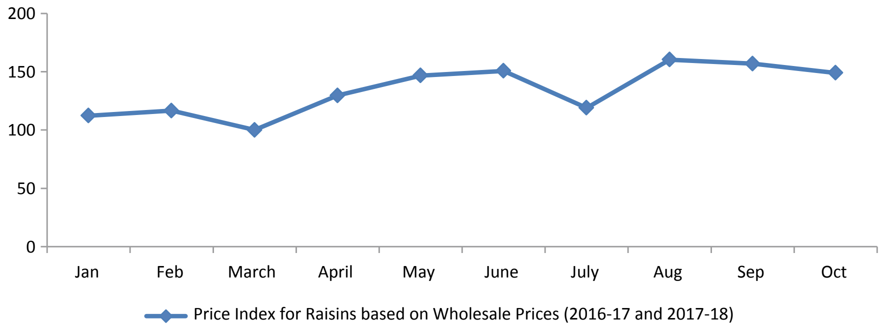


Fig. 5.37 Price index for raisins based on wholesale prices: 2016–17 and 2017–18. *Source* Agmark (2018), authors' calculations

Table 5.7 Price escalation from grapes to raisins: 2018

Players in raisin value chain	Cost + margins (INR)	Price escalation
Grape grower (4 kg of grapes) @ INR 20 per kg	80	
Raisin maker (4 kg of grapes) @ INR 15 per kg	60	140
Cold storage cost for 1 kg raisins for 4 months	4	144
Distress sale by farmers to traders in April (INR 170/kg good quality and INR 120 bad quality)		157.5
Accounting profits to farmers (INR)		13.5
Accounting rate of returns to farmers (%)		9.3
Sale by traders to wholesalers of 750 gm high-quality raisin in July		168.75
Sale by traders to wholesalers of 250 gm low-quality raisin in July		40
Total wholesale value of raisins per kg		208.75
Accounting profits to traders (INR)		51.25
Accounting rate of returns to traders (%)		32.5

Source KIIs and authors' compilation

The calculations show that the raisin value chain is not as efficient as the GVC; a large part of the value of raisins accrues to the trader and not to the farmer (Table 5.7).

Arils (Pomegranate Seeds)

Even though production and exports of pomegranates have scaled up tremendously, the scope economies within the PVC have been limited. Very few firms exporting pomegranates have diversified into selling arils, i.e. pomegranate seeds. There is a huge demand for arils, internationally. The price of 1 kg of aril is nearly 5 times higher than the price of 1 kg of pomegranate. However, the technology for exporting arils is still in its nascent stage. Pomegranates have to be de-seeded, and the arils have to be sorted carefully, taking care not to break the seeds. If the seeds break, it can potentially start off a fermentation process that destroys the entire consignment. Hence, sorted and graded arils are immediately frozen. The consignment is extremely thermo-sensitive due to the delicate nature of the frozen arils. The packaged arils have to be necessarily flown to EU; the success rate of shipping the aril punnets has been very low. Alternative packaging options are not yet available to ship the consignments to the EU and/or to Dubai, at low costs.

Very few companies (Sahyadri, Chitale Agro, Frestrop, Jain Irrigation, Aarvee Farm Products, Drona Farmers, SAM Agro, etc.) have successfully exported arils thus far. KIIs reveal the most important challenge is lack of continuous power supply in many states. Companies require generator backup, which leads to an increase in production cost.

The other important challenge has been the logistics. Frozen arils are necessarily flown to export destinations and need a seamless facility in terms of cold chain from farm to international consumer. Mumbai air cargo terminal has only 4 work stations for perishable air cargo clearance. This leads to undue delay for clearing the cargo, which impacts the quality of the consignment. Further, pallet scanners are not available at Mumbai, due to which the boxes carrying the aril punnets are unloaded at the clearance station and loaded again, thereafter. This additional handling of the cargo adversely affects the quality of the delicate packaged arils.

5.7 Access to Finance

Access to finance is a critical component for developing value chains, wherein all the stakeholders including farmers are able to access affordable finance. Here, we examine whether farmers, especially the small and marginal farmers, have access to finance at affordable interest rates. We also examine the existing subsidy schemes offered to the farmers as well as to other stakeholders in the GVC and PVC.

5.7.1 Farmers' Access to Finance

In Nashik, our interactions with farmers revealed that crop loans are easily available for farmers, provided there is no default on crop loans taken in the preceding year. Table 5.8 summarizes the interest rates available for crop loans for grapes and pomegranates from nationalized banks.

However, the main problem experienced by farmers is availing land development loans or term loans. Farmers require credit for activities such as preparation of land, installing trellises, preparing pits, staking the new shrubs, buying sprayers or other implements and equipment. However, while sanctioning this loan, banks are reluctant to carry out valuation and accept farm land as collateral. Primary Agriculture Credit Societies (PACSs) were good sources to avail term loan credit for the farmer, but after

Table 5.8 Interest rate schedule for crop loans taken for grape and pomegranate farming in Nashik in nationalized banks

Amount of crop loan	Rate of interest charged by nationalized bank (%)
Less than INR 100,000	0
INR 100,000–INR 300,000	4
INR 300,000–INR 700,000	7
More than INR 700,000	11

Source KIIs with farmers and banks at Nashik

the demonetization in November 2016, most societies have either become defunct or stopped their lending activities. The small farmer is left with no other option but to avail credit from the local moneylender or *Savkar* at an interest rate of (5 to 7)% per month.

The other source of lending for the farmer is the *arthiya*, which is mostly available to experienced and well-off farmers, they know and trust. The smallest farmers are not privy to the loan facilities from the *arthiyas*.

Subsidy schemes are available for grape and pomegranate cultivation from National Horticulture Mission (NHM) as well as National Horticulture Board (NHB). These are implemented by the Horticulture Division of Agriculture Department, Government of Maharashtra. The NHM subsidies are available only for those farmers with less than 5 acres of land. The subsidy is only given for drip irrigation and vineyard and/or orchard plantation. But there is inadequate provision towards assistance for buying equipment such as sprayers and pumps. Further, there is an online procedure to avail of the NHM subsidy, which is found to be a deterrent by small farmers.

NHB subsidies are given to loanee farmers only. For example, a farmer avails a term loan for an orchard plantation. Once the project is complete, a joint inspection is done by the NHB and the bank, following which the subsidy is disbursed.

NHB and NHM subsidy norms assume annual production costs of grape farming to be INR 70,000 per acre and pomegranate farming to be INR 60,000 per acre, which are inadequate. Our KIIs with farmers reveal the annual production costs to be as high as INR 100,000 for domestically oriented farmers and INR 150,000 for farmers catering to the export markets.

5.7.2 Financial Risk Mitigation for Grape and Pomegranate Growers

Grape and pomegranate farmers typically extend a credit of about 50% of the total value to the exporter or to the domestic trader. The farmer bears the risk of the exporting firm/trader not paying the outstanding balance to the farmer.

The sensitivity analysis reveals that non-return of credit severely reduces profits of the farmers. Within the GVC, the accounting rates of return fall from 159% to 55% if 40% of the due amount is not returned, while within the PVC, they reduce from 207%

to 54% if 50% of the due amount is not returned (See Tables 5.5 and 5.6). In fact, non payment of outstanding balance by exporting firms and traders has become a serious issue affecting the livelihood of grape farmers in the Nashik belt. There have been several instances of the exporting firms and domestic traders disappearing without paying the farmers, which severely threatens the income security of the farmers.

Export Credit Guarantee Corporation (ECGC)

Farmers need a risk mitigation mechanism in order to hedge this risk. This risk mitigation mechanism could be simply in the form of a scheme modelled along the lines of the Export Credit Guarantee Corporation (ECGC). The ECGC exists to help exporters hedge risk of non-repayment by importing firms. ECGC basically creates a profile of the credit worthiness of the import firms and issues advisories on the maximum line of credit that could be prudentially offered to the import firm based on its assessment. It insures the exporter firm for credit given up to the limits recommended as per its assessment. Thus, the ECGC has essentially created an insurance model to hedge the exporter against risk of non-payment by the importer. Such products are needed while dealing with new import firms as also in dealing with relatively unknown markets such as Russia. Following are some of the schemes of the ECGC which could be effectively applied to FPOs/FPCs:

Small Exporter's Policy (SEP): This is one of the standard products offered by ECGC. See ECGC (n.d.[a]). It covers the exporter for multiple risks. These include risk of insolvency of buyer and political risks such as occurrence of war between export and import countries. It is issued to exporters whose anticipated export turnover for the period of one year does not exceed INR 50 million.

Buyer Exposure Policy: The Buyer Exposure Policy is to insure exporters having a large number of shipments to a particular buyer with simplified procedure and rationalized premium. See ECGC (n.d.[b]). An exporter can choose to obtain exposure-based cover on a selected buyer. The cover would be against commercial and political risks, as outlined in the Small Exporters' Policy.

However, there is simply no advisory that creates a credit rating of the different export firms and domestic traders to help the farmer assess the risk involved in the transactions. Obviously, no insurance products have been developed in this space at all. Thus, it is extremely important to create formal advisory services which can assess the credit worthiness of all actants within the value chain. It is also important to design insurance products to help the actants hedge risks while dealing with other actants in the respective value chains.

In 2017–18, as per APEDA (2018a), the total value of grape and pomegranate exports stood at INR 19.59 billion and INR 5.53 billion, respectively. Our calculations suggest that the grape and pomegranate farmers get 71% and 80% of the fob value of exports, respectively. This implies that around INR 18.33 billion would be the total value accruing to the farmers from the export value chains. Credit extended to the export firms would be around INR 9 billion. This is the value at risk (VAR) due to the current absence of a risk-hedging intermediation within the export value chain.

Around INR 17 billion accrue to the farmers from the domestic trade, of which the credit extended, stands at about INR 8.5 billion. This is the VAR to the farmer from the domestic operations.

5.7.3 Access to Finance for Intermediaries

Exporter firms buy the produce on spot sale at the farms itself. This produce is then taken to pack houses with pre-cooling and cold storage facilities; these are generally leased in by the exporters. A few export firms have their own pre-cooling and cold storage facilities. Nashik has a cold storage capacity of about 70,000 MT. However, many of these facilities (approximately 30%) were created during the 1990s, were largely created in response to the emerging trend in grape export and are in urgent need for upgradation. This implies that about 25,000 MT capacity needs urgent renovation. This translates into a credit demand for about INR 2.5 billion just for creation of cold storages within Nashik.

The All-India Pomegranate Growers' Association claims that the current cold storage facility at Solapur (mostly utilized for pomegranates) stands at 1000 MT but needs to be rapidly upgraded to about 5000 MT by 2024–25. The new food trade regime demands accreditation of pack houses. As demand escalates, creation of modernized pack houses will be imperative to sustain the growth of pomegranate value chain. The total investment requirement in Solapur for creation of accredited pack houses up to 2024–25 is about INR 500 million.

Given the increment in acreage under pomegranates in other districts in Maharashtra as well as in other states such as Gujarat, Madhya Pradesh and Rajasthan, credit will be required to facilitate cold storage creation as well as upgradation in all the pomegranate-producing regions.

The NHB gives 40% credit-linked capital subsidy for construction and/or modernization of existing cold storages. A number of schemes and subsidies for post-harvest management (PHM) are available from APEDA. The Maharashtra State Agriculture Marketing Board (MSAMB) is the nodal agency for implementation of APEDA schemes in Maharashtra. Assistance under the schemes is available for registered exporters, FPOs, and central and state agencies. The major heads for the schemes are export infrastructure development, quality development and market development.

Details of assistance under the schemes are given in Table 5.9.

APEDA gives assistance for infrastructure development such as cold storages, pack house facilities and pre-shipment treatment facilities. However, APEDA gives assistance only when the exporter gets the necessary clearances from the banks and multiple government departments. Multiple inspections and clearances add to the time and transaction cost involved in obtaining the assistance from APEDA. Thus, the main constraint faced by stakeholders is lack of a single window for all clearances. The other issue faced is that the scheme only provides assistance for creation of capital assets, but lack of working capital often makes the capital asset defunct.

Table 5.9 Assistance provided by APEDA for PHM under various schemes: 2018

Schemes	Components	Maximum assistance
Export infrastructure development	Cold storage, pack house facilities, pre-shipment treatment facilities such as vapour heat treatment, hot water dip treatment and some basic processing facilities such as screening, sensors and filth/metal detectors	INR 10 million
Quality development	1. Implementation and certification of quality and food safety management for all APEDA-scheduled products	40% of cost of equipment s.t. maximum limit of INR 400,000 per individual beneficiary
	2. Procuring handheld devices (HHDs) for capturing farm-level coordinates for traceability systems	
	3. Testing of water, soil, residues of agrochemicals, pesticides, etc.	INR 5000 per sample
	4. Upgradation of APEDA-recognized laboratories	40% of cost of equipment s.t. maximum limit of INR 7.5 million
	5. APEDA registered exporters for in-house laboratory equipment	40% of cost of equipment s.t. maximum limit of INR 2.5 million
Market development	1. New market development, feasibility studies	40% of cost of equipment s.t. maximum limit of INR 1 million per beneficiary
	2. Trial shipment for produce	40% of cost of equipment s.t. maximum limit of INR 0.5 million per container
	3. Registration of brand/IPR outside India	40% of cost of equipment s.t. maximum limit of INR 2 million per container

Source APEDA (2018b)

Exporters face another credit constraint due to the peculiar nature of the consignment sale, wherein the final price is not known to either party until the final realization of the sale. Exporting firms receive only (40–60)% payment as advance from the importing firms, and the remaining payment is done almost 40 days after the produce is shipped.

Exporters need working capital for carrying out the expenses related to packaging, pre-cooling, transport, labour, etc. Typically, banks sanction working capital loans only against the advance payment mentioned in the export order and hence the available working capital is not enough to cover all the expenses incurred by the exporting firms. According to the industry norm, working capital of INR 100,000 is required to export a consignment of 1 MT. The working capital loans are usually sanctioned by commercial banks at about 12% interest.

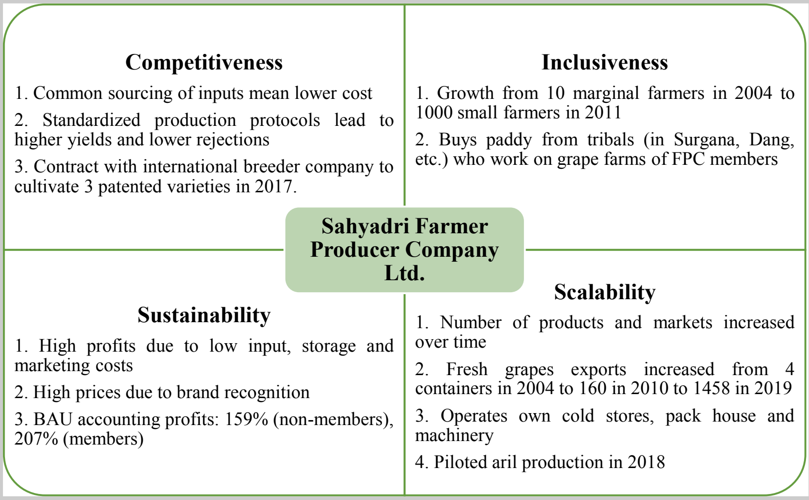
5.7.4 Access to Finance for FPOs/FPCs

Promotion of FPOs or FPCs specializing in grapes and/or pomegranates could be immensely beneficial in strengthening the value chains and empowering farmers to earn higher prices. The FPCs can enable minimizing the pre and post-harvest costs, access to expert know-how as well as reduced costs in terms of chemical molecules required for grape and pomegranate cultivation.

Sahyadri Farmers Producer Company Limited has emerged as a success story, and its journey is worth studying to understand how FPCs/FPOs can benefit farmers. It is the largest FPC in India which started its operations with 10 marginal grape growers in 2004 in Nashik. The case of Sahyadri FPC Ltd. which formally registered as a FPC in 2011, is an interesting case of competitiveness, inclusiveness, sustainability and scalability. The company imports soluble fertilizers and other inputs for its members and thus acts as an aggregator. The growth in all vineyards is tracked online, and harvest is planned as per maturity of vineyards, storage capacities and demand schedules. Sahyadri farmers are able to save nearly INR 20,000 per acre, and the members claim that their exportable output is 7 tonnes per acre as compared to the Nashik average of 6 tonnes per acre. All activities such as production, pruning and spraying on farms of all 1000 plus members of Sahyadri are planned in the same weeks. These are tracked on special digital apps, helping the members to adhere to production protocols gainfully.

Given the need to increase cold storage capacity in Solapur from 1000 to 5000 MT over the next 5 years, such capacity expansion can be undertaken and financed through FPOs or FPCs. However, a common problem observed is that infrastructure created is often unused due to the unavailability of working capital at affordable interest rates. Hence, once FPOs/FPCs are rated on the commercial sustainability of their venture, access to finance for creating cold storages or pack houses can be enhanced through matching equity grant schemes.

Box 5.1: Sahyadri Farmer Producer Company Ltd: A Case of Competitiveness, Inclusiveness, Sustainability and Scalability



Box 5.2: Innovative Practices and their impact at Sahyadri FPC Ltd.

- Common schedule for pruning, spraying, harvesting, etc., for all member farms.
- Online tracking of vineyards: harvest planned as per maturity of vineyards, storage capacities and demand schedules: There is a saving of nearly INR 20,000 in costs per acre, and the members claim that their exportable output is 7 MT per acre as compared to a Nashik average of 6 MT per acre.
- Automated weather stations (AWSs) and Agromet advisories.
- Accounting profits of members show a remarkable jump from 159% to 207% on joining the FPC.
- Cultivating three new varieties for an international breeder company. FPC to pay a 5% royalty on the entire exports of the patented varieties from India.

5.8 Policy Recommendations

Studying the grape and pomegranate value chains using the CISS-F framework has put forth very interesting insights and important policy implications. This section discusses key policy reforms that can help strengthen both the grape and pomegranate value chains by overcoming the challenges and leveraging the opportunities. As demand for high-value commodities increases both domestically and globally, India is very well positioned to cater to both these markets. It will be critical to ensure that the economic benefits of such market expansion are shared equitably with the primary producers to live up to the vision of inclusive growth.

Diversity in Variety of Grapes and Pomegranate that have Remunerative Markets
Lack of varieties is one of the major issues faced by grape as well as pomegranate farmers. The international grapes market heavily favours new varieties, and the secret of success for grape growers in Peru and Chile is their penchant for export varieties. Indian grape farmers from Nashik have nearly 70% share in the global market for Thompson Seedless. However, this is not so much due to cost competitiveness of Indian grape growers. This is primarily because grape growers from competing countries such as South Africa, Chile and Peru have started rapidly harvesting coloured, patented varieties. For India to take advantage of a fairly diversified global grape market, cultivation of those varieties needs to be promoted. Thus, there is a need for aggressive research (to be carried out at NRC Grapes) so as to breed coloured varieties that are amenable to cultivation in Indian soil, topography and weather conditions.

For pomegranates, India exports the cultivar *Bhagwa* only. This is the most popular variety consumed in the domestic market. While the cultivar has stabilized quite well, it is optimally sized at 250 g. The EU and Gulf markets price the bigger fruits of size 350 g at a premium of at least around 20% over the regular size of 250 g. The farmers can earn a higher premium if the same variety of *Bhagwa*, with higher optimum fruit size, could be researched and developed.

Aggressive research backup, education and extension have to be strengthened by the government for sustaining the profit momentum within the export value chains of grapes and pomegranates.

Improved Access to Finance in the Value Chain (Norms, Coverage and Actual Coverage of Credit/Subsidies)
Credit is given by almost every player to the next actant in the grape value chain. Thus, farmers give credit to the exporters and/or domestic traders and the exporters in turn give credit to the import firms. Chances of non-return of the credit extended can play havoc with the economics of grape and pomegranate farming.

Despite, Export Credit Guarantee Corporation (ECGC) of India providing insurance to exporters to hedge risks, it is found that the grape- and pomegranate-exporting firms do not avail such insurance.

It is critical to design formal advisory services which can assess the credit worthiness of all actants within the value chain. Also, creation of insurance instruments to help the actants hedge risks associated with price volatility, non-payment, etc., is relevant. An entity could be designed on same lines as the ECGC to cater to the needs of the domestic agriculture markets. ECGC is a central government organization which offers guarantees against default on payment by the importing firms. With a small fee, ECGC gives information on the credit score of importing firms.

Hence, small exporters can take informed decisions on how much credit to extend to their importing counterparts.

This kind of a scheme is also needed for domestic markets as well, especially under the framework of the new marketing laws, which allow farmers to trade with any other PAN card holding entity in India. If credit scores of buyers can be created and provided to farmers, it will help the farmers to take an informed decision on extending credit to the buyers. As has been mentioned earlier, farmers extend credit to exporters as well as domestic traders and hence are vulnerable to a risk of default by these parties. Our calculations show that the value at risk (VAR) due to non-availability of insurance products stands at INR 17.5 billion within the grape and pomegranate value chains alone.

This entity would also be a logical plug-in to the e-NAM design. NHB and NHM subsidy norms assume annual production costs of grape farming to be INR 70,000 per acre and pomegranate farming to be INR 60,000 per acre, which is inadequate. Subsidy norms fixed by government agencies should reflect field realities accurately.

Strengthening Logistics to Enhance Marketability

Exporter firms buy the produce on spot sale at the farms. This produce is then taken to pack houses with pre-cooling and cold storage facilities. Nashik has a cold storage capacity of about 70,000 MT. New multi-facility cold facilities that can be accredited as export safe are required at Nashik, Solapur as well as Sangli. Other grape- and/or pomegranate-producing states such as Gujarat, Madhya Pradesh and Rajasthan also need cold stores to be developed. If dedicated cold storage facilities for grapes and pomegranates could be developed in Bihar or Delhi, the farmers in Maharashtra can also access the more remote and fairly remunerative markets of Jammu and Assam.

There are a number of inadequacies in the logistics chain that do not allow products such as arils to be exported easily. Limited number of clearance stations at Mumbai Cargo Terminal, lack of pallet scanners and multiple handling of the produce lead to product damage and rejection of the consignment. It puts exports into jeopardy. These facilities need to be provided so as to smooth out the rough edges connected to aril exports.

Strengthening Institutions such as FPOs/FPCs

Farmers in Sangli often have to sell off raisins to the traders at unremunerative prices. The reason is that raisins require cold storage and these are largely controlled by raisin traders. FPC-promoted cold chains could be an effective solution to help farmers earn remunerative prices and make raisin value chains more inclusive for small and marginal farmers.

FPC membership has also improved the rates of returns experienced by small farmers sharply. Well-managed, professional FPCs might well evolve to be the best business models for grape and pomegranate value chains.

Both grapes and pomegranates are high-value commodities and have robust markets for fresh and value-added products. For small and marginal farmers to access these domestic and global markets, FPCs can play a large enabling role. Aggregation of input and service requirement of farmers can help reduce costs of production.

Technology solutions for better value addition and meeting stringent quality standards can be organized and made more affordable to the farmers. Professionally managed FPCs can help strengthen existing value chains and ensure that these are inclusive of small and marginal farmers.

States like Karnataka, Andhra Pradesh, Tamil Nadu, Punjab and Haryana have favourable agro-climatic conditions that support vineyards. A cluster-based approach could be adopted in these states to promote grape cultivation through handholding of farmers, bringing in the right package of practices and providing the required institutional support. The demonstrated success of grape cultivation and marketing in Maharashtra can be shared with potential states to boost grape cultivation in the country.

Addressing Issues related to Climate Change
Climate change has been impacting the profitability of grape as well as pomegranate cultivation for the farmers. Particularly, it affects pomegranate production more, because standardized production protocols are not yet developed. Thus, farmers are not aware of the right technology solutions that can help them address issues related to a drought or a very cold spell. They cannot anticipate the onset of diseases due to changes in weather conditions well in advance to control crop damage. On the contrary, grape farmers are aware and better equipped with the technology solutions and have been able to face climate uncertainties relatively better. Hence, there is need for considerable research in designing production protocols for pomegranates to help farmers cope with production uncertainties related to weather, environment and diseases.

For grapes as well as pomegranates, if water is not available at the right time, it affects the yield as well as quality of produce. Farmers suffer losses as they are unable to sell in the export market and are forced to sell in the domestic market. Although farmers are quite vulnerable to the adversities arising out of climate change, insurance instruments to help them hedge against production and price risks are still in a nascent stage. Farmer awareness regarding such products is also quite low. Hence, there is need for making such insurance available to the farmers and promote greater awareness among them about the benefits of availing such risk mitigation measures.

Norms for Reporting Data Pertaining to Export of Horticulture Produce
According to the export firms interviewed during field visit, the importing firm normally pays only 50% of the expected consignment sale value to the exporter on the day of shipping. The importing agent normally credits the rest of the amount to the exporter's account after about 15 days after the consignment reaches the retailer. On the day of shipping, the exporter does not know the final value that he will receive (that depends on the price movements in the next month) for the consignment. Hence, he only submits a proforma invoice as a part of the documentation required by APEDA. The proforma invoice carries details of the value of the consignment as received by the exporter on the day of shipping as well as details of the volume of the consignment shipped. However, the value received by the exporter on the day of shipping the consignment is only (50–60)% of the actual value that he eventually receives.

APEDA maintains data on only proforma invoices submitted by the exporters and not on the actual value received by them eventually. To the extent that the values entered in the proforma invoices are understated, this implies that calculations of unit values based on APEDA data are also underestimated.

The value eventually received by the exporter is entered on the Bank Realization Certificate (BRC) which is part of the documents submitted to the DGCIS, based on which the DGCIS releases the MEIS subsidies. It is of vital importance that the DGCIS data be integrated with the APEDA database, so that the actual value of grape exports from India is recorded correctly.

Grapes and pomegranates are extremely high-value horticulture products with well-established value chains. The domestic as well as export value chains have shown robust performance despite the presence of several challenges and policy gaps. The study creates an understanding of different actants within the value chain through the CISS-F lens and comes out with suitable policy interventions that can help better the performance of the value chains.

Annexures

Annexure 5.1: Calculation of NPC for Indian Grape Exports

Year	UV1	UV2 = UV1 less port handling	UV3 = UV2 less 7% trader margin	UV4 = UV3 less 32% packing, labour, pre-cooling, transport, marketing costs	UV5 = UV4 adjusted 10% for quality	Av wholesale prices (3 months)	NPC
2006-07	35.13	34.63	32.37	24.52	22.29	12.10	0.54
2007-08	32.78	32.28	30.17	22.85	20.78	18.73	0.90
2008-09	31.07	30.57	28.57	21.64	19.68	15.99	0.81
2009-10	36.74	36.24	33.87	25.66	23.32	19.23	0.82
2010-11	42.30	41.80	39.07	29.60	26.90	26.38	0.98
2011-12	54.48	53.98	50.45	38.22	34.74	36.18	1.04
2012-13	69.67	69.17	64.64	48.97	44.52	32.06	0.72
2013-14	89.67	89.17	83.34	63.14	57.40	26.85	0.47
2014-15	103.07	102.57	95.86	72.62	66.02	46.75	0.71
2015-16	102.70	102.20	95.51	72.36	65.78	35.32	0.54
2016-17	89.77	89.27	83.43	63.21	57.46	37.97	0.66

Source: NHB (2018a, b); APEDA (2018a) and Authors' calculations

Annexure 5.2: Calculation of NPCs for Indian Pomegranate Exports

Year	UV1	UV2 = UV1 less port handling	UV3 = UV2 less 7% trader margin	UV4 = UV3 less 16% packing, labour, pre -cooling, transport, marketing costs	Av wholesale prices (3 months)	NPC
2006-07	36.72	36.22	33.85	27.3	31.04	1.14
2007-08	25.93	25.43	23.76	19.16	33.75	1.76
2008-09	32.93	32.43	30.3	24.44	41.92	1.72
2009-10	35.79	35.29	32.98	26.6	60.42	2.27
2010-11	38.96	38.46	35.94	28.99	83.01	2.86
2011-12	48.83	48.33	45.17	36.42	79.43	2.18
2012-13	65.09	64.59	60.36	48.68	81.23	1.67
2013-14	121.9	121.4	113.46	91.5	94.35	1.03
2014-15	153.97	153.47	143.43	115.67	73.98	0.64
2015-16	102.27	101.77	95.11	76.7	74.55	0.97
2016-17	98.58	98.08	91.66	73.92	75.92	1.03

Source: NHB (2018a, b); APEDA (2018a) and Authors' calculations

Annexure 5.3: Business as Usual Scenario and Sensitivity Analysis for Grapes

Assumptions for constructing BAU financial estimates for the export-oriented farmer with 1 acre of land under grapes:

- Precision farming for grape yields about 10 MT per acre.
- Around 60% is exported; 30% is sold on domestic markets and 10% damaged.
- FGP for export quality fruit = INR 70 per kg; FGP for domestic market = INR 50 per kg.
- Cost of establishment of the vineyard and maintenance of the same for the first two years (drip, land preparation for the plantation, trellises and stakes, planting material, implements such as sprayers) stand at INR 500,000 in 2018.
- The annual production cost (A2) after second year of operations is INR 220,000.
- Imputed cost of family labour is assumed to be INR 120,000 per annum. Rental value of 1 acre land is valued at INR 50,000 per acre in Nashik. Further, the opportunity cost of fixed capital (INR 500,000) at 8% is INR 40,000 per year. Since almost all sales are carried out on farm, there are no marketing costs for the farmer.

Indicative revenues, costs and rate of returns to export-oriented grape farmers under BAU scenario

S. No.	Indicative revenues and costs (INR)	
1	Revenues—exports	420,000
2	Revenues—domestic	150,000
3	Cost of cultivation (A2) after two years of establishment	220,000
4	Net profit per annum	350,000
5	Capital cost	500,000
6	Life of project	10 years
I	Accounting rate of return (per annum over recurring costs)	159%
II	Internal rate of return of project (over A2)	70%
III	Internal rate of return of project (over A2 + FL)	45%
IV	Internal rate of return of project (over C2)	30%

Source KIIs and authors' calculations

Assumptions for constructing BAU financial estimates for the domestically oriented farmer with 1 acre of land under grapes:

- Yield is 12 MT per acre (grape yields on domestic-oriented farms are higher than export-oriented farms).
- 10% lost in damages, and rest sold at INR 35 per kg.
- The cost of establishment of the vineyard and maintenance of the same for the first two years stands at INR 500,000 in 2018.
- The annual production cost (A2) after second year of operations is INR 120,000 for a one-acre grape plantation. The imputed value of family labour is assumed to be INR 100,000 per annum. Rental value of 1 acre land is INR 50,000 per acre in Nashik. Further, the opportunity cost of fixed capital (INR 500,000) at 8% is INR 40,000 per year. Since almost all sales are carried out on farm, there are no marketing costs for the farmer.

Indicative revenues, costs and rate of returns to domestically oriented grape farmers under BAU scenario

S. No.	Indicative revenues and costs (INR)	
1	Revenues—exports	0
2	Revenues—domestic	378,000
3	Cost of cultivation (A2) after two years of establishment	120,000
4	Net profit	258,000
5	Capital cost	500,000
6	Life of project	10 years
I	Accounting rate of return (per annum over recurring costs)	215%

(continued)

(continued)

S. No.	Indicative revenues and costs (INR)	
II	Internal rate of return of project (over A2)	51%
III	Internal rate of return of project (over A2 + FL)	25%
IV	Internal rate of return of project (over C2)	6%

Source: KIIs and authors' calculations

Annexure 5.4: Business as Usual Scenario and Sensitivity Analysis for Pomegranate

Assumptions for constructing BAU financial estimates for the export-oriented farmer with 1 acre of land under pomegranates:

- The farmer practises precision farming techniques which yields about 8 MT per acre. The export is oriented to Gulf markets.
- Around 60% of the yield is of export quality. Around 30% of the produce is sold on domestic markets, and about 10% is damaged.
- FGP for export quality fruit = INR 60 per kg; FGP for domestic market = INR 40 per kg.
- The cost of establishment of the pomegranate orchard and maintenance of the same for the first two years (drip, land preparation for the plantation, pits, planting material, stakes, implements such as sprayers) stand at INR 180,000 in 2018.
- The annual production cost (A2) is INR 125,000. Imputed cost of family labour is assumed to be INR 120,000 per annum. Rental value of 1 acre land is INR 50,000 per acre in Nashik. Further, the opportunity cost of fixed capital (INR 180,000) at 8% is INR 14,400 per year.

Indicative revenues, costs and rates of return to export-oriented pomegranate farmers under BAU

Indicative costs and revenues (INR)		
1	Revenues—exports	252,000
2	Revenues—domestic	96,000
3	Cost of cultivation (A2) after two years of establishment	125,000
4	Net profit per annum	223,000
5	Capital cost	180,000
6	Life of project	10 years
I	Accounting rate of return (per annum over recurring costs)	207%
II	Internal rate of return of project (over A2)	144%

(continued)

(continued)

Indicative costs and revenues (INR)		
III	Internal rate of return of project (over A2 + FL)	77%
IV	Internal rate of return of project (over C2)	40%

Source KIIs and authors' calculations

Assumptions for constructing BAU financial estimates for the domestically oriented farmer with 1 acre of land under pomegranates:

- Yield is 7 MT. (Without precision farming techniques, pomegranate yields vary from 6 to 10 MT per acre, assuming water availability.)
- 60% of the produce is of good quality; price in APMC market is INR 40.30% sold at INR 25 in the domestic *mandi*, and 10% of the produce is damaged.
- The cost of establishment of the pomegranate orchard and maintenance of the same for the first two years stand at INR 180,000 in 2018.
- The annual production cost (A2) after second year of operations is INR 100,000. Imputed cost of family labour is assumed to be INR 100,000 per annum. Rental value of 1 acre land is assumed to be INR 50,000 per acre in Nashik. Further, the opportunity cost of fixed capital (INR 180,000) at 8% is INR 14,400 per year.
- Since pomegranates are necessarily routed through APMCs or *mandis*, there is a cost of marketing incurred by the farmer. The farmers pack the pomegranates in 20 kg crates and transport the pomegranates to the Nashik APMC market by small tempos. The rent for the tempo depends on the actual distance travelled; we assume a rent of INR 30 per crate. The farmer then pays INR 10 per crate as labour charges and also pays INR 20 per crate to the arthiya as auctioning charge. Thus, the farmer bears a cost of around INR 63 per crate.
- Out of an average yield of 7 MT, 90%, i.e. 6.3 MT, is taken across to the APMC *mandi* in crates. Since each crate carries 20 kg, 315 crates are required to carry 6.3 MT to the market. The cost per crate is INR 63. Thus, the domestically oriented farmer bears a marketing cost of INR 19,845.

Indicative revenues, costs and rate of returns to domestically oriented pomegranate farmers under BAU scenario

S. No.	Indicative revenues and costs	
1	Revenues	220,500
2	Cost of cultivation (A2) after two years of establishment	100,000
3	Cost of marketing—315 crates @ INR 63 per crate	19,845
4	Total costs	119,845
5	Net profit per annum	100,655
5	Capital cost	180,000
6	Life of project	10 years

(continued)

(continued)

S. No.	Indicative revenues and costs	
I	Accounting rate of return (per annum over recurring costs)	84%
II	Internal rate of return of project (over A2)	55%
III	Internal rate of return of project (over A2 + FL)	0%
IV	Internal rate of return of project (over C2)	0%

Source KIIs and authors' calculations

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Chapter 6
Dairy Value Chain

T. Nanda Kumar, Sandip Das, and Ashok Gulati

6.1 Introduction

Livestock sector is the backbone of Indian agriculture and plays a crucial role in the development of the rural economy. More than one-fifth (23%) of agricultural households in India with area less than 0.01 hectare reported livestock as their principal source of income (GoI 2014). Livestock is one of the fastest-growing sectors of Indian agriculture. Livestock sector accounts for 31% of the gross value of output in agriculture and allied sector (GVOA). Within livestock, milk is the biggest component with 20% share in GVOA. In fact, milk is the largest agriculture commodity in terms of value of output, worth INR 772,705 crores, which was more than the value of cereals, pulses, oilseeds and sugarcane combined, worth INR 623,462 crores in 2018–19 (MoSPI 2021). Around 70 million rural households are engaged in milk production, most of them being landless or small and marginal farmers (DAHD 2018). As a source of livelihood for millions of poor households, dairying also supplements their dietary sources of protein and nutrition, thus playing a critical role in the country's food security needs.

Globally, India is the largest milk producer and accounted for 20% of the milk production in 2017. In the 1950s and 1960s, the country's milk production was stagnant, even witnessing negative growth in many years. Imports of dairy commodities were a norm in the first two decades of the post-independence era. Operation Flood (OF) implemented by National Dairy Development Board (NDDB) (1972–1996) created a national milk grid linking rural producers to urban consumers through a network of dairy co-operatives. The dairy revolution or the white revolution in

T. Nanda Kumar
Former Senior Visiting Fellow, Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

S. Das · A. Gulati (✉)
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

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India was led by the largest and most successful co-operative, Gujarat Co-operative Milk Marketing Federation (GCMMF) Limited or Amul. The stellar leadership of Sardar Vallabhbhai Patel and Lal Bahadur Shastri and persistent groundwork by local leaders like Tribhuvandas Patel combined with the innovative genius and technological prowess of Dr. Verghese Kurien, shaped the dairy co-operatives. Dr. Kurien championed the launch of Operation Flood, which resulted in creation of three-tier dairy co-operative structure in the states also known as milk-sheds where liquid milk could be produced, procured and transported to nearby cities.

After following a heavy protectionist and licensing regime, dairy industry was liberalized during 1991 economic reforms and the doors were opened for private entrepreneurs to compete with the co-operatives in procurement and marketing of milk. But due to political pressure from the co-operatives, the Milk and Milk Products Order (MMPO), 1992 was announced by the government under the Essential Commodities Act (ECA) in order to regulate production of milk and milk products, thereby, reintroducing licensing of the processing industry. It was only in 2001, when the Atal Bihari Vajpayee led government amended MMPO, thus abolishing the license renewal system. In 2003, all restrictions on processing and manufacturing plants were removed. The amended Order emphasized sanitary, hygiene, quality and safety of milk and milk products. As a result of this delicensing, there was a major fillip in creation of processing capacity by the private sector. In fact, private processing capacity created in two decades since 1990s has been more than the capacity created by the co-operatives over three decades (Dairy India 2017). However, the pasteurized liquid milk market is still dominated by the co-operatives. Following the implementation of Operation Flood (OF) between 1970 and 1996, India's milk production increased at a steady pace, surpassing the United States as the world's largest milk producer in 1998 (Fig. 6.1). Between 2001–02 and 2018–19, milk production in India increased from 84.4 million metric tonnes (MMT) to 187 MMT, at a compound annual growth rate (CAGR) of 4.4%.

Global trade in dairy products amounted to about USD 45 billion in 2017, significantly up from USD 39 billion in 2016 (Global Dairy Industry 2018). It is the European Union (especially countries like France, Ireland, and Germany) popular

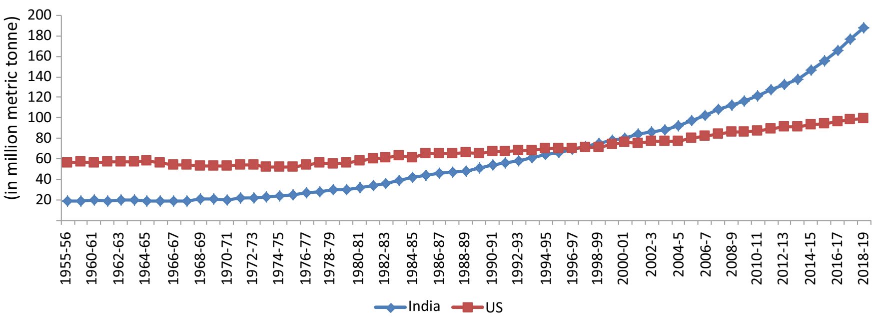

Fig. 6.1 India and USA milk production. *Source* DAHD (2019), USDA

for their cheese and butter that has the largest share of about 39% in the global trade of dairy products. New Zealand and Australia (Oceania region) are also important exporters of milk in skimmed milk powder (SMP) form.

It is against this backdrop that we study the dairy value chain in India with an objective to assess how far it is globally and domestically Competitive, Inclusive, Sustainable and Scalable with adequate access to finance (CISS-F).

6.2 Overview of the Dairy Sector

6.2.1 Global Dairy Sector

The world milk output reached 811 million tonnes in 2017, 1.4% higher than in 2016. Across geographic regions, milk output expanded in Asia, the Americas and Europe while it stagnated in Africa and declined in Oceania. About 150 million households in the world are engaged in milk production.

India accounts for about 20% of global milk production, almost same as the European Union (EU), followed by USA (12%), with China and Pakistan producing roughly 5% each (Fig. 6.2). But India, despite being the leading producer of milk globally, does not figure in the top 5 exporters of SMP. In 2016, SMP exports were highest by USA (27%), very closely followed by EU (26%), New Zealand (20%), Australia (7%), and all others accounting for about 18% (Table 6.1). SMP remains the dominant dairy produce in global markets (51% in value), others being cheese (36%) and butter (13%) (Table 6.2).

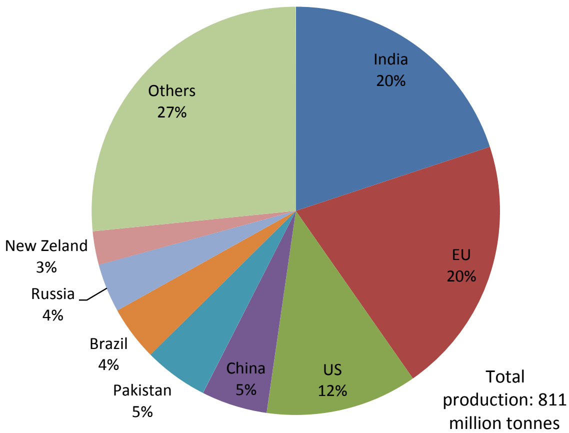

Fig. 6.2 Country-wise share of global milk production (TE 2017). *Source* FAO (2017)

Table 6.1 Global trade in SMP 2016

Total global trade/exports	21.87 (lakh tonnes)/USD 4870 million
European Union	5.74 (26%)
The United States	5.93 (27%)
New Zealand	4.44 (20%)
Australia	1.64 (7%)
Others	*4.12 (18%)*

Source FAOSTAT (2016), FAO (2017)

Table 6.2 Global market in dairy products (2016)

Commodities	Trade volume (lakh tonne)/value (USD/million)	% of total trade (volume/value)
Milk powder[a]	46.52/11,030	57/51
Cheese	24.78/7815	31/36
Butter	9.63/2742	12/13

Source FAO (2017)
Note [a]Whole milk powder/skimmed milk powder

6.2.2 Domestic Dairy Sector

Milk production in India increased from 83.7 million tonnes in TE 2002–03 to 176.5 million in TE 2018–19 (Fig. 6.3). Per capita consumption of milk increased from 221 grams per day to 374.7 grams per day during the same period. India has the world's largest bovine (cattle, buffalo, mithun and yak) population of 302.8 million, which is 56.5% of the total livestock population (535.8 million) (DAHD 2019). Cross-bred/exotic milch cattle population increased by 32.2% between 2012 and 2019. However, indigenous buffaloes account for 48.9% of the milk production, followed by cross-bred cattle at 27.3%.

Notwithstanding steady increase in India's milk production, especially since 1980s, milk production is concentrated in few states. In 2018–19, ten states contributed more than 81% of the country's milk production (Fig. 6.4). India's milk production continued to increase mainly because of rising demand for processed food from increased urbanization. This milk output growth was supported by rising milk collection and processing facilities especially by dairy co-operatives along with rising role of Artificial Insemination (AI) adopted by the organized sector (FAO 2020).

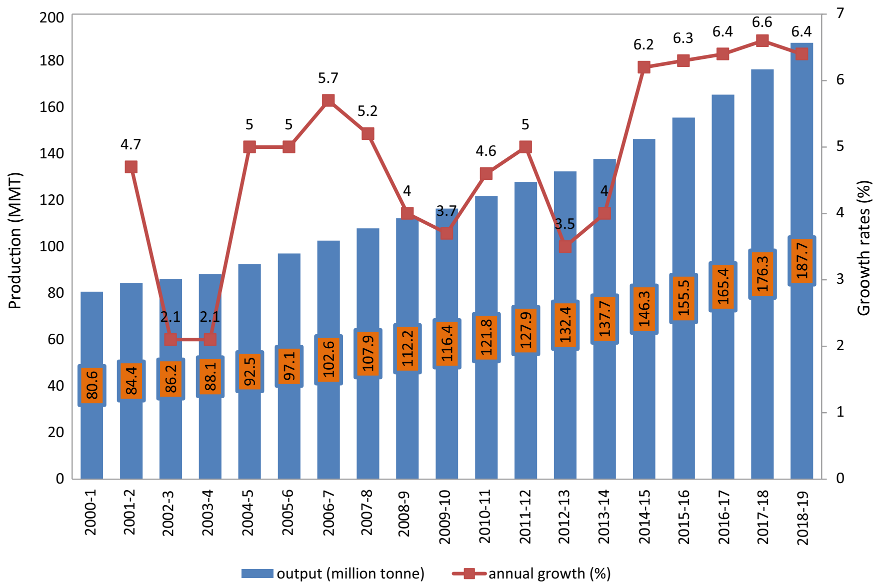

Fig. 6.3 Milk production in India. *Source* DAHD (2019)

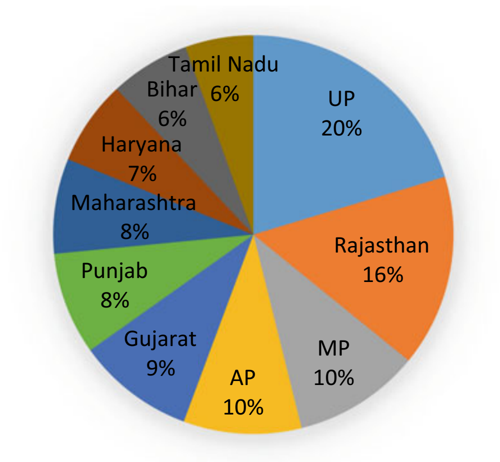

Fig. 6.4 Share of milk production in top 10 milk producing states (TE 2018–19). *Source* DAHD (2020)

6.2.3 Milk Procurement and Processing

It is estimated that 48% of milk is retained for self and local consumption and the remaining 52% is marketed to urban consumers through organized sector (31%) and unorganized sector (21%) comprising of *dudhwalas* (milk vendors) and *halwais* (sweet shop owners), who collect milk from producers and supply unprocessed milk to the customers at their doorstep. Co-operatives and private players account for an equal share of the organized dairy sector. GCMMF or Amul is the leading player in the dairy sector with average milk procurement of 229 lakh litre per day (LLPD) reported in 2018–19, which is 45% of the total procurement by co-operatives. Amul is followed by Karnataka dairy co-operative, (Nandini) at 74 LLPD (15%), Maharashtra (Mahananda and others) cooperatives at 39 LLPD (8%), Tamil Nadu (Aavin) at 33 LLPD (7%) and Rajasthan (Saras) at 27 LLPD (5%) (NDDB 2020). The top five state co-operative federations contribute close to 80% of the total milk procurement by mainly 15 states dairy federations (Fig. 6.5).

As of 2015–16, Uttar Pradesh based VRS Foods Ltd and Tamil Nadu based Hatsun Agro Product Ltd are the top two private dairy players with an average milk procurement of 25 LLPD and 18 LLPD, respectively. Maharashtra based Parag Milk Food procures 12 LLPD of milk. Besides, there are 8–9 private dairy companies across the country with an average milk procurement of 7–15 LLPD each (Dairy India 2017). However, official data on volume of milk procurement as well as processing capacity of organized private sector is not known. While Food and Safety Standard Authority of India (FSSAI) collects data on registration and licensing of dairy plant capacity, the data is not disaggregated into co-operatives and private organized players (Lok Sabha 2019a).

Unlike in the European Union, Australia and New Zealand, SMP is a residual commodity and not a value-added product in the Indian domestic dairy market. Due to seasonality in India's milk production, where winters are generally flush with milk and summers witness dip in production, SMP is produced mostly out of compulsion to help farmers with assured income and smoothen inter-year milk supply fluctuations. This seasonal variability results in SMP production being restricted to only about 4–5 months in a year. No official estimates of SMP production and prices are available in India. However, industry experts suggest that about 3% of total milk production gets converted into SMP, annually.

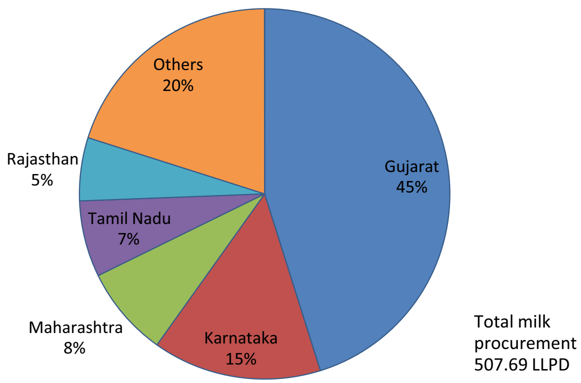

Fig. 6.5 Percentage of milk procured by co-operatives: 2018–19. *Source* NDDB (2020)

As a policy, co-operatives procure the entire quantity of liquid milk that is offered by their members. In winter or flush season that extends from October to January, co-operatives procure a large surplus of milk and in summer, lower milk production results in lower milk procurement. In the case of private sector, a few of them produce SMP for the domestic food industry. Some private processors manufacture SMP when market (both domestic and export) conditions are good. Generally, SMP is not available at the retail level and is traded between dairy and dairy/food companies depending on the seasonal fluctuations in milk demand.

6.3 Competitiveness

This section examines the competitiveness of the Indian dairy value chain both at the international as well as the domestic levels. While international competitiveness is examined by estimating Nominal Protection Coefficients (NPCs) of SMP, i.e. whether the Indian SMP prices are lower (efficient) or higher (inefficient) than global prices. Domestic competitiveness is assessed by estimating farmer's share in consumer rupee. If the farmer's share in consumer's rupee is high, it indicates that the intermediation costs are low and therefore milk value chain is efficient.

6.3.1 International Competitiveness

Dairy Trade Policy

India's dairy trade policies are formulated mostly in response to local demand and supply conditions, thereby, subject to periodic changes. Between 2000–01 and 2006–07, SMP imports attracted import duty of 60%. Imports routed through National Dairy Development Board (NDDB) had an import quota of 10,000 tonnes in a financial year, attracting a duty of 15%. In 2016–17 and 2017–18, SMP attracted an import duty of 64% (basic duty of 60% and special countervailing duty of 4%). This duty structure continued in 2020–21.

In February 2011, the government banned SMP exports in an attempt to contain rising domestic prices of milk. On June 11, 2012, the government removed any restriction or ban on exports of SMP and provided export subsidy (5% of FOB value of exports) for SMP through *Vishesh Krishi and Gram Udyog Yojana* (VKGUY), also known as Special Agriculture and Village Industry Scheme. The scheme was aimed at compensating any exporter from the village to the port. For clearing huge inventory of SMP (estimated at more than 200,000 tonnes as per industry sources), especially with GCMMF/Amul and other co-operatives, the government of Maharashtra and Gujarat announced an export subsidy of INR 50,000 per tonne (July 2018). The central government announced an additional export subsidy of 10% on export price (Lok Sabha (2019b)).

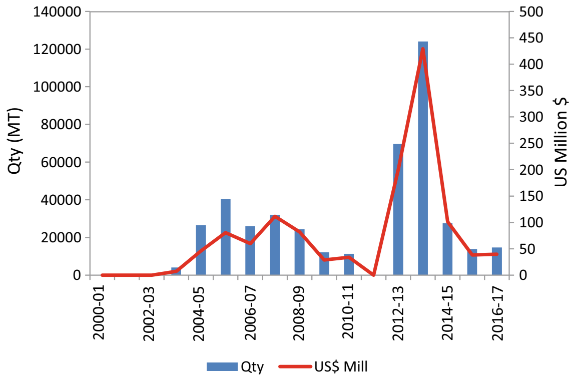

Fig. 6.6 SMP export from India. *Source* APEDA (2019)

SMP Exports from India

India's SMP exports are mostly confined to countries such as United Arab Emirates (UAE), Bangladesh, Nepal, Pakistan, Bhutan and Sri Lanka. In 2016–17, India exported 14,698 tonnes of SMP worth USD 40 million accounting for 30% of total dairy exports. In 2013–14, global SMP prices rose sharply in contrast to domestic price that resulted in a spurt in exports (Fig. 6.6).

New Zealand in Comparison to India

New Zealand exports around 85% of its milk production, mostly in processed form and has been the price setter in the global SMP market. The country's dairy business model is aligned to international prices and the prices given to farmers vary accordingly. Farm gate prices offered to New Zealand farmers by Fonterra varies as per international market conditions. Fonterra has around 10,500 farmers and shareholders. Between 2014 and 2015 (February), the farm gate milk prices for the New Zealand farmers were reduced by about 43% because of fall in global prices. Similarly, prices given to farmers rose by 66% between 2006 and 2008.

However, in the case of Indian dairy co-operatives, the prices given to farmer members are never rolled back. In such a downward sticky-price situation, Indian co-operatives are unable to compete in a highly volatile market by adjusting milk prices to SMP prices. Differences in farm gate prices offered by Fonterra and Amul are illustrated in Fig. 6.7.

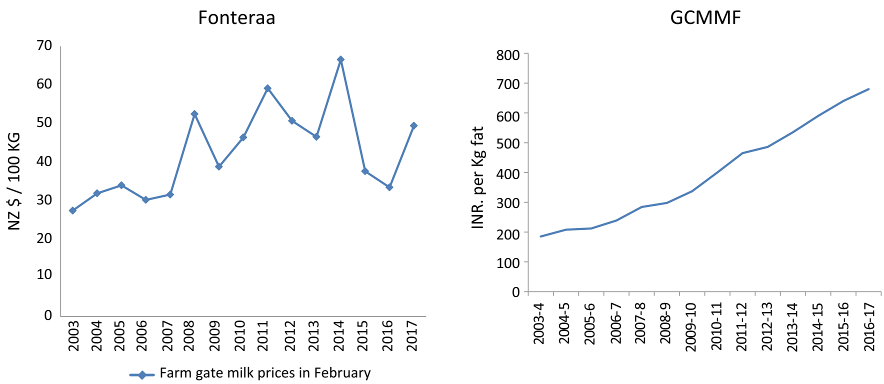

Fig. 6.7 Historical overview of farm gate milk prices: Fonterra (NZ) and GCMMF (Amul)

Estimation of NPC of SMP for Three States

The nominal protection coefficient (NPC) of SMP is estimated for three states—Gujarat, Maharashtra and Uttar Pradesh for 17 years (2000–01 to 2016–17). For the domestic farm gate prices of milk, data from co-operatives and a major private player in Maharashtra and co-operatives in Gujarat and Uttar Pradesh have been used. These three states provide a unique diversity in the Indian dairy sector. In Maharashtra, both private and co-operatives have an almost equal share in milk procurement while in Gujarat; the co-operatives have a monopoly in milk purchase. Uttar Pradesh, despite being the largest milk producing state in India, does not have any significant presence of the co-operatives and private sector (mostly unorganized) has ample operating space in the state.

Out of the total 17 years (2000–01 to 2016–17), with two years of exceptionally low prices, the Gujarat co-operatives have been globally competitive only in 5 years (Figs. 6.8 and 6.9). In Maharashtra, the co-operatives and private sector have been globally competitive in SMP in 9 and 15 years, respectively. Uttar Pradesh's co-operative and private sector have been globally competitive in SMP in 11 and 15 years, respectively (Figs. 6.10 and 6.11).

While Gujarat, because of co-operatives' inclusive approach towards small dairy farmers, can be competitive only in high-value dairy products exports and not in SMP exports, unless they price SMP as a part of overall strategic pricing. Uttar Pradesh with a small presence of co-operatives but a large and diversified presence of the private sector, should explore investment, consolidation and export opportunities for SMP, globally. Gujarat could continue to work on its strength of inclusiveness, high procurement and sale of liquid milk, and value-added products. Even Maharashtra could look for supplying value added products and SMP to global market.

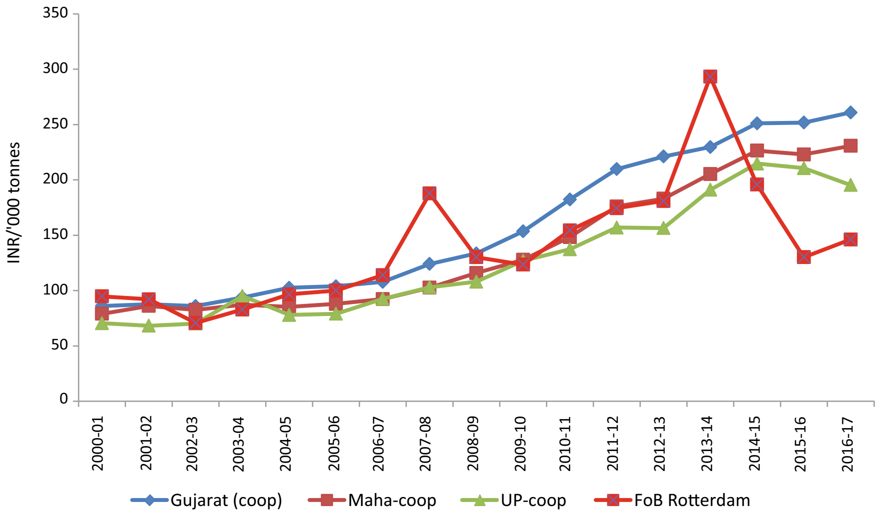

Fig. 6.8 SMP price comparison—co-operatives and global (Oceania) prices. *Source* Authors' calculation using data from co-operatives

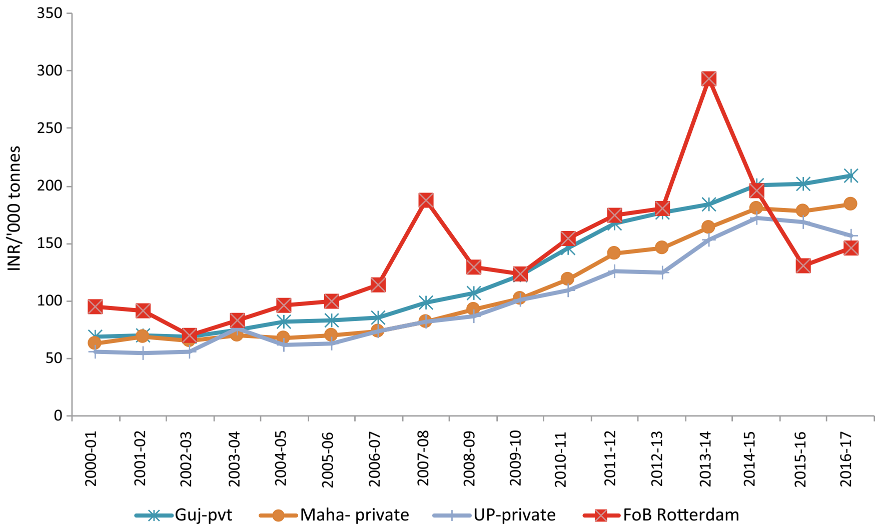

Fig. 6.9 Comparing NPCs (co-operative) and export volume. *Source* Authors' calculation using data from co-operatives

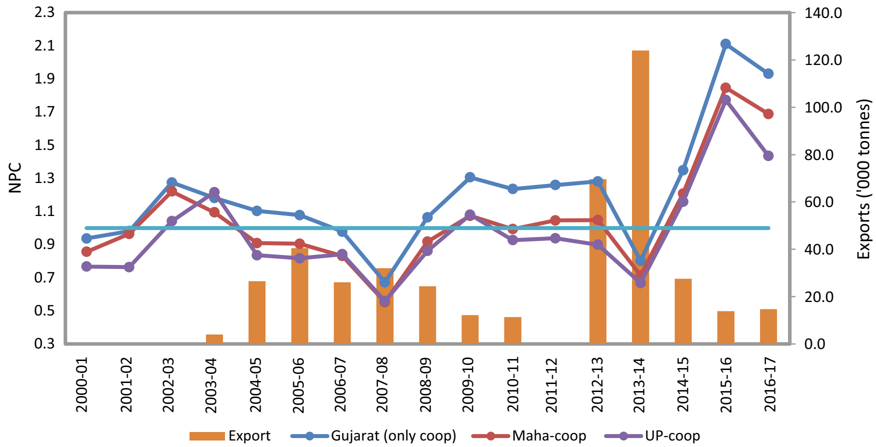

Fig. 6.10 SMP price comparison—private and global (Oceania) prices. *Source* Authors' calculation using data from organized private players

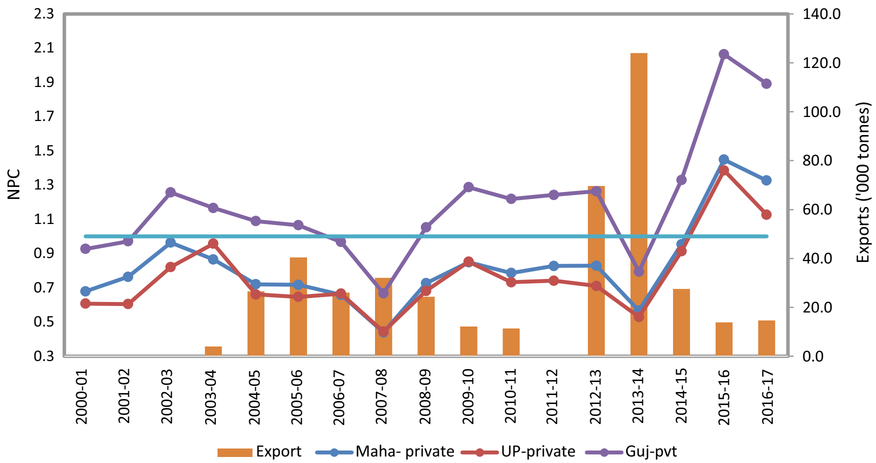

Fig. 6.11 Comparing NPCs (Private) and Export Volumes. *Source* Authors' calculation using data from organized private players

6.3.2 Domestic Competitiveness

The domestic efficiency of the dairy value chain is studied by estimating the share of farmer's price in consumer rupee for a leading dairy co-operative, an organized private player and a multinational company (MNC). In the co-operative sector, it is estimated that about (75–85)% of what the consumer spends goes back to the farmers. This often includes value of services rendered and subsidized inputs. The organized private dairies follow a different approach in milk procurement compared to co-operatives. While the co-operatives procure all the milk brought in by their members to collection centers, the private organized players are not obliged to purchase entire quantity of milk from the farmers. The organized private players also hire aggregators at the village level to procure milk and transport it to the processing units. Figure 6.12 indicates the mark-ups on consumer rupee spend on milk marketed by co-operatives and private organized players.

Maharashtra's biggest dairy co-operative—*Kolhapur Zila Sahakari Dudh Upadak Sangh* or popularly known as Gokul, passed on INR 1656 crores (about 81% of its turnover of INR 2034 in 2016–17) to its farmer members as price of the milk procured. This also includes the cost of veterinary and cattle feed supplies provided by the co-operatives. In case of a leading MNC operating in Moga (Punjab), milk procured from the farmers is used for manufacturing value added products like dairy whitener, baby products and other dairy products. Unlike co-operatives or private organized players, the MNC is not into liquid milk business.

As more than 70% of consumer's rupee reaches the dairy farmers, dairy value chains are much more efficient than other high-value commodities like fruits and vegetables in India. This comes with the caveat that the majority of marketable surplus of milk is still handled by the unorganized sector. The major difference between the co-operative dairy value chain and fruits and vegetables value chain is the number of intermediaries involved between the farmers and the end consumer. While co-operatives deal directly with the farmers, fruit and vegetable value chains have long chain of intermediation.

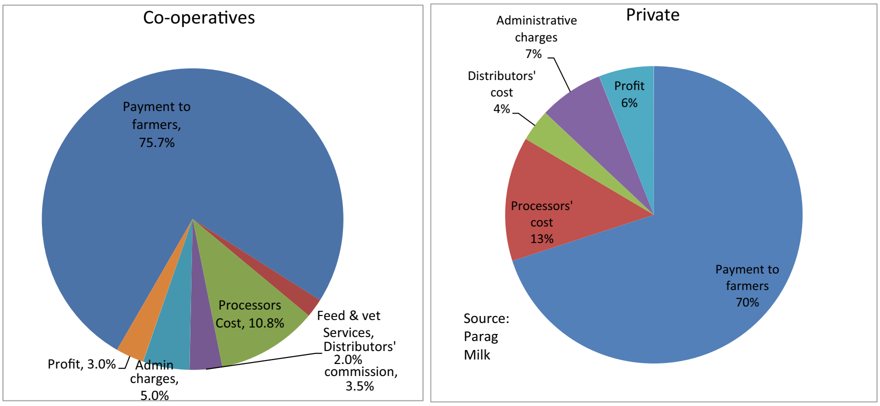

Fig. 6.12 Mark-ups of consumer rupee spend on milk of co-operatives and private (organized). *Source* Bihar State Milk Co-operative Federation/Sudha (derived from 2016–17 financial results) & Private Dairy, Pune

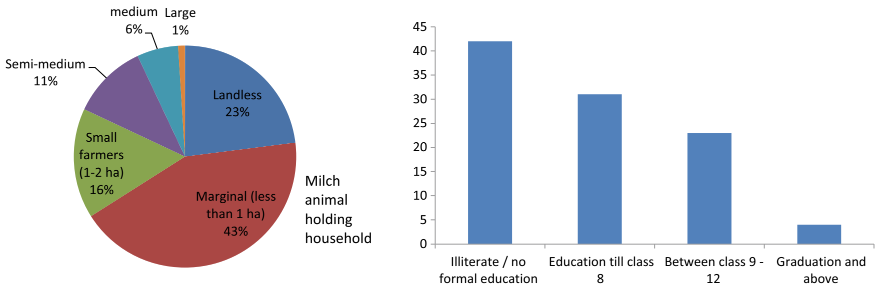

Fig. 6.13 Distribution of Milch Animal Owning (MAH) households. *Source* Development and Research Services Pvt. Ltd. (2013)

6.4 Inclusiveness

Dairying in India is an inclusive livelihood option, as a major share of milk production is contributed by animals reared by small and marginal farmers and landless labourers. Following the implementation of Operation Flood (1970–1996), Indian dairy sector witnessed a sharp increase in milk output and per capita availability, which enabled India to achieve self-sufficiency in milk production. An evaluation study conducted by an external agency (Development and Research Services Pvt. Ltd. 2013*)* for monitoring and evaluation of National Dairy Plan Phase I (2011–12 to 2018–19) stated that 66% of the milch animal owning households (MAH) are landless or have small land holdings (Fig. 6.13). The study also found that 55% of the dairy households have a single bovine animal, on an average. The report also stated that each milch animal owning household in the NDP project area on an average had 1.8 adult female animals, which clearly indicates the inclusiveness of the sector.

6.4.1 Inclusiveness in Dairy Co-operatives

In 2018–19, average milk procurement by co-operative milk unions in India was 507.7 lakh litres of milk per day against 475.3 lakh litres per day in 2017–18, registering a growth of about 7%. Liquid milk sales went up to 354.5 lakh litres per day, marginally higher than the sales recorded in 2017–18. Women accounted for 30% (5.06 million) of the co-operative membership (as on March 2019) (NDDB 2020).

From a modest beginning of procuring 250 litres of milk daily in 1948, Kaira District Co-operative Milk Producers' Union (Amul) procured around 25 lakh litres per day (LLPD). In 2018, close to 700,000 farmers were members of Kaira union and 17% of the members were women. Over 80% of the dairy farmers associated with Kaira co-operative have on an average less than five animals. *Kolhapur Zila Sahakari Dudh Upadak Sangh* (Gokul) procured 14 LLPD milk from close to 400,000 farmers across 5600 villages located mostly in Kolhapur and adjoining districts of

Table 6.3 Member farmers with Bihar State Milk Co-operative Federation—Sudha (in lakhs)

Year	Cumulative numbers			New members		
	Total Members	Women Members	% of Women	Total	Women	% increase of women
2013–14	8.72	1.30	15.0	1.13	0.17	15.6
2014–15	9.42	1.46	15.6	0.69	0.16	23.2
2015–16	10.04	1.67	16.7	0.62	0.20	33.1
2016–17	10.86	2.01	18.5	0.81	0.33	41.5
2017–18	11.39	2.25	19.8	0.53	0.24	45.8

Source Bihar State Milk Cooperative Federation (Sudha)

Maharashtra in 2017–18. Gokul also supports its members through Milk Producers Provident Fund Scheme and Farmers' Insurance Package Scheme.

Bihar State Milk Co-operative Federation or Sudha, with a daily milk procurement of 16 LLPD is the largest dairy co-operative in eastern India. It focusses on including more women as members of the co-operative. In 2017–18, out of the 1.14 million dairy farmers supplying milk to Sudha, nearly 20% of them were women. In 2016–17 and 2017–18, new women members associated with the co-operatives increased by 42% and 46%, respectively (Table 6.3).

The Karnataka Co-operative Milk Producers' Federation, the second biggest state dairy federation after Gujarat has been inclusive. Number of dairy co-operative societies (DCS) at the village level have increased from 416 in 1976–77 to 15,772 DCS in 2018–19. As per Census 2011, Karnataka has 27,586 villages, which implies that more than half of the villages have their own DCS. Similarly, farmer membership of the state dairy federation has seen a sharp increase from 37,000 in 1976–77 to 2.45 million in 2018–19.

Box 6.1: Dairy Sector lifts Socio-Economic Indicators of a Water Stressed Region: Banas Dairy, Gujarat

In July 2017, Banaskantha District Co-operative Milk Producers' Union or popularly known as Banas dairy, procured a record 60 lakh litre of milk in a day from the farmers, thus setting a new benchmark for the Indian dairy sector. Banas dairy's average milk procurement for 2016–17 was 39.2 lakh litre per day (LLPD), which was 25% of the total procurement of 153.1 LLPD by Gujarat Cooperative Milk Marketing Federation (GCMMF) or Amul in the state.

This dairy union which is India's largest district dairy co-operative, paid INR 5381 crore (71% of the total turnover of INR 7555 crore in 2016–17) directly to farmers for milk procurement in 2016–17. This implies that each dairy farmer received on an average INR 1.28 lakh by selling milk to Banas Dairy (2015–16) which is higher than the average annual income of agricultural households (from four sources—agriculture, livestock, non-farm sector and wages and salaries) in the country at INR 8931 per month (INR 1.07 lakh annually) (NABARD 2018).

Dairying is the best livelihood option for the farmers in Banaskantha district, which is a water-stressed region. Average annual rainfall received in the district is around 600 mm. Out of the total geographical area of district, about 47% of area is irrigated. The value of output of livestock products is considerably higher in arid and semi-arid areas like Banaskantha. The large number of rural women find good opportunities to work in several operations of animal husbandry (Government of Gujarat 2016).

The Banas dairy also provides cattle feed and round the clock veterinary services at subsidized rates to their farmer members. This implies that about 80% of their sales income goes back to farmers as price for milk procurement and cost of additional services provided by the dairy. In 2018–19, around 4.2 lakh dairy farmers poured milk into Banas dairy procurement system. Out of 3.5 lakh registered farmers with village level societies or DCS of Banas dairy, 1.2 lakh farmers are women. In most households, though men are registered as members, women look after most of the work related to dairying. With 1200 Bulk Milk Chilling Units (BMCs) located across 1400 village-level dairy co-operative societies (DCS) in Banaskantha district, women engaged in dairy do not need to travel far to pour milk.

Majority of the farmers affiliated to Banas dairy own 2–5 animals on an average, thus providing vital supplementary income, especially when rainfall is deficient. Given the inclusive nature of Banas Dairy, it procures the entire quantity of milk brought to it by its member farmers or non member farmers.

6.4.2 Inclusiveness in Private and MNC Dairies

In case of organized private dairy companies, milk is procured either directly from the farmers or through contractors, collection agents, service providers, or aggregators and transported to the nearest processing plants. A leading private dairy company in Maharashtra procures about 13 LLPD milk from farmers mostly in and around Pune district. The company undertakes direct milk procurement through its own infrastructure network—*Dudh Sankalan Kendras*. The company procures around half of its milk requirement through bulk suppliers or contractors. A leading MNC in Punjab procures around 8 LLPD milk from 80,000 small farmers (those who supply 150 L or less milk daily) including 60,000 women farmers and around 2000 large farmers mostly from one district in Punjab. The company also provides veterinary services and feed at reasonable prices. More than 47% of the milk procured is sourced from large farmers. The company provides incentives of about 8% over the milk price to small farmers, who supply more than 500 L of milk, daily. For ensuring quality milk procurement, the company has been focusing on large farmers and is non-inclusive in its approach. For large farmers, the company has installed bulk milk cooler at their doorsteps. The volume of milk procurement is based on demand and the company has not expanded its procurement operations extensively.

6.5 Sustainability

Dairy value chain has been studied with respect to its financial as well as environmental sustainability. While financial sustainability focuses on financial viability of the co-operative sector, environmental sustainability focuses on issues such as water footprint in dairy sector, availability of fodder and challenges of dealing with large livestock population.

6.5.1 Financial Sustainability

Financial viability of dairy co-operatives is one of the key challenges.

As per annual accounts and financial information from 175 co-operative milk unions (out of 210) for the year 2013–14, 95 co-operative milk unions had accumulated net losses, of which 55 and 14 loss making unions were from Uttar Pradesh and Tamil Nadu, respectively. The remaining 80 milk unions had reported net profits. If we take into account the support received from state and central governments by these co-operatives, (the data is not available), the number of co-operatives making profits may be much less (Lok Sabha 2015).

There has been no visible attempt to restructure these co-operatives to make them efficient and accountable farmers' organizations as envisaged during Operation Flood. This has led to the collapse of the dairy co-operative sector in states like Uttar Pradesh. Successful co-operatives like GCMMF (Amul) forayed into other states, but not in the Anand pattern. Since farmers outside Gujarat cannot be members of GCMMF, they do not get any bonus and they cannot be elected to the Board. These co-operatives become benevolent private sector entities in other states, unless they are declared multi-state co-operatives.

6.5.2 Environmental Sustainability

The availability of adequate quality and quantity of feed and fodder is crucial for sustaining and improving the productivity of livestock. One of the major reasons for low livestock productivity in India is non-availability of quality feed as it alone contributes to nearly 60% of the cost of milk production (Halli et al. 2018). The National Institute of Animal Nutrition and Physiology (NIANP) estimated the deficit in the requirement and availability of dry fodder, green fodder and concentrates. In 2015, the three types of fodder had a deficit of 21%, 26% and 34%, respectively. This deficit is likely to increase to 23%, 40% and 38%, respectively by 2025 (Table 6.4). The fodder demand is expected to reach 1207 MMT of green fodder and 671 million MT of dry forage. At the current level of growth in forage resources, there could be 66% deficit in green fodder and 25% deficit in dry fodder by 2030 (IGFRI 2011).

As the Ministry of Agriculture & Farmers' Welfare (MoA&FW) does not collect data on fodder crops, reliable data on fodder production does not exist. According to India Grassland and Fodder Research Institute (IGFRI), Indian Council for Agricultural Research (ICAR), precise data on production of fodder crops, yield, adoption of improved varieties and technology are not available and there is no agency to monitor these aspects. This seriously dampens effective policy formulation and research planning for fodder development and cultivation.

According to NDDB, chronic shortage of green fodder may make dairying an uneconomical and unattractive livelihood option for farmers. However, dairy farmers can increase their income by making available good quality green fodder in adequate quantity from their own fields. Cultivation of newly developed varieties and hybrids of fodder crops in farmers' field should be promoted on a mission mode (NDDB 2017). Fodder shortage could be overcome by increasing the cultivation of forage crops, which are major feed resources for livestock across states. The increase in the availability of crop residues over the years has been largely due to increase in

Table 6.4 Fodder scarcity (units in MMT)

Types		2012	2015	2020	2025
Dry	Requirement	480	491	530	550
	Availability	375	387	408	433
	Deficit (%)	– 22	– 21	– 23	– 23
Green	Requirement	820	840	880	1000
	Availability	614	619	596	600
	Deficit (%)	– 25	– 26	– 32	– 40
Concentrates	Requirement	82	87	96	105
	Availability	55	58	61	65
	Deficit (%)	– 33	– 34	– 36	– 38

Source NIANP (2013), data on requirement and availability production of paddy, wheat and other crops. There is a need to strengthen location-specific technologies for forage production, forage cropping systems and other land-use strategies to achieve higher production of fodder. There is also a need to identify suitable varieties or cropping system to match the changing climate scenario.

Ecological Sustainability

Like other ruminants, buffaloes, sheep, goats and cows excrete substantial quantities of methane, a greenhouse gas (GHG). India's livestock farming is a significant anthropogenic source of methane (CH_4) in the world. According to a study by National Institute of Animal Nutrition and Physiology (NIANP), ICAR, while India accounts for around 15% of global livestock population, its contribution to global methane emissions is around 10.6%. The major chunk of Indian livestock rearing is based on open grazing and straying on forestlands, community land, among others. The GHG namely, methane (CH_4) and nitrous oxide (N_2O) are emitted by livestock through enteric fermentation and manure (animal wastes) management. All livestock and poultry contribute to GHG emissions, through N_2O and CH_4 from manure, nitrogen from urine and feces (IPCC 2007). In 2016, agriculture contributed 14% of total GHG emissions. Within agriculture, livestock sector (enteric fermentation) accounted for 54.6% of GHG emissions of which buffalo and indigenous cattle accounting for 40.2% and 36.4% respectively, followed by cross-bred cattle at 15.8% and rest at 7.6% respectively (MoEFCC 2021).

India does not have legally binding emission reduction commitments with regard to reducing GHG. However, in its Intended Nationally Determined Contributions (INDC) submitted to UNFCCC in October 2015, India has volunteered to reduce emission intensity by (33–35)% by 2030 from 2005 level. India in its submission to the UNFCCC, 2018 stated that there exists a potential for increasing production levels by addressing the problem of imbalanced nutrition with existing feed and animal resources. In its submission, India also stated that optimum feeding of animals through Ration Balancing Program (RBP) helps to enhance milk production commensurate with the genetic potential of the animals (UNFCC 2018). The RBP implemented during 2012–2019, resulted in reduction of average cost of feeding per kg of milk by more than 10% and a reduction in enteric methane emission by 13.7% per kg of milk in lactating cows and buffaloes (World Bank 2020). RBP covered 2.86 million milch animals in 33,374 villages across 18 states. If the program is extended to all milch animals, there could be a substantive reduction in costs, GHG emissions and fodder requirements.

Despite the huge increase in milk production, about 37% of the growth has been due to increase in productivity of animals implying that the increase in the number of livestock is the dominant source of growth in milk output. Such growth rate in milk production driven by increase in number of livestock is not sustainable (Chand 2017). India, with large cattle population along with low productivity faces challenges in terms of curbing GHG emissions and rendering dairying environmentally sustainable.

Water Use Intensity
Dairy farming is a water-intensive activity as large amount of water is required for cultivation of forage crops, concentrate feed ingredients as well as to cater to the drinking and cleaning requirements of animals. With the demand as well as supply for milk rising steadily, the water intensity of the sector remains an area of concern from the sustainability aspect of dairy value chain.

NDDB study on water foot prints of milk production states that the average water foot print of milk from indigenous cows, cross-bred cows and buffaloes in Gujarat was 1970 and 1820 cubic meter[1] (m^3) per tonne, respectively. The study revealed that feeding animals in the traditional pattern led to a higher water footprint. In contrast, animals fed on a balanced ration, comprising a judicious mix of green fodder, dry fodder and concentrate feed ingredients, led to 14% lower[2] water foot print from 1236 to 1062 litre/Kg (NDDB 2020). NDDB and other government agencies have to map water foot print of dairy sector extensively for formulating future strategy which would ensure sustainable use of water.

6.6 Scalability

The Operation Flood helped quality milk reach consumers across 700 towns and cities through a National Milk Grid. The program also helped remove the need for middlemen thereby reducing the seasonal price variations. Because of the co-operative structure, production and distribution of milk and milk products became economically viable for farmers to undertake themselves. However, OF did not impact dairy development evenly across the country. Especially in eastern and north-eastern regions, dairy co-operatives could not expand their procurement operations with the exception of Bihar State Milk Co-operative Federation or Sudha, which achieved limited success. Also, the per capita availability of milk remains far below the national average in the eastern and north-eastern states. Despite substantial support by the government, scaling up the co-operatives post OF in many states seem unsustainable. The scaling up in these regions have to come from the private sector.

Private sector organized dairies have expanded their base across states like Uttar Pradesh, Maharashtra, Tamil Nadu and Gujarat. Highest concentration of private dairy units is in Uttar Pradesh and Maharashtra, accounting for half of the total dairy plants in the country (Dairy India 2017). The future scaling of dairy processing would be driven by the private sector. Keeping in mind the increasing role of private sector in milk processing, the government had announced INR 15,000 crores Animal

[1] One cubic meter is equal to 1000 L. Water foot print of milk is defined as the sum of the volume of fresh water consumed in different steps of milk production chain, measured in units of water consumed (Litre per Kg of milk).

[2] https://www.nddb.coop/services/animalnutrition/climate-smart-dairying/water-footprint-of-milk.

Husbandry Infrastructure Development Fund (AHIDF) in June 2020 which could play a critical role in coming years.

Indian dairy sector has undergone several technological innovations and breakthroughs, which have boosted production and processing of milk. Some of the key aspects of the technological innovations during OF period included imported semen from the high yielding Holstein–Friesian and Jersey cross breeds, introduction of technology for drying milk, machinery for pasteurization, installation of automatic milk vending machines, bulk milk coolers, transportation of milk through refrigerated trucks, large milk trains, etc.

Genetic Improvement of Cattle Population

Majority of India's milk production in 1950s and 1960s were contributed by cattle and buffalo. The indigenous varieties of cows (desi) are known to have less milking potential than exotic cows like Jersey or Holstein Friesian. However, the critical challenge was that the exotic breeds were unable to cope with the Indian climate. Recognizing this, the government aggressively promoted a systematic cross breeding program using imported semen. The strategy was to increase milk yield by cross-breeding with exotic cows like Jersey, and Holstein Friesian. The cross-breeds have substantially more milk yield than the desi varieties. Also, they are much more resilient than the exotic pure breeds. The Artificial Insemination (AI) technique was first introduced way back in 1940s. However, the real boost to spread of AI came in the third stage OF which commenced in 1985.

The Artificial Insemination (AI) coverage, which helps in improving productivity of bovines by upgrading their genetic potential needs to be expanded. Cross-breeding of high-productivity animals of foreign selected high genetic merit bulls and selected indigenous breeds; and sexed semen technologies assuring female progenies, are some of the methods which need to be adopted to increase animal productivity.

MoA&FW stated that although AI coverage is expanding, its acceptability amongst the farmers is still poor and 100% breeding by AI is not practically possible. The average success rate of AI has been in the range of (35–40)%, implying higher cost for the farmers and adverse impact on expansion of AI. For increasing productivity, more research and development has to be carried out to reduce inter-calving interval (for buffalo, average 400–500 days) and age at first lactation.

Table 6.5 indicates that productivity of milch animals is far below the global standards of more than 20 kg per day. Cattle productivity increased by a CAGR of 3.8% for non-descript/indigenous cow, 1.25% for exotic/crossbred cows and 1.76% for buffalo between 2011–12 and 2016–17.

Table 6.5 Cattle productivity–average yield per in-milk animals (kg/day)

Year	Non-descript/indigenous cows	Exotic/CROSSBRED cows	Buffaloes
2011–12	2.27	6.97	4.71
2016–17	2.84	7.51	5.23

Source DAHD (2016, 2017)

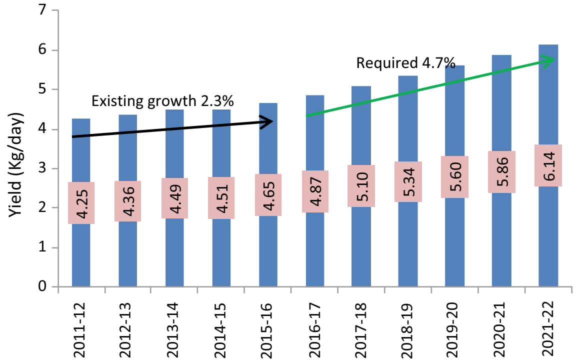

Fig. 6.14 In-Milk Animal Yield (anticipated). *Source* DAHD (vision-2018)

As seen in Fig. 6.14, the productivity of milch animal is targeted to increase at a faster rate (more than double) by 2022 compared to previous years. The NAPDD vision document—2022 stated that, with the present constraint of feed and water resources, it would not be feasible to increase absolute number of bovine population.

Creating Demand for Anticipated Increase in Milk Production

As per the DADH&F projections, per capita availability of milk was likely to go up to 417 g per capita by 2021–22. Dairy co-operatives along with private sector need to revamp their operations to procure and process more quantity of milk. Despite lack of any official data on private dairying capacity, it is noteworthy that the private sector is nearly at par with co-operatives in handling liquid milk. It is expected that the former will overtake the co-operative sector in the times to come (Dairy India 2017). However, co-operatives are likely to dominate the Indian dairy market, especially liquid milk over the next decade.

The dairy sector, be it co-operatives or private sector, would need to invest in rural milk procurement network and reduce its dependence on intermediary milk collectors and transporters. Currently, co-operatives procure about 77% of total volume of milk from Gujarat, Karnataka, Maharashtra, Rajasthan, Tamil Nadu and Andhra Pradesh. States like Uttar Pradesh, Madhya Pradesh, Odisha, West Bengal, Chhattisgarh and Jharkhand could be potential candidates for meeting the procurement target as milk production increases in the next five years or so. Due to weakness of the co-operative model in many of these states, alternative forms of institutions like producer companies, and self-help groups could be formed for milk procurement, which can be linked to a co-operative like GCMMF or the private sector.

If the entire projected growth depends on increased demand, the state governments should provide milk as part of Mid-Day Meal (MDM) program, which in turn would address malnutrition amongst children. As per the National Family Health Survey (2015–16), about 36% of the children in the country were undernourished. Some of the states which provide milk for addressing malnutrition include Karnataka and Gujarat.

- Under the Karnataka's *Ksheera Bhagya* scheme launched in 2013, more than 10 million children get 150 ml of flavoured milk, five days a week, across all the *anganwadis* and government schools. The milk powder (SMP) for the scheme is provided by Karnataka Milk Federation (KMF), the country's second-biggest milk co-operative after GCMMF (Amul). *Ksheera Bhagya* was launched mainly to fight malnutrition amongst children and also allow KMF to dispose their surplus milk.
- The *Doodh Sanjeevani Yojana* launched by Gujarat government in 2006–07 provides 200 ml fortified milk to primary school children in the tribal talukas as part of their Mid-Day Meal (MDM) program. The focus of the program was to prevent dropouts from schools and ensure nutrition of the students. At present, the program covers more than 7.5 lakh students in 4700 primary schools. Pre-packed milk to children and women through programs such as Integrated Child Development Services (ICDS) or MDM scheme would meet twin goals of tackling malnutrition as well as creating demand for surplus milk.

Through the Corporate Social Responsibility (CSR) initiatives like NDDB Foundation for Nutrition (NFN)'s *Giftmilk* program, demand for milk could be generated. *Giftmilk*, jointly promoted by NDDB and its subsidiaries (Indian Immunological Limited, IDMC Limited, and Mother Dairy Fruit & Vegetables Private Limited) and GCMMF supplies and distributes flavoured milk to about 3500 underprivileged children (200/150 ml servings per day) in selected schools in Gujarat, Telangana and Delhi.

6.7 Access to Finance

The financing pattern of dairy value chain was analyzed taking into account the main stakeholders in the process—farmers or producers, entrepreneurs, dairy companies, co-operatives and retailers operating in the production, procurement, processing and marketing of milk and milk products. Primary field study shows that at dairy farmer level, there are no specific schemes for buying new cattle. However, there are programs for financing small dairy units and both public and private banks provide loans to purchase milch animals.

6.7.1 Existing Financial Channels

Across the country, financing initiatives for dairy value chain being implemented include Dairy Processing and Infrastructure Development Fund (DIDF), Dairy Entrepreneurship Development Scheme (DEDS), Animal Husbandry Infrastructure

Development Fund (AHIDF), NDDB Term Loans, Working Capital Finance Scheme for Dairy Co-operatives and the Ministry of Food Processing Industries sponsored Cold Chain scheme. The National Co-operative Development Corporation (NCDC) under MoA&FW also provides financing to dairy co-operatives. At the farmer level, programs such as Pradhan Mantri Mudra Yojana (PMMY), Kisan Credit Cards (KCC) for dairy farmers and financing by banks for setting up small dairy units are some of the existing channels of finance.

Dairy Processing and Infrastructure Development Fund (DIDF)

In the Union budget 2017–18, the central government announced setting up of the Dairy Processing and Infrastructure Development Fund (DIDF) to upgrade and modernize existing infrastructure for milk production and processing for dairy co-operatives—milk unions, state dairy federations, multi-state milk co-operatives, milk producer companies and NDDB subsidiaries. Since the dairy co-operatives generally pass on the maximum share of sales realization (usually between (75–80)% of the consumer rupee) to the milk producers as well as ensure supply of milk at affordable prices to the consumers, they have lower financial resources to invest in setting up infrastructure for increasing milk processing (NDDB no.date.).

The fund which was initially operational from 2017–18 to 2019–20 with an outlay of INR 10,881 crore (NABARD loan of INR 8004 crore and borrowers' contribution of INR 2001 crore) has been extended until 2022–23. As on July 31, 2020, 37 projects across 11 states including Karnataka, Maharashtra, Punjab, and Haryana, worth INR 1073 crore have been sanctioned under DIDF. NABARD also raises fund from market and provides the same to NDDB or NCDC, which further provide loans at an annual interest rate of 6.5% to borrowers with a repayment period spanning 10 years with initial two years moratorium (Lok Sabha 2020). The concerned state governments are required to guarantee loan repayment.

The fund is being used by co-operatives for modernization and creation of milk processing facilities, creation of village-level chilling infrastructure and installation of bulk milk coolers (BMCs). DIDF aims to help more than 9.5 million farmers by creating additional milk processing capacity of 12.6 million litres per day. It also aims at installation of 28,000 bulk milk cooling (BMCs) along with electronic milk adulteration testing equipment and value-added products manufacturing capacity of 5.9 million litres per day.

Dairy Entrepreneurship Development Scheme (DEDS)

DAHD has been implementing Dairy Entrepreneurship Development Scheme (DEDS) through NABARD since September 2010. The scheme provides capital subsidy of 25% (on loan amount) for general category beneficiaries and 33.33% for

SC/ST beneficiaries for purchase of cattle apart from other dairy activities. Under the scheme, the cost of a maximum 10 animals is fixed at INR 6 Lakh. Loans are provided under DEDS for purchase of milking machines, other dairy processing equipment, cold storage facilities, dairy marketing outlets, etc. Rate of interest charged for the loan extended is as per RBI guideline (base rate) and the policy of the concerned banks. Until May 2019, INR 1310 crore had been disbursed to around 3.2 lakh beneficiaries.[3] However, DEDS had been discontinued since August, 2020 (DAHD 2020).

Inclusion of Dairy Farmers under Kisan Credit Cards Scheme

For meeting the working capital requirement of dairy farmers, central government in the Union Budget 2018–19 announced the extension of Kisan Credit Cards (KCCs) to fisheries and animal husbandry farmers. A special drive had been undertaken by DAHD to provide KCCs to all dairy farmers associated with co-operatives and milk producer companies. DAHD has been aiming to provide KCC to around 1.5 crore dairy farmers associated with 230 milk unions in the country. As on 22nd December 2020, milk unions collected 5.1 million applications of dairy farmers and forwarded 4.14 million applications to the banks (PIB 2020).

Those who have KCCs, get agriculture credit at a reduced interest rate of 7% per annum while MoA&FW implements an interest subvention scheme for short term crop loans up to INR 300,000. Under the subvention scheme, additional subvention of 3% is given to those farmers who repay their short-term crop loan on time, thus reducing the effective rate of interest to only 4% per annum. All farmers who own cultivable land, tenant farmers, share croppers and SHGs of farmers are eligible to avail credit under KCCs.

Animal Husbandry Infrastructure Development Fund (AHIDF)

In June 2020, while announcing *Atma Nirbhar Bharat Abhiyan* stimulus package for dealing with the adverse impact of Covid 19 on the economy, the Cabinet Committee on Economic Affairs approved Animal Husbandry Infrastructure Development Fund (AHIDF) worth INR 15,000 crores. The aim of this fund was to incentivize investment in infrastructure development for the private sector engaged in dairy and meat processing. The eligible beneficiaries under AHIDF include farmer producer organizations, medium and small enterprises, private companies and entrepreneurs, who would contribute a minimum 10% margin money while balance 90% would be loan component from the scheduled banks. The government will provide 3% interest subvention for loans under AHIDF, two years moratorium period for principal loan amount and six-year repayment period thereafter. As on 22nd December 2020, project loans worth INR 150 crores under AHIDF has been sanctioned by the banks (PIB 2020).

[3] Data provided by NABARD official, in May, 2019.

Ministry of Food Processing Industries' Cold Chain Scheme

The Ministry of Food Processing Industries (MoFPI) also provides loans for integrated cold chain and preservation infrastructure facilities, from the farm gate to the consumer end. Out of 238 projects approved, so far, 54 pertains to the dairy sector. Subsidy in the range of (25–35)% with a cap of INR 10 crore is available as well.

Mudra Loans

Under the Pradhan Mantri Mudra Yojana (PMMY), loans in the range of INR 50,000–INR 10 lakh are provided to dairy farmers. Kwality, a big private dairy farm based in Uttar Pradesh and Haryana, tied up with Bank of Baroda to provide loans under MUDRA to around 100,000 farmers in its key milk procurement areas of western Uttar Pradesh. Mudra Loans are provided at 8% interest per annum and are available to traders, shopkeepers (or retailers) and micro business owners. In Punjab, the leading MNC facilitates loans for dairy farmers (for buying calf or equipment) from banks (at base rate/Mudra scheme). In case of organized private dairies and MNC, the BMCs and other equipment required for procurement, are provided by the respective companies. The farmers associated with private organized players and MNC need working capital for buying calf and/or equipment.

Bank Finance for Setting up Small Dairy Units

Public sector banks extend loans for setting up small dairy units (less than 10 milch animals) based on financial viability of the project. The loan component is 90% if quantum of loan exceeds INR 1 lakh with maximum ceiling of INR 5 lakh. The loans are provided to those dairy farmers who are members of the milk procuring societies or located on the milk route. The eligibility criterion for availing loans for a dairy unit with less than 10 animals is minimum 0.25 acre of land for every five animals for growing fodder and balance requirement procured locally. Dairy unit with 10 animals and above requires minimum one acre land for cultivation of fodder. The loans to dairy units are provided as per the interest rate decided by the bank (base rate) with a tenure of 4–5 years. RBI has details of loans given to dairy units by banks during 2013–2016 (Table 6.6).

Table 6.6 Bank loans to dairy units: 2013–14 to 2016–17

Year	No of accounts (in lakhs)	Amount of loan (INR crore)
2013–14	1.17	1375
2014–15	1.4	1150
2015–16	2.39	2010
2016–17	10.83	3952

Source LokSabha (2016)

Financing Opportunities at Retail Level
With the growth and expansion of the dairy sector, there would be increasing opportunities of financing at the retail levels. The biggest dairy co-operative—GCMMF or Amul has 10 lakh retailers and 10,000 dealers across the country. Therefore, combined financing opportunities at the retail level for dairy industry would be large for financial institutions.

6.7.2 Key Financing Sources for Dairy Co-operatives

In this section, financing aspect of key dairy co-operatives—Banaskantha or Banas dairy (Gujarat), Sudha (Bihar State Milk Cooperative Federation) and Gokul (Kolhapur Zilla Sahakari Dudh Utpadak Sangh, Maharashtra) have been studied.

Banas Dairy: In 2018–19, leveraging its volume and financial capabilities, Banas Dairy accessed loans from leading private sector banks at competitive rates for enhancing its processing capacity (INR 150 crores for a processing plant at a rate of interest of 6.5% per annum). It availed loan from NCDC at an interest rate of 8%, while loans availed with support from NDDB via State Bank of India (INR 318 crores) at an interest rate of 8.3%. Access to finance for meeting working capital requirements like cattle or equipment is not adequate. Farmers have been accessing finances from informal sources at interest rates up to (25–30)% per annum or availing personal loan (at 10% interest per annum) from public sector banks. About 1200 out of 1400 DCSs have BMCs which cool the milk to 4 degree Celsius before it is transported to processing units. Banas dairy provides loans to DCSs for setting up BMCs at an annual interest rate of 9%. There is a subsidy under the World Bank aided National Dairy Plan for setting up BMCs.

Sudha Dairy: In case of Bihar State Milk Cooperative Federation or Sudha, finance for expansion of processing capacity has been carried out through NCDC loans worth INR 573 crores which were sanctioned in 2014 at the prevailing annual interest rate of 12.75%. This was brought down to 10.9% in 2018. The Bihar dairy federation has availed INR 225 crores loans so far for the six projects out of which 25% of the loan amount is subsidized, thus effectively bringing down the cost of financing further.

Gokul Dairy: The financing of the Maharashtra's biggest dairy co-operative union's (*Kolhapur Zilla Sahakari Dudh Utpadak Sangh*) operations are met through loan from NDDB and other government supported schemes. However, at the ground level, dairy farmers access loans from both public and private sector banks with the interest rate ranging from (12–13)% annum for the purchase of cattle.[4]

[4] Based on personal interactions with officials of Gokul as well as farmers.

6.7.3 *Anticipated Investments in Dairy Sector*

If we achieve 5% annual growth rate in milk production between 2016–17 and 2023–24, output is expected to touch 236 million tonnes. The additional capacity creation for processing is likely to be 2242 LLPD by 2023–24 by both co-operative and private sector. Total investment required would be more than INR 84,000 crores. There are other additional investments required like setting up drying and chilling capacity, cattle feed plant, manufacturing value-added products, Visi coolers, etc. which would be about INR (12–15) crores for a one LLPD plant. We have considered INR 37.5 crores as estimated investment required for creating one LLPD capacity for the dairy sector (Table 6.7).[5]

In case of 6% annual growth rate in milk output by 2023–24, the total investment required would be more than INR 90,000 crores. The additional processing capacity required would be 2402 LLPD. As per the industry norm, for setting up milk processing capacity, INR 25 crores per LLPD is required.

Taking into account INR 37.5 crores investment required for creating a LLPD of milk processing, the projected investment for creating additional milk processing capacity would be in the range of INR 78,000 crores (in case of 5% annual increase in milk output between 2016–17 and 2023–24) and INR 84,000 crores (in case of 6% annual increase in milk output by 2023–24). Out of these, co-operatives would require INR 32,000 crores and INR 35,000 crores, respectively. Private sector would require INR 45,000 crores and INR 49,000 crores, respectively based on the NAPDD assumption that 30% of total milk production would be processed by private sector and 20% by the dairy co-operatives by 2023–24.

Table 6.7 Projected investment required for increasing dairy processing capacity

	Milk output in MMT	Output in (LLPD)	Processing (LLPD) by Coop	Processing (LLPD) by private sector	Total processing (LLPD)	% coverage of milk output by Coop & organized pvt sector
2015–16	155.5	4136	440	430	870	21
2016–17	165	4520	497	497	994	21
2023–24*	236	6473	1295	1942	3236	50
2023–24**	248	6795	1358	2038	3396	50

Source Authors' calculations based on anticipated growth in milk production
Note *On the basis of 5% annual growth from 2016–17, **on the basis of 6% annual growth from 2016–17, by 2023–24, organized private sector is anticipated to handle 30% and cooperative 20% of the total milk production. Lakh Litre per Day (LLDP), Million Metric Tonne (MMT)

[5] Although the official data about dairy processing capacity created by private sector is still not available, the paper has relied on available data from various sources to arrive at the possibility of quantum of investment required in the next five to six years.

The DIDF and financing schemes of NDDB and NCDC would meet around half of the amount required. Under DIDF, INR 10,800 crores is available to co-operatives for creating additional processing capacity of 126 LLPD by 2019–20. Significant opportunity for the financial institution exists in the dairy sector as domestic demand for processed products increase in the next few years. Animal Husbandry Infrastructure Development Fund (AHIDF) worth INR 15,000 crores launched in June, 2020 is being used by private sector. If NAPDD's target of achieving 300 million tonnes of milk production by 2023–24 is to be achieved, the requirement for funds would be much more.

Significant financing opportunity by the financial institutions exists in the dairy sector as domestic demand for processed products increase in the next few years. While a portion of financing would come from DIDF, the rest of the finance or credit would have to be met by various channels such as banks loans, bonds, etc.

6.7.4 Need for Finance at Reasonable Rate for Dairy Farmers

During the field visits, we found that in Maharashtra, village-level dairy co-operative societies (multiple societies at village level) are providing loans (INR 30,000) to farmers to buy new calf at 9% rate of interest. Banks (public, private and co-operative) in Maharashtra are providing loans to dairy farmers at an interest rate ranging from (12–13)% per annum for a tenure of 3–5 years. Through interaction with farmers, we found that there are additional charges or cost of processing of the loans availed by the dairy farmers. On a loan of INR 10 lakh from a public sector bank for a tenure of 3–5 years, the additional charges (about 5% of loan amount) include—mortgage fee (INR 15,000), application processing charges (INR 2500), registration fee (INR 8000) and premium towards the term insurance (INR 30,000). This is where the cost of finance for the dairy farmers can be reduced by providing soft loans and handholding support provided by co-operatives and private sector on timely procurement of milk from the farmers.

6.8 Conclusion and Policy Recommendations

Following are the key recommendations to make the dairy value chain in India more competitive, inclusive, sustainable, and scalable with adequate access to finance.

1. Limited export opportunities for SMP exist for the private sector in South Asian countries, which needs to be encouraged. Particularly states like Uttar Pradesh should explore such opportunities. However, growth of the Indian dairy sector cannot be achieved from export competitiveness in SMP alone as

it is only a residual product. The dairy sector would need to focus on high-value dairy products for exports to specific markets of South Asia and Gulf countries.

2. The key challenge is to include more women in actual functioning of co-operatives through greater representation in the board of dairy co-operatives. At present, less than 3% of the members of the board of the dairy co-operatives are women, although they constitute 18% of the membership.
3. There is a need for strengthening technologies for forage production, cropping systems and other land-use strategies for ensuring sustainable growth of the dairy sector.
4. Another critical challenge the dairy sector is likely to face over the next few years pertains to impact of climate change which may pull down growth in milk output in the country. Milk production may get hit following an average rise in temperature which would create scarcity of water and dry fodder for the cattle. A strategy needs to be developed to deal with the situation arising out of climate variability.
5. Advanced herd management needs to be promoted for maintaining and improving the genetic potential of the cattle.
6. The government agencies need to conduct extensive study on the water foot print of dairy sector for formulating future strategy keeping in mind water use efficiency of the sector.
7. Dairy co-operatives need to be treated as private enterprises of farmers and freed from any government imposed controls. For ensuring transparency and accountability, the government should ensure that co-operatives' financial results are disclosed in public.
8. The future growth in milk production should be driven by increasing yield per cattle. There has to be an acceptable solution for disposal of male cattle not wanted by farmers. Use of frontier technologies like sex-sorted semen, genomic selection of high merit animals, embryo transfer, data collection and analytics need to be promoted on priority.
9. The co-operatives need to expand their base in states including Uttar Pradesh, Madhya Pradesh, Odisha, West Bengal, Chhattisgarh and Jharkhand for meeting the procurement target, as milk production increases.
10. The central government could consider providing vitamin-enriched milk to the 100 million children currently covered under Mid-Day Meal (MDM) for boosting demand for milk. Compared to huge annual food subsidy budget, the cost of providing milk under MDM would be much smaller.
11. The financial institutions must provide working capital assistance to dairy farmers at reasonable rates. In the absence of institutional financing structure at the ground level, dairy farmers are forced to seek credit from the informal sources at much higher interest rates. Provision of specific windows for accessing credit for purchase of animals need to be made. Kisan Credit Cards to dairy farmers would help farmers in meeting their working capital requirements.

12. Expansion and modernization of milk processing facilities would need substantial investments. Since a major portion of this has to be carried out by the private sector, a financing mechanism at par with co-operatives will have to be set up to ensure that dairy farmers in areas not covered by the co-operatives have the opportunity to enhance their incomes, significantly.

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Chapter 7
Poultry Value Chain

T. Nanda Kumar, Anisha Samantara, and Ashok Gulati

7.1 Introduction

In the livestock sector in India, poultry farming holds a prominent position owing to its impressive growth led by the private sector. Poultry sector has shown rapid growth, with chicken meat growing at an average annual growth rate of 9% and eggs growing at 6% from 2000–01 to 2018–19 (DAHD 2020). The recent steady growth in domestic demand for chicken meat has made it possible to increase production with a ready market putting India among the top poultry producers in the world. India is the third-largest egg producer after China and the USA with a production of 96 billion eggs and fifth-largest chicken meat producer with a production of 3.7 million tonnes in TE 2018–19 (FAOSTAT 2018). This transformation in the poultry sector has been led by the commercial poultry industry, which contributes about 80% of the total poultry production. The other 20% is produced by the traditional backyard poultry. The broiler industry is concentrated in the southern and western states and accounts for a major share of total output. Similarly, the layer industry is dominated by well-developed states like Andhra Pradesh, Tamil Nadu and Maharashtra, accounting for nearly 60% of the production (DAHDF 2017). Commercial poultry farming is yet to make a mark in more populous states like Bihar, Odisha and Uttar Pradesh.

There has been evidently a sharp jump in India's domestic egg and chicken meat production outpacing the two major competitors—beef and veal since 2004–05. Nearly 36% of the production of meat is contributed by poultry followed by buffalo

T. Nanda Kumar
Former Senior Visiting Fellow, Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

A. Samantara
Former Research Assistant, ICRIER, New Delhi, India

A. Gulati (✉)
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

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(22%), goat (19%), pig (9%) and sheep (8%) (DAHDF 2015). Factors contributing to this growth can be attributed to innovations in technology, institutions and markets. Supply side factors affecting growth arise from rapid technological changes that were absorbed by local producers creating spill-over effects across the industry. The shift from backyard to commercial poultry operations has dramatically increased the number of birds a farmer can manage, resulting in a further replacement of labour with capital and productivity gains (Narrod and Pray 2001). Innovations have played a key role in the recent past. Factors attributed to innovations are initiation of pure-line breeding, domestically, in both private and public sectors. At the same time, development of input sub-sectors like feed mill, hatchery and farm appliances, bio-security and laboratories, and simultaneously aided vertical and horizontal integration in poultry farming were instrumental in the development of the sector.

Poultry farming comes with its own risks, specifically in terms of marketing infrastructure. Lack of adequate cold chain facilities and organized and regulated wet markets results in volatile prices of poultry products. As marketing is controlled by commission agents and private traders, procurement from smallholders in remote and backward areas is hardly prioritized. While it is clear that vertical coordination in agriculture supply chain is instrumental in bringing down costs and risks for smallholders, it has been difficult to prove that it takes place uniformly in the Indian poultry sector. The monopolized concentration of commercial poultry in certain regions has led to a neglect of other rural areas from this revolution. To overcome this, a strong marketing network to strengthen and expand direct farmer-market linkages is needed. Even with a shift towards non-vegetarianism, demand has not been able to keep pace with production, coupled with limited acceptance of processed poultry products in domestic markets, which poses restrictions on the expansion of the sector.

This chapter seeks to capture the dynamics of poultry value chain with respect to four critical aspects-Competitiveness, Inclusiveness, Scalability, and Sustainability, overarched by access to finance that intersect all of these (CISS-F). The study uses a combination of secondary data sources (production, exports and price data from the period 2000–01 to 2015–16) and interactions with different stakeholders during field visits. The study examines the trends and features of the Indian poultry sector, growth of integrators and contract farming models, structural reforms in the livestock sector vis-à-vis poultry and its implication on inclusiveness of small farmers and the financial and environmental sustainability of such growth.

7.2 Overview of the Poultry Sector

7.2.1 Global Overview

The global poultry sector has undergone a series of structural changes during the last two decades making it one of the fastest-growing livestock sectors. The poultry industry has witnessed modern production technology, genetic improvements, better bio-security measures and improved disease control and prevention. As the world progresses towards increased urbanization and higher incomes, developed as well as developing countries offer opportunities for poultry producers to capitalize on these positive trends.

Developing countries registered an increase in poultry meat consumption of 35 million tonnes between 1990s and 2005, recording almost double of what developed countries experienced (Narrod et al. 2008). Henderson 2015 studied that BRIC countries (Brazil, Russia, India and China), which have a share of 40% in global consumption would play a major role in fueling growth of protein export from countries like the USA. On the contrary, historical trade patterns show that US exporters may struggle to expand their share in these markets, with India, an important case in point. India ranks third in egg production with around 103.3 billion eggs produced in 2018, after China and U.S.A and is the fifth-largest chicken meat producer (FAOSTAT 2018). Poultry meat production in India increased from 69,000 tonnes in 1961 to 4.06 million tonnes in 2018. Figure 7.1 summarizes the top five egg and chicken meat producing countries.

An increase in poultry production means an enhanced demand for maize, which is the largest component of poultry feed. The rise in poultry consumption worldwide has driven global maize production which increased at a compound annual growth rate of 5.5% from 729 MMT in 2004–05 to 1060 MMT in 2015–16 (FAOSTAT 2018). Asia recorded a phenomenal increase in poultry meat production and accounts for about 25% of poultry production.

While global poultry sector has moved towards vertically integrated commercial broiler operation engaging with farmers in a contract mode, the level of integration varies across countries and individual firms. Robust urban demand has fueled the expansion of large integrator models. There is also a preference to set up operations closer to input supplies, as observed in Brazil, for instance. Informal domestic markets in the form of wet markets still dominate in countries like India, Indonesia and

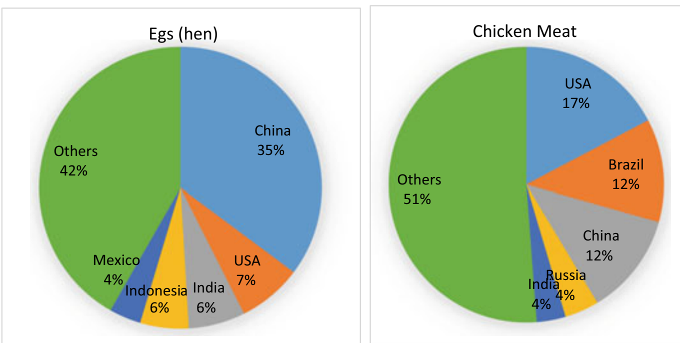

Fig. 7.1 Top Eggs and Chicken Producing Countries (TE 2018). *Source* FAOSTAT (2018)

Vietnam. Brazil and the USA dominate in broiler export market while China is emerging as an active broiler exporter (Narrod et al. 2008).

At present the global poultry market is characterized by a handful of giant poultry companies that control a large fraction of global production, processing and exports, for instance, JBS and BRF in Brazil, Tyson Foods in USA, CP group in Thailand and Wen's Food group in China. It is interesting to note that technology spillovers and competitive production in Asian countries have made some of these companies viable competitors in the global market. Demand side factors are traceable to increase in consumption of poultry meat, which witnessed an unprecedented growth over the years due to its high nutritional value and affordability compared to other meats. Supply side factors involve developing countries as global competitors in the agribusiness sector. Dominated by developed country exporters in the past, the dynamic poultry market of the world is increasingly led by developing countries, which seem to be highly competitive in the coming years.

7.2.2 *Domestic Overview*

Poultry production in India soared since early 2000s, showing an increase in demand and reduced prices of poultry products in the country. Along with structural changes, there also exists a direct and positive relationship between increase in income and consumption of meat as studied by Mehta et al. (2003). The per capita availability of egg has risen from 5 eggs per annum in 1950–56 to 74 eggs per annum in 2017–18.

Among Indian states, the largest egg producer is Tamil Nadu which produces 19% of the total eggs in the country, followed by Andhra Pradesh (18%) and Telangana (13%). Meat production in general has shot up in the country from 4 million tonnes in 2007–08 to 7.7 million tonnes in 2017–18 with a CAGR of 6.1% in these years. If we look at individual years, the annual growth rate was as high as 13.25% in 2011–12 as supported by the boom of commercial poultry led by large integrators and could also be traced to gains from exports during that period. In TE 2017–18, India produced 3.8 MMT of poultry meat with Maharashtra producing 15% of the total production followed by Tamil Nadu, Haryana and West Bengal (Fig. 7.2).

Although India is a competitive poultry meat producer, due to lack of processing facilities, small farm sizes and no-brand credibility, Indian poultry exports have been abysmally low. India exports smaller quantities of frozen whole chicken and cuts to South Asia, Middle East and more recently, to Japan and South-east Asia (USDA FAS 2016). Poultry products for export traditionally include table eggs and egg powder. The prospects for imports of poultry products in India are limited due to competitive domestic production. Since 2007, import of poultry products has been prohibited from nations exposed to Highly Pathogenic Avian Influenza (HPAI) and Low Pathogenic Avian Influenza (LPAI).

Feed costs in terms of prices of maize and soybean have a serious repercussion on the competitiveness of the poultry sector as input prices related to feed cover (60–70)% of the cost of production. Soybean production declined significantly in

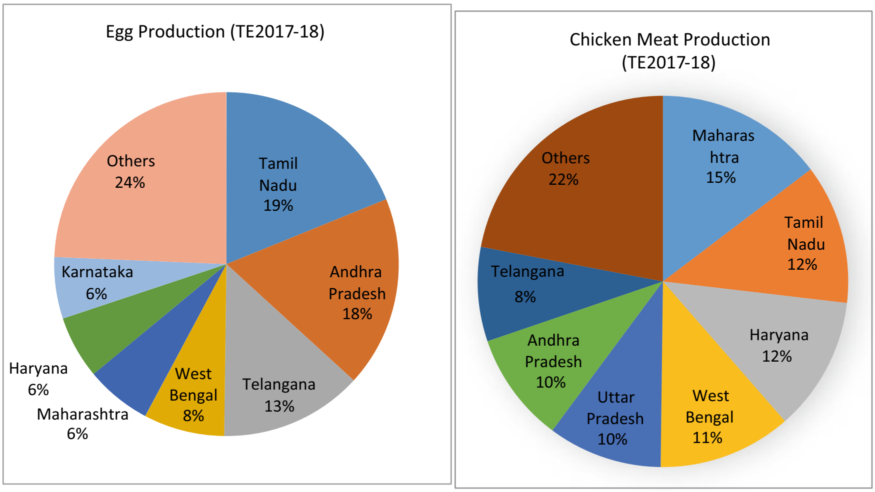

Fig. 7.2 State wise Poultry Meat and Egg Production (TE 2017–18). *Source* Basic Animal Husbandry Statistics (2019)

2015–16 due to drought conditions. Despite recovering from the drought in 2016–17, problems still exist when it comes to availability of soybean and corn, locally. Soybean import is not an option for India due to GM issues. From 2010 to 2015, soya bean and corn prices increased at a compound annual growth rate of 9.8% and 9.1%, respectively, while price of poultry chicken increased by 4.5% only (USDA FAS 2016). Hence, to contain the cost of feed, it will be important to enhance the feed conversion ratio. Singh 2019 reported that feed conversion ratio increased by about 40% owing to productivity gains as well as efficient feeding practices. Estimates suggest that the ratio for broilers increased to 1.65 kg in 2015 from 2.2 kg in the 1990 (Kotaiah 2016).

7.3 Competitiveness

Competitiveness of the poultry value chain has been analyzed at the international and domestic levels. Firstly, we look into India's poultry export basket, trade policies and then analyze whether poultry (chicken and eggs) sector in India is price competitive in terms of Nominal Protection Coefficients (NPCs). Secondly, we discuss a typical value chain of poultry in India and evaluate its domestic competitiveness by computing farmer's share in consumer rupee.

7.3.1 International Competitiveness

India's Poultry Export Basket and Trade Policies

India's participation in world poultry trade was negligible until the 1990s. In 2003, India exported only 0.07% (6.9 thousand tonnes) of 10 million tonnes of poultry meat (Mehta et al. 2008). Currently, India contributes to less than 0.4% of the global poultry and poultry-based trade. India has exported 4.50 lakh tonnes of poultry products worth USD 79 million in 2016–17 (DGCIS 2018).

The Middle East pull effect has resulted in an increase in poultry exports to Gulf countries in recent years. In 2017–18, India's exports to the Middle East were about 3.5 lakh MT (USD 35 million) (APEDA 2018). During the same period, India recorded its highest egg exports to Oman, valued at USD 24 million. Its share in total egg exports from India was recorded at 73%, followed by Maldives (15%; USD 5 Million) and the other Middle East countries such as Kuwait (3.3%) and Qatar (2.3%). Major markets for table eggs are Oman, Kuwait, Saudi Arabia, UAE and Yemen. In 2008, egg powder accounted for 36.1% of India's total egg exports and increased to 56% in FY2014 (Pradhan 2016). However, exports of egg powder declined in recent years and the market for egg powder is limited to Japan and the European Union (EU).

Eggs (hen-in-shell) are the largest component of poultry products exported from India and eggs (dried) are the second largest. A decline in egg exports post 2007–08 can be attributed especially to Japan where the dip was a result of import duties imposed by Japan (8% on egg albumen powder, 21.3% on whole egg powder and 18.8% on egg yolk powder) on Indian egg product exports (Fig. 7.3). This treatment did not help Indian exporters since Mexico under a bilateral agreement with Japan negotiated for zero duty for its export of egg products, making Indian egg powder uncompetitive in the Japanese market (GoI 2017). Exports of poultry meat was 14% of production in TE 2017–18 (Fig. 7.4).

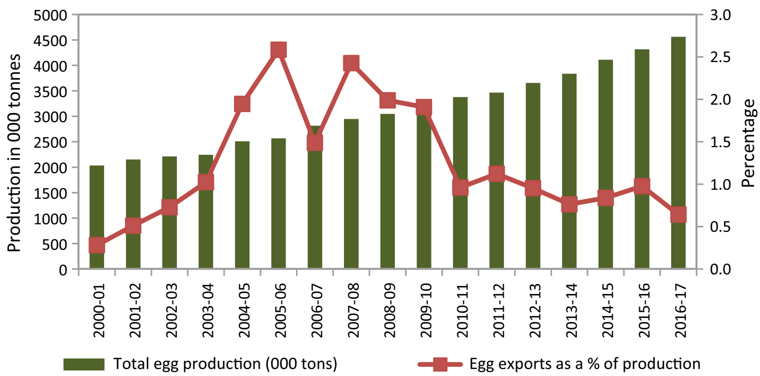

Fig. 7.3 All India egg production and exports. *Source* DAHDF (2018) of India and APEDA

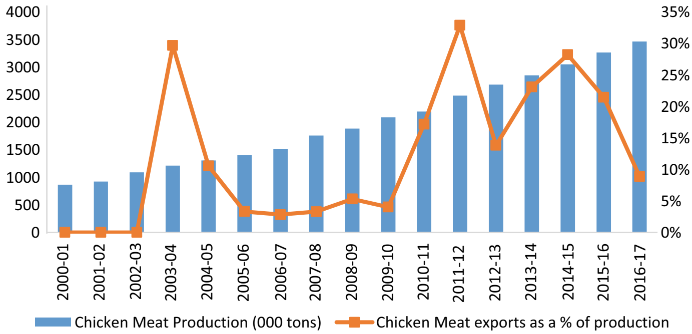

Fig. 7.4 All India chicken meat production and exports. *Source* DAHDF (2018) of India and APEDA

Potential for Breaking into Global Trade

The growing domestic demand for poultry has not been accompanied by any increase in imports as consumption in India is driven by fresh meat from live markets (90%) and not processed/chilled or frozen meats (around 7–10%). This reflects consumer preferences, inadequate processing, and lack of refrigeration infrastructure. The domestic pull for poultry supply is so strong that it diverts producers away from the export markets as domestic markets fetch a higher price for farmers who do not have the resources or cannot strictly comply with quality standards, to meet international demand. A positive lead has been taken by firms such as Shanthi Poultry Farm (P) Ltd. that freeze and pack chicken meat that comply with stringent international sanitary norms and caters to markets in the Middle East, Europe and America. There appears to be an opportunity where Indian exporters can identify and segregate poultry meat products and find markets for Indian chicken breast meat. Given that the cost of production is competitive with those of high performing countries, a strategy to boost exports would require a focused understanding of international market demands for diversified poultry products (frozen/chilled/chilled cuts) together with a comparative freight advantage as well as a host of other sanitary norms and quality concerns.

Table 7.1 presents a SWOT analysis of the poultry sector that can help strengthen the poultry value chain to cater to both domestic and international markets as well as enable poultry farmers to benefit from the marketing gains.

Table 7.1 SWOT analysis: poultry sector (eggs and meat)

SWOT analysis: poultry sector (eggs and meat)	
Strengths	*Weaknesses*
• CAGR for eggs is 5% and 7% for poultry meat	• Lack of infrastructure; Processing, cold storage, refrigerated vehicles
• For last 5 years, CAGR of GVA for egg and poultry is 13% and 15%, respectively (DAHDF 2017)	• Sanitary conditions in handling of meat
• Backyard poultry contributes nearly half of household income in terms of livestock rearing for rural households	• No division between White & dark meat in the consumer market (hence no premium chargeable by producers)
• Coping with production of maize and soya bean	
• Integrators in the value chain of commercial poultry, proving contract farming has worked in this sector historically	
Opportunities	*Threats*
• 90–95%—Wet markets, still scope to transform, markets for chilled chicken are increasing as opposed to frozen chicken	• Avian influenza
• Initiatives to develop LIT (Low Input Technology) birds by CPDOs for backyard poultry	• Mono-breed-Venky's Vencobb captures 70% of market share
• Untapped potential for exports of diversified value-added products	• Rise in domestic maize prices due to MSP
• More state-of-the-art technology in the egg processing sector (low cholesterol & omega-3 rich designer eggs)	
• Brand development for indigenous breeds like Kadaknath and Aseel	
• Formulating Good Practices (SAPPLPP) & Industry–R&D partnerships	

Source Authors' adaptation from GoI No Date

Nominal Protection Coefficient (NPC)

For the purpose of calculating NPC for eggs and chicken meat, weighted average wholesale price of eggs and chicken meat are taken from the Directorate of Economics and Statistics (several issues of Agricultural Prices in India) for Andhra Pradesh and Tamil Nadu (which constitute more than 50% of production). The FOB price has been adjusted with respect to port handling charges, transportation and freight (margins obtained from industry sources). India has been traditionally competitive in egg production and has exported large volumes of egg products to the markets in Japan and the Gulf. NPC of eggs-in-shell has been less than 1 for most of the study period (2003–04 to 2016–17). However, with the onset of Avian Flu outbreaks and certain tariff on Indian egg exports by Japan, the competitiveness has gone down post-2010. Egg exports have dominated poultry exports as a whole and have remained competitive from the start except for certain years due to volatility.

As far as chicken meat in concerned, 2005–06, 2006–07 and 2007–08 were years, when production of chicken meat in India was badly struck due to Avian Flu and adversely impacted the reputation of Indian broiler meat (Fig. 7.5). The entire industry suffered as a result of which even though India was a competitive producer, export of broiler meat was dismally low. Post containment of Avian Flu and after revival of the poultry sector, exports have risen but not as expected, compared to exporting giants like Brazil, Thailand and USA. For instance, according to a Kuwait based Broiler Company, the demand in Gulf for frozen chicken is 60,000 tonnes per month. The Indian broiler company only sells 1000 tonnes per month to Kuwait. Although there is a large demand for exports, Andhra Pradesh exporters face quality issues. Due to fragmented and small-sized poultry farms with poor or no processing, refrigeration and cold-chain infrastructure facilities, the quantity for actual exports after quality checks is very low. Poultry meat was competitive since 2003–04 but has been able to find a minute place in the global market (Fig. 7.6). As mentioned earlier, India has the potential to breakthrough in price competitiveness while competing with traditional exporting giants like USA and Brazil.

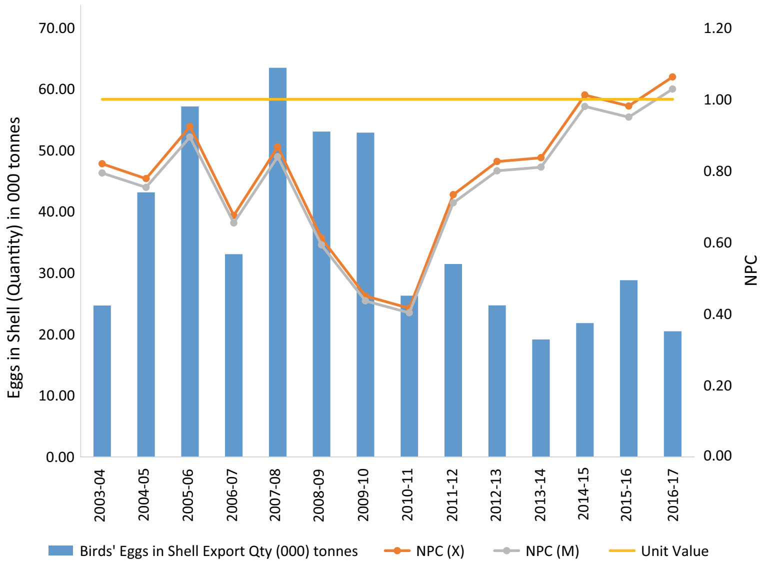

Fig. 7.5 Egg exports and nominal protection coefficients. *Source* APEDA and Authors' calculation

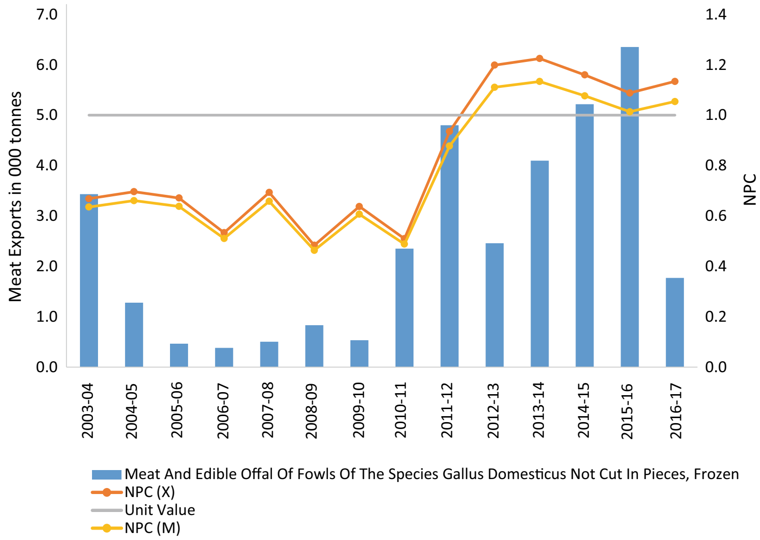

Fig. 7.6 Chicken meat exports and nominal protection coefficients. *Source* APEDA and Authors' calculation

7.3.2 Domestic Price Formation

Vertical Integration of Technology and Markets

Traditional poultry production is an imperative part of rural farm household activities, while commercial poultry is a flourishing agri-business sector. However, Department of Animal Husbandry, Dairying & Fisheries (DAHD&F), Central Poultry Development Organizations (CPDO) and Indian Council for Agricultural Research (ICAR) prioritize backyard sector and started promoting small-scale, semi-intensive commercial poultry models using local or crossbreeds. The major share of egg and meat production (80%) comes from the commercial sector which can be further categorized into contract and non-contract farms. The success of this widespread integration model in the west and south comes from the set-up of the model itself.

A contract farming agreement in the case of broiler farming is referred to as a chick growing agreement, wherein an integrator supplies inputs and procures the output, thus establishing key control and ownership of major components of the value chain. The integrator provides day-old-chicks (DOCs), feed, veterinary services, and vaccines to the contract farmer and the contractor also takes charge of the final marketing of the output either in wet markets or for further processing and distribution. The contract farmer provides his land, housing, equipment (litter shed), labour (family or hired) and takes care of day-to-day farm management. The contract is based on the assumption that both parties will honour their role and attain maximum performance from the flock. There are certain incentives given along with growing charges, if the farmers perform better than the fixed standards/specifications. For instance, contract farmers are given an incentive bonus if the Feed Conversion Ratio

(FCR) and/or mortality rate is lower than those agreed upon in the contract. Thus, poultry growers benefit from considerable price assurance and risk mitigation. Integrators, typically, pay contract growers pre-decided prices for about 42 days old broiler birds (Narrod et al. 2008).

Feed, comprising of maize and soymeal is the largest component of production costs for both broiler and layer production, accounting for (65–70)% and (75–80)% of total production costs, respectively. Poultry integrators have followed a trend of expansion in Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra. Around Pune, Venkateshwara Hatcheries and Godrej Agrovet Group together have about 6000 contract farmers. Suguna has a major hold in the south and account for 60% of production, unlike northern regions where integration has moved rather slowly. Contract farming has considerable potential and advantages for small and marginal farmers who cannot be competitive on their own due to lack of literacy, resources and access to markets. Since small and marginal farmers dominate the Indian agricultural landscape and livestock in particular, contract farming fills the gaps by providing technical guidance, input sourcing, management skills and technical knowledge. This allows fulfilling the twin objectives of skill-building and income generation. Assured input and buyback are the real game changers. Table 7.2 illustrates the cost and benefit accruing to the farmer in contract and non-contract poultry farmers.

The farmer under the contract farming model gets 4.7% of the consumer rupee. However, this share is much lower compared to other value chains because the major cost of production and input provisions are taken care of by the integrator, and not the farmer (Fig. 7.7). This puts the risk burden on the integrator who makes 60% of the consumer rupee.

The wholesaler connects the producer and the retailer and operates on a smaller margin which comes to 7.8% of the consumer rupee (Fig. 7.8). However, the retailer has a critical role to play in converting the live chicken into raw meat, apart from his other operating costs.

Table 7.2 Risk mitigation and assured return in the broiler integration model

Cost/benefit to farmer	Non-contract farmer	Contract farmer
Day-old chick cost	Yes	No
Feed cost	Yes	No
Labour and land cost	Yes	Yes
Medicine/veterinary services	Yes	No
Initial investment barrier	Yes	No
Insulation from market price fluctuations	No	Yes
Finance available	12.5% p.a. (repayment time is 6–8 years)	

Source Field study

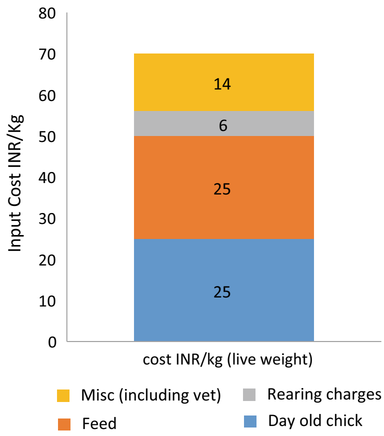

Fig. 7.7 Input cost (INR/kg). *Source* Field interactions

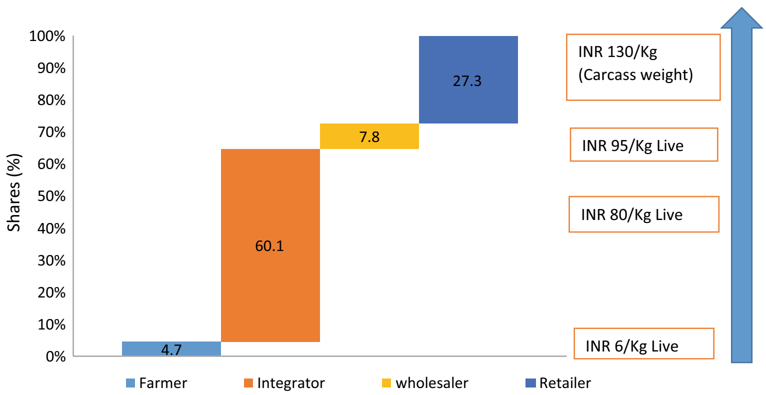

Fig. 7.8 Markups for poultry meat (Andhra Pradesh and Tamil Nadu). *Source* Authors' calculation. *Note* The calculations are based on the assumption that 1 kg live bird is equivalent to 750 g of meat

7.4 Inclusiveness

The Indian poultry sector is by far one of the few sectors that have proven to be inclusive as far as production activities are concerned. Although there are variations in benefits accruing to different stakeholders, poultry has attracted large and small farmers, alike. Geographic and cluster production has been the trend in India. More than 60% of eggs are produced in Andhra Pradesh, Maharashtra, Punjab, Haryana, Tamil Nadu and around 60% poultry meat is produced in Andhra Pradesh, Maharashtra, Punjab, Karnataka and West Bengal. Such variations put certain states at a disadvantage as the benefits of economies of scale are not spread out evenly. The polarization of regions where maximum backyard poultry is practiced leads to inefficiencies along the value chain—technology barriers, high production costs, no market incentives and lower returns.

As commercial poultry is a sustainable option for income generation for a large number of smallholders in rural areas, it is essential to provide an enabling policy environment which encourages the collectivization of smallholders. This calls for innovations in policy and institutional frameworks. The 2017 scheme of Innovative Poultry Production Project (IPPP) under the National Livestock Mission (NLM), aimed to enhance egg production towards scaling-up of small low-input producers to make their ventures profitable. Under IPPP, the number of birds provided to broiler and layer farmers have substantially increased, compared to the Rural Backyard Poultry Development Program (RBPDP), thus benefiting backyard farmers and rural communities. Another positive impact of promoting backyard farming is its potential to promote greater genetic diversity amongst the birds while giving them a less crowded and less stressful environment. They rely on feed which is naturally procured and is free from antibiotic use, therefore minimizing the risk of emergence of new disease strains.

Narrod et al. (2008) identified five essential elements in ensuring smallholders have fair access to agricultural markets. These include extension service and assistance for high-value quality produce; modern infrastructure that helps reduce costs of marketing; access to reliable market intelligence; bandwidth to farm certifiable quality produce; and prompt farm to market linkages, to leverage existing demand. Poultry farming model similar to Amul milk collection and marketing model could help small farmers to collectively market their produce across India. Along with marketing channels, extension and veterinary services should acquire a pivotal role, if inclusiveness is to be addressed. There is enough evidence to support the fact that the growth of the sector has taken place largely with help of private capital. Given strong market opportunities, strong backward linkages with small poultry farmers have the potential to create win–win situation for all actors in the value chain.

As far as institutional support is concerned, there are subsidies that exist but are targeted at commercial poultry or exports, which is imperative as well, but social safety nets (subsidies or insurance) for smallholders is still missing from the framework. The lack of insurance schemes that are tailored to the needs of vulnerable poultry farmers is a major setback for their expansion. Smallholders can compete with modern commercial poultry because of acquired productivity advantages. However, it should be emphasized that there is a need to substantially increase public investment, particularly for institutional development to help smallholders overcome high transaction costs while accessing quality inputs and markets.

7.5 Sustainability

The Indian poultry industry is at a turning point with ever-growing implications for sustainability of the sector as a whole and welfare of smallholders, in particular.

At this point, it becomes essential to analyze the viability of the sector, so far and what the future looks like, given the growing demand for poultry products driven by consumer behaviour, technological breakthrough and adoption of the integrator model. The question of sustainability thus rests on two pillars—environmental and financial. With strides in development, there are environmental costs that need to be abated because of rising pressure on resources, recognition of safety standards and animal welfare conditions.

The vision of aligning Indian poultry with world standards and standing up to stiff competition would mean taking into consideration certain laws that demand quality assurance. Thus, there is a shift to more evidence-based decision-making systems and the need to establish traceability of poultry products. These factors affect the entire value chain starting from hatcheries to feed mixing units and the final sale of finished meat products.

7.5.1 Financial Sustainability

Feed Market Implications—Variation between Feed Price and Poultry Production
If production has to remain competitive, the sustained availability of high quality and affordable feed is crucial. Poultry feed accounts for 47% of total maize consumption (FICCI 2018). Maize largely remains the preferred energy source for the sector and is expected to grow from 26 MMT in 2016–17 to 45 MMT by 2022 (India's Maize Vision 2022). India's maize yield of 2.5 MT/hectare is lower than the global average of 5.5 MT/hectare (FICCI 2018), though there is evidence of much higher yields being obtained in various parts of India. One of the reasons explaining this could be the fact that only about 30% of the area is under SCH (Single Cross Hybrid). Adoption of SCH technology was the driving force behind increasing productivity of maize in countries like USA and China; replication of same in India calls for a change in policy perspective. Poultry sector in India can benefit from increased R&D in developing maize hybrids and their rapid adoption and the private sector can play a larger role in strengthening the maize value chain.

Catering to Markets and a Vision for the Future
In India, there exists a dominant wet market for poultry meat, and rural and urban consumers, alike, prefer live meat markets. This limits the processed chicken meat sector to only (7–10)%. However, as firms start diversifying and expanding operations, they come up with innovative marketing strategies. For example, Suguna's layer variety, Lohmann LSL-Lite is capable of producing over 325 eggs in 72 weeks saving production cost of over 3% per egg. In terms of branding strategy, Suguna's eggs were priced more than the unbranded local eggs in the market and to justify the premium, Suguna employed product differentiation; their eggs were clean, shiny and uniform in size and shape and packed attractively. Additionally, to cater to the needs of high cholesterol patients, Suguna has a range of eggs under the variant Suguna-Heart which are rich in Omega-3 fatty acid and contain less cholesterol.

The firm's product differentiation strategy is not only a domestic market-led initiative, it also places the firm at the centre of modern technology, which is recognized globally. The export impetus that India needs has come institutionally more from the private sector as far as breeding and export readiness are concerned. Suguna has a turnover of INR 7870 crores (in FY2019–20) and a state-of-the-art processing plant in Tamil Nadu with an operational capacity of 3600 birds (1500 MT) per month. Suguna's processing plant is closely monitored by Export Inspection Agency (EIA) and Meat Food Products Order (MFPO) of the Ministry of Food Processing Industries (MoFPI) as it is approved by the government for exports. Suguna was the pioneer in poultry integration when it started a contract farming system with 200-layer birds in Udumalpet, Tamil Nadu in 1986. Now it boasts of a farmer network of 30,000 in 18 states across the country.

The Integrator System and Sustainability

The integrator model has been successful in making poultry farming profitable for small farmers by undertaking the costs and risk of poultry farming. This together with the ability of the integrators to cater to a large market for poultry products and investing in the supply chains have positive implications for its financial sustainability. By streamlining the value chain, integrators are able to cater to rising demand at affordable prices and deliver higher gains to the farmers. At first glance, it would seem that integrators assume a significant risk to protect farmers, but the returns received cover their costs and risks, thus making them operate on a good profit margin. Suguna's average operating profit margin over five years is about (7–8)% and net profit margin is around 4%. For Venky's, net profit for the first quarter of 2018, stood at INR 69.42 crores, up by 66.4% from last quarter of 2017.

In addition to integrator model, poultry value chains driven by co-operatives and producer companies have been successful in strengthening inclusive growth. Structured on the lines of integrator model providing inputs, day-old chicks, advisory and extension services as well as market linkages, such models have the potential to positively impact large number of vulnerable people who struggle to participate in these mainstream livelihood options owing to lack of financial resources and absence of market linkages. One such example being that of Madhya Pradesh Women Poultry Producers Company Private Limited that has its genesis in PRADAN led poultry producer collectives comprising of Gond tribal women in the Kesla block in Madhya Pradesh in 1994. This market-led model was first of its kind in integrating women poultry producers living below poverty line to competitive poultry markets and delivering income security to the women. The first co-operative was registered in 2001 as *Kesla Poultry Sahkari Society Maryadit*. As on 2018–19, there were 14 co-operatives and Poultry Producer Companies under the Madhya Pradesh Women Poultry Producers Company Private Limited, which is an apex federation. The membership stands at 8121 all women members with a sales turnover of INR 297.7 crores and member profits of INR 24.9 crore, about 8.4% of the turnover. Under a smallholder broiler model, each woman producer has 500–1000 birds and rears five to six batches annually. This fetches an income of INR (40,000–80,000) per year for 200 days of work at the rate of 3–4 h a day. For layer farm of 400–500 bird size and yield of 320–340 eggs in 52–60 weeks, each woman producer makes about INR (55,000–60,000) per year.[1]

Harshvardhan 2010 reports that KPS has been paying higher rearing charges to its poultry growers compared to the integrators in different parts of India. While KPS has been successful in delivering higher incomes to individual growers, the larger impact will be seen when small growers do not face any hurdles in joining such collectives. Models such as KPS that have come at par with integrators in terms of scale of operations are enabling penetration of organized poultry farming beyond southern and western states. Also, the decentralized model of poultry farming will be effective in strengthening the inclusiveness of poultry value chains.

7.5.2 Environmental and Epidemiological Implications

Efficient poultry farm management in terms of safe handling of dead birds and farm waste are necessary to prevent environmental hazards including water contamination, among others. During disease outbreaks, it becomes critical to ensure safe disposal of dead and infected birds without which the environment can be adversely affected. The environmental impact of poultry production depends on farm size, production systems, diet composition of birds, type of infrastructure and bio-security levels. There have been rising sustainability concerns which in turn have led to recommending the use of poultry manure and litter as a soil fertilizer for crop production. Organic production of poultry has emerged as an alternative production system. Litter from birds contain significant amount of nutrients essential for plant growth and in some states under certain smallholder programs, poultry litter is converted to bio-gas, but a large-scale intervention is needed at the national level. Van der Sluis (2007) reported that poultry meat and egg production were environmentally less burdening than beef, sheep and pork production. For instance, global warming potential (CO_2 equivalent) was 3.6 in poultry meat production compared to 15 in beef; and 17 in sheep meat. Gerber et al. (2013) studied that while beef production accounted for 41% of the GHG emissions, poultry meat and egg production contributed to 9% and 8%, respectively.

Avian Influenza and the Degree of Economic Losses to Producers

The single most devastating threat to the poultry sector are diseases like Avian Flu (highly pathogenic avian influenza (HPAI), A (H5N1) and H7N9), which can completely wreck the profitability and productivity of poultry, for big and small players, alike. The severity of these disease outbreaks disrupt both production and consumption patterns, as observed in India and other countries. World Organization for Animal Health (WOAH) and FAO play a critical role in issuing guidelines and charting out clear actions with respect to monitoring and containing the outbreaks at a global level. India has benefitted from the Prevention and Control of Infectious

[1] https://mpwpcl.org/.

and Contagious Disease in Animals Act, 2009, which regulates the outbreak across states as well as provides quarantine guidelines. The relevant and applicable framework makes sure the spread of any infectious disease is contained in the particular state/region and urgent steps are taken to reduce the far-reaching negative impacts of the outbreak. However, disease surveillance remains an area of concern in the livestock sector.

HPAI has strong micro-impacts in the regions affected and a macro impact as a result of an interconnected global trade route. With the onset of an epidemic, small growers face significant costs related to culling of birds and restocking (Verbiest and Castillo 2004). Also, as measures to control the epidemic are rolled out, cost of production increases, which again poses a financial burden on the small poultry growers. The study by Kumer et al. (2008) in Manipur, post the outbreak of HPAI in July 2007, shows that about 3.39 lakh birds were culled post the notification issued by Government of India. With nearly (43–79)% of the household income in Manipur coming from the poultry sector, the outbreak had severe economic consequences for the layer and broiler producers. The study estimated that while the producers suffered a loss of INR 31.6 million, the government compensation was only INR 9.9 million, which was grossly inadequate. While the farm gate price of broiler was INR 56/Kg, the compensation was INR 30/Kg and there was no mechanism to account for the economic losses suffered from damage of eggs. In addition to the income and livelihood loss, such outbreak poses immense challenges related to compliance in bird culling and operations in containing the outbreak. Given that the poultry sector is threatened by such disease outbreaks, sustainability of livelihoods of small growers emerges as a major concern.

7.6 Scalability

India's poultry sector is characterized by the co-existence of a high capital and technology intensive sector (which is controlled by integrators and has major potential to propel India into global poultry trade), and backyard poultry sector (which has strong implications on poverty reduction and nutritional improvement in rural areas).

7.6.1 Vertically Integrated Production Systems and Inflow of Technology

The structural changes experienced by the poultry industry cannot be ignored as the accelerated growth has benefitted small and marginal farmers by establishing a contract farming system with its own risk-assurance and extension services within the model (Fig. 7.9). The increase in consumer demand for poultry led to movement towards mass production in 1980s in a unique manner which was not seen in any other industry in the country during that period. Figure 7.10 provides a snapshot of

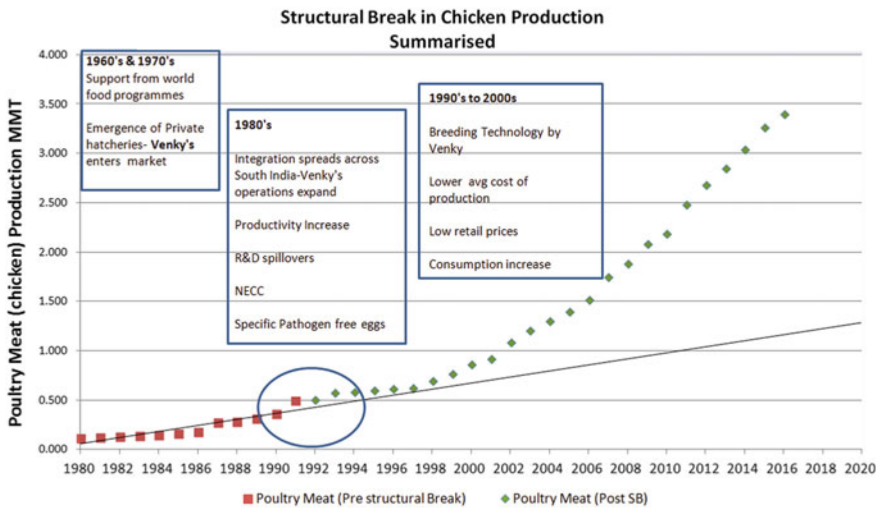

Fig. 7.9 The various stages of poultry revolution in India. *Source* Authors' calculation

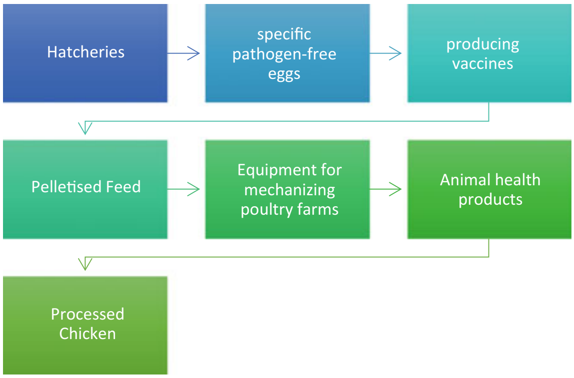

Fig. 7.10 Key pillars of innovation for poultry sector. *Source* Authors' own illustration

the key pillars of innovation that aided this transformation. Integrators came into the market and brought new technology and production systems that transformed the sector. This was accompanied by a shift from indigenous bird varieties to hybrid birds with special characteristics like increased hatchability, faster growth of chicks and more eggs/meat per bird. Emphasis on innovative research resulted in giant leaps in the productivity levels of eggs and broilers in the 1970s.

Figure 7.11 depicts that the future gains in the poultry sector will be driven by the integrator/organized model. The organized sector provides greater scope for processing and retailing, which will be important for scaling up the poultry value chain.

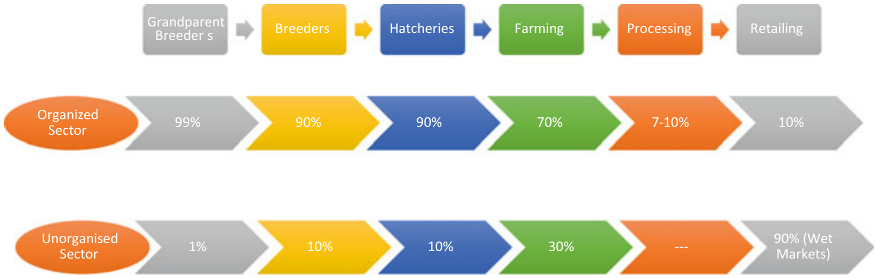

Fig. 7.11 A typical integrator model of poultry. *Source* Authors' own illustration

The contract farming system has a mutually binding contract that is followed by the integrators and the contract farmers and there is very little room for error or non-compliance. The design of the contract helps balance out the inefficiencies and absorb risks by the integrator in return for the specified output demanded. The contract specifies the mortality rates (set around 5%), Feed Conversion Ratio and weight of birds (between 1.8 and 2.2 kg). India started off with a low feed conversion ratio (FCR) of 2.2 in the 1990s and now it has an internationally competitive FCR of 1.65, which has been possible through the advancements made in genetics, veterinary health and poultry feed improvement—all of which were pioneered by integrators. According to industry sources, Vencobb is the preferred broiler breed which was derived from the Cobb variety and further enhanced and brought into the Indian market by Venkateshwara Hatcheries. Vencobb has the ability to withstand extreme temperatures and has competitive feed efficiency. Ross, Marshall, Hubbard, Hybro-Avian and Anak are some of the other popular breeds (USDA FAS 2016).

7.6.2 Availability of Low-Priced and High-Quality Animal Feed in Southern and Western India

It is imperative to consider why most integration operations are concentrated in a few states resulting in increase in production of poultry meat (Fig. 7.12). Although the industry as a whole has benefited from scientific leaps in poultry breeding and disease control, the availability of low cost and high-quality feed has further fueled this growth (Ravindran 2013). Until the 1980s, 70% maize was primarily consumed as direct food and the rest was used as inputs for feed and industrial use in equal proportions (Singh and Pal 1992). However, in the last three decades, the proportion of maize used in the poultry feed industry has risen rapidly and accounts for 47% of India's maize production (FICCI 2018). Presence of vertical integration in southern region has helped ensuring feed is available easily and at affordable rates, thereby lowering the cost of production compared to other regions (Narrod et al. 2008).

Increase in production levels in recent years has been largely due to an increase in the size of poultry farms given a host of other inter-related factors (NCAER 2015).

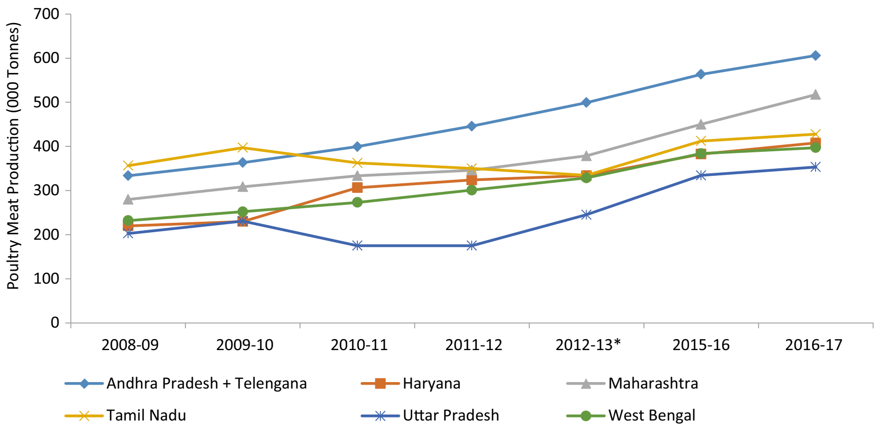

Fig. 7.12 Top poultry meat-producing states over recent years. *Source* Basic Animal Husbandry Statistics

Unlike earlier, when broiler farms produced on average 200–500 chicks per cycle, at present units with 5000–50,000 birds per week cycle are quite common. These entities are increasingly engaging in the integrator/contract farming system. High cost of feed, veterinary services including vaccines, transportation costs and lack of adequate finance are rendering smaller units economically unviable.

7.7 Access to Finance

Credit facilities for the poultry sector are available from commercial, co-operative and regional rural banks (RRBs). NABARD provides refinance facilities for poultry production and marketing. The accessibility and ease of procedural norms are still to be evaluated carefully. Besides providing financial resources, NABARD has also guided preparation, appraisal and monitoring of various schemes. Table 7.3 provides the financing requirements of poultry broiler farmers with respect to the farm size in different states that were studied.

In the case of a farmer interviewed in Hisar, Haryana, no loan was taken from the bank. The farmer used his own agricultural land and made his own investment. In Andhra Pradesh, farmers under the Suguna contract took loans from state banks at an interest rate of 12.5% per annum. Also, 8 out of 14 farmers studied relied on formal source of credit subject to their farm size. However, the loan system is still biased towards asset-owning farmers.

Table 7.3 Financing requirements of poultry broiler farmers

Farm size	Approximate cost (capital cost only)	States reviewed
500 birds	INR 1.61 lacs	Andhra Pradesh
1000 birds	INR 3.22 lacs	Andhra Pradesh
4000 birds	INR 9.5 lacs	Telangana
8000 birds	INR 19 lacs	Telangana
10,000 birds	INR 20 lacs	Andhra Pradesh, Telangana
30,000 birds	INR 60 lacs (automated)	Hisar

Source Field study

NABARD and Ministry of Micro, Small & Medium Enterprises (M/oMSME) promotes the Poultry Venture Capital Fund (PVCF) scheme for strengthening the poultry industry by generating employment or entrepreneurship opportunities in backward areas. Integrators like Venky's have better access to finance in the value chain, passing on the benefits indirectly to farmers and securing risks. For instance, Venky's finances most of their operations via reserves and surpluses, term borrowings from banks and a small percentage through share capital. The cost break-up of a contract broiler production value chain (item-wise) is summarized in Table 7.4.

Table 7.4 Costs, margins and sources of finance for poultry farmers

Cost/details	Integrator 1 Tamil Nadu	Integrator 2 Andhra Pradesh
Cost		
Rearing charges	INR 4.15/kg (INR 3.5/kg-minimum)	INR 7/kg (INR 4/kg-minimum)
Cost of production to the integrator (fixed by the company)	INR 60/kg	INR 72/kg
Cost of day-old chick	INR 20/chick	INR 22/chick
Mortality	5%	3–4%
FCR	1.7	1.7
Average no. of days to reach max weight	35–38 days	38–39 days
Average body weight	2 kg	1.8–2.1 kg (winter/summer difference 500 g)
Batches	5–6 batches per year	5–6 batches per year

(continued)

Table 7.4 (continued)

Cost/details	Integrator 1 Tamil Nadu	Integrator 2 Andhra Pradesh
Margin		
Wholesaler	INR 4–5 per kg (mark-up = INR 10 per: INR 5/kg for expenses like lifting, transportation, etc. + INR 4–5 for margin)	INR 2–3/kg
Trader/dealer		INR 2–3/kg
Retailer	INR 20/kg (margin)	INR 10/kg or INR 20 per bird (2 kg bird will give 1.6 kg meat with this particular integrator's birds, otherwise a 2 kg bird fetches 1.3 kg meat)
Finance		70% of poultry farmers finance from their own pocket 30% farmers take bank loans (Indian Bank and Axis bank are largely active in this area) Only a few farmers get loans sanctioned depending on security provided Rate of interest 1–1.5% per month
Average farmer's return in Southern India		
Farmer gets	INR 6/kg (cost + incentive); bird weight 2–2.5 kg	
Farmer's cost	INR 2.5/kg	
Net return	INR 3.5/kg	
Cost of setting up a farm	500 birds—1.61 lacs 1000 birds—3.33 lacs 4000 birds—12 lacs	4000 birds—9.5 lacs (Telangana Animal Husbandry Dept.) 8000 birds—19 lacs 30,000 birds—66 lacs

Source: Authors' estimates based on field study

As per a survey in 2001, commercial loans to the poultry farmers were available at around 15% per annum which was lower than that available from the informal sources (Ramaswami, et. al 2005). In northern India, integrators regarded enlistment, organization, or management of contract farmers as significant issues. The southern states have been able to handle the financing problems relatively better, which was evident during the field interactions with contract broiler farmers of Suguna. A summary of the detailed interaction with industry sources and farmers gives an abstract picture of farmers accessing institutional finance or whether they rely on self-finance which is either through savings or borrowing from informal sources (Table 7.5).

Table 7.5 Share of formal finance by poultry farmers

Region	Average farm size	Per cent of self/formal finance
Ludhiana (Punjab)	7000–8000 up to 25,000 birds	50% each
Madanapalle (Karnataka)	5000 birds	8/14 farmers use formal lending
Bangalore (Karnataka)	5000 birds	–
Odisha	3000 birds	80% self-financed

Source Field interactions

7.8 Conclusion and Policy Recommendations

The Indian poultry industry is export competitive in egg-hen, eggs-in shell, eggs dried and eggs-liquid. Although export competitive, chicken meat exports have been dismal due to rising production costs doubled with the onslaught of Avian Influenza (AI) and lack of infrastructure pertaining to storage, cold chains and export willingness. The domestic industry is price competitive in production of meat in southern and western India. The cluster-export approach production model may work and can be replicated. Given the importance of feed in the poultry value chain, maize and soya bean price movements are fundamental determinants of the competitiveness and sustainability of the sector. Inclusiveness is limited in the commercial model but more dispersed models like the Kesla Poultry Model have delivered higher economic gains to the marginal and disadvantaged population, including women. Retail prices and producer-retail margins are generally higher in the northern region, where poultry integrators are least active. There is very limited scope for producers from low-cost regions to market their product in high-cost regions. Issues related to disease outbreak and unregulated use of antibiotics fuel certain perceptions that affect demand for poultry products and hence marketability. These perceptions need to be corrected and we should move to a more responsible system with awareness and surveillance campaigns. Based on the findings of the study, we recommend the following policy measures to ensure a more competitive, inclusive, sustainable and scalable poultry value chain with enhanced financing mechanisms.

- Expanding the scope of mid-day meal scheme for school going children to include at least two eggs per week along with milk is an effective way of expanding markets that will help provide remunerative prices to local producers. The suggestion is rooted in the idea of a decentralized market mechanism where local, small and marginal poultry farmers get a ready market and scale-up their production to cater to this new semi-urban and rural mid-day meal market. This will subsequently increase the overall demand at the national level. If 50% of 9.5 crore children i.e., 4.75 crore children who are served mid-day meals consume 2 eggs per week, then total demand for eggs will be approximately 5 billion eggs, annually.

- Foreign direct investment (FDI) in the poultry value chain to upgrade infrastructure, boost uptake of technology, improve farm management practices, can add a further boost to the sector for which the incentives and creation of an enabling environment will be critical.
- Poultry export market can be expanded, provided there is freight advantage and India is able to compete with Brazil and USA.
- Growth in the poultry sector is confined to zones and clusters in the west and south-thus increasing the regional foot print in states with a higher potential (catering to domestic markets). This needs to be panned out across the country to help potential poultry farmers benefit from commercialization and greater integration of poultry farming.
- Maize prices have a direct bearing on the cost of production and any policy affecting prices would have a direct and critical impact on poultry producers' profitability. Hence policy measures to increase productivity of maize and making quality feed available at affordable prices should be a priority.
- Strengthening access to veterinary and extension services for non-contract farmers, adequate provision must be made for the establishment of veterinary ITIs (as has been done in Andhra Pradesh), which would result in more number of veterinary technicians at the grass-root level.
- Supporting collectivization of smallholders to achieve economies of scale (for example, co-operatives, producer companies) would ensure the supply of inputs (day-old-chicks, veterinary services including vaccination, feed, production supervision and monitoring,); facilitate and enable market linkages; and mitigate price risks.
- Addressing food safety issues along with effective surveillance (early detection) and containment mechanism for diseases, especially, Avian Flu would significantly reduce the negative impact on domestic as well as export demand.
- Other important issues such as animal ethics and welfare will have to be considered to strengthen the value chain. Technologies like artificial intelligence, robotics, etc. in the livestock sector will play an effective role in overcoming the challenges.

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Chapter 8
Pulses Value Chain- Pigeon Pea and Gram

Kavery Ganguly and Ashok Gulati

8.1 Introduction

8.1.1 Significance of Pulses in India

Pulses form an important part of Indian agriculture given that the country is the largest producer, consumer and importer of pulses. Owing to their natural resilience to extreme weather conditions, low water requirements and being environmentally benign, pulses have been traditionally a smallholder's crop. However, with poor price realization, farmers have been switching towards other remunerative crops such as sugarcane, soybean, among others. Unlike rice and wheat, pulses are not covered by the regular public procurement system which makes marketing of pulses at fair and remunerative prices, a challenge for the farmers. Pulses are no longer a poor man's diet given the escalating consumer prices. Nonetheless, it is considered as an important source of protein (given the large vegetarian diet base in India), consumption of which is being promoted to address the protein gap in the diets. Over time, per capita availability of pulses has declined like other traditional cereals. With changing consumption patterns and emerging dietary deficiencies, there is scope for enhancing consumption of pulses through traditional and value-added products.

Pulses account for only 4% of the value of crop agriculture and cover about 11.7% of the gross-cropped area. Since 1950s, area under pulses as a per cent of total area under food grain remained almost unchanged at 20% with some minor annual deviations. The share of pulses as a per cent of total food grain production declined over a period of time and is about 7% average for the five-year period ending 2016–17. About 17% of the area under pulses is irrigated for the five-year period average ending 2013–14. In addition to being less water intensive compared to other crops, pulses can withstand extreme temperatures and also enable natural

K. Ganguly · A. Gulati (✉)
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

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fixation of nitrogen in the soil due to its leguminous properties. Gram and pigeon pea together account for 52% of pulses area and 61% of production (as estimated for TE 2015–16). Agricultural imports in India largely comprise of pulses, after edible oils. Yellow peas accounted for 49% of pulses import for the period 2010–11 to 2016–17. Factors related to lack of expansion of area under pulses through persistent low yields due to lack of any major technological breakthrough have restricted production expansion. Coupled with this, a weak procurement regime has resulted in inadequate domestic availability of pulses. Owing to these gaps, Government of India (GoI) adopted a focussed policy thrust to augment pulses production and programs such as the National Food Security Mission (NFSM); Integrated Development of Pulses Villages, among others. While these are more supply side policy efforts, enough emphasis on marketing infrastructure and practices has been missing, resulting in poor price realization for the farmers. Responding to situations when market prices fell below minimum support price (MSP), government procured pulses through the public procurement agencies such as National Agricultural Cooperative Marketing Federation of India Limited (NAFED) and Small Farmers Agribusiness Consortium (SFAC) through the Price Stabilization Fund (PSF) and Price Support Scheme (PSS). In 2016–17 and 2017–18, farmers had been under severe distress owing to market prices crashing below MSP resulting in state-wide agitation and demonstration by the farmers. The crisis situation forced several state governments to ease off the pressure by announcing loan waivers and introducing price deficiency payments and direct benefit transfer programs. Notably, Madhya Pradesh introduced the Bhavantar Bhugtan Yojana (BBY) in September 2017, to compensate the farmers, the difference between MSP and average sale price without getting into physical procurement. In the case of loan waivers, there are concerns about the extent to which farmers under distress actually benefit. Loan waivers have been widely debated and are perceived to be more populist in nature and lacked economic rationale.

8.1.2 Major trends in Consumption and Production of Pulses

Pulses are an integral part of the staple vegetarian diet of Indians. Per capita availability of pulses reduced by 38%, to 43.8 g per day in 2015 from a peak of 70.3 g per day in 1956. Pulses contributed to 10.6% of protein intake in rural areas and 12.4% in urban areas in 2011–12 (Government of India 2014a). The increase in protein intake from pulses over the years has been the slowest among all other foods. As per the NSSO estimates for 2011–12, an average Indian consumes 739 g per month or 8.9 kg per annum of pulses in rural areas while and 857 g per month or 10.3 kgs per annum of pulses in urban areas. The share of pulses in per capita consumption expenditure on food has been fluctuating. It decreased from 5.9% in 1993–94 to 5.4% in 2004–05, then increased to 6.8% in 2009–10 and declined to 6.1% in 2011–12 (Government of India 2014a). Prices of pulses have increased significantly, notably in urad, tur and chana. Since April 2006, the highest peak in wholesale price index of pulses was observed in November 2015. Although retail prices of pulses escalated sharply, the same has not resulted in higher prices for farmers.

With 32% of the area and 25% of global production, India cultivates the largest pulses varieties. Pulses production in India increased from about 8.4 million tonnes in 1950–51 to a record level of 25.2 million tonnes in 2017–18 (according to fourth advanced estimates). Between 2015–16 and 2017–18, production increased from 16.4 million tonnes to 24.5 million tonnes, registering a growth of 49.4%. With two consecutive years, 2014–15 and 2015–16, when production fell to 17.2 and 16.4 million tonnes, respectively, farmers were incentivized through increase in MSP to grow more pulses. This together with soaring market prices in 2014–15 and 2015–16, resulted in unprecedented production levels in 2016–17 and 2017–18, with market prices crashing below MSP. The highest yield in pulses was registered at 789 kg per hectare in 2012–13 from a lowest of 377 kg per hectare in 1966–67 (Fig. 8.1). This indicates that pulses are yet to undergo a major technological breakthrough that has a positive impact on yield performance.

Assessing the overall food grain sector, it is observed that cereals and particularly rice, wheat, and more recently, maize have done well in terms of production, in comparison with pulses. While the green revolution and maize revolution propelled production of these crops, similar breakthrough in pulses has not been achieved till date. While the share of pulses in area under food grain remained unchanged at 20% during 1950–51 to 1959–60 and 2010–11 to 2015–16, the share in overall food grain production declined dramatically from 16% to 7% during the above period.

Under these prevailing circumstances, it is important to ensure that goals pertaining to productivity gains should be dovetailed with profitability for farmers, thereby creating a sustainable ecosystem. With increasing importance of technology be it high yielding, climate-resilient seeds or advanced mechanization, cost of production is bound to increase for the farmers. However, the quantity and quality of produce should allow farmers to recover their cost of production and make reasonable profits to be able to sustain pulses farming. Just as millers, wholesalers and retailers are

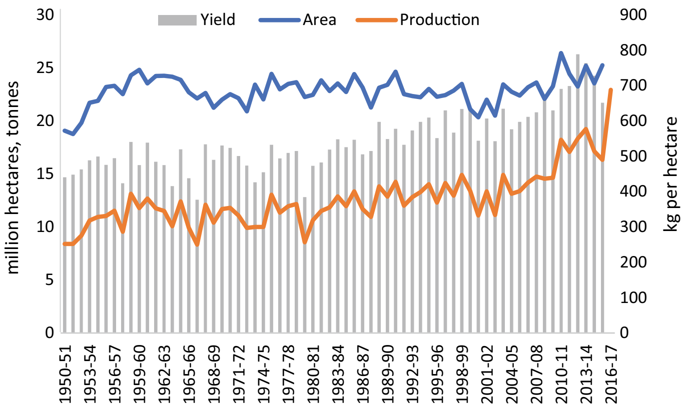


Fig. 8.1 Trends in pulses production, area and yield in India since 1950–51. *Source* Agricultural statistics at a glance 2016, 4th advance estimates, MoA&FW, GoI (2017). *Note* Area and yield data up to 2015–16

able to play the markets, farmers should be given similar options. Hence, marketing opportunities need to be widened for the farmers to benefit from higher price realization either by streamlining the physical value chain and reducing the margins or providing farmers the option of holding their produce in warehouses and participating in futures market.

8.1.3 Study Objective

The objective of the study is to map the current pulses value chain in the context of competitiveness, inclusiveness, sustainability and scalability and access to finance (CISS-F). This study focusses on gram/*chana* and pigeon pea/*tur/arhar*, which together account for nearly half of the pulses production basket.

- **Competitiveness** is assessed in terms of domestic price formation in the pigeon pea and *chana* value chains. Wholesale and retail prices are analyzed to assess the spread of prices in the respective value chain. Since the study is not based on primary representative surveys, obtaining the actual costs and margins in the chain was not feasible. Competitiveness also includes the international import and export trends and tariff regulations.
- **Inclusiveness** is assessed in terms of the irrigated and non-irrigated area under pulses. Majority of the farmers are marginal and small and operate less than 2 hectares of land, and pulses are largely rainfed. Access to irrigation results in higher productivity of pulses and hence higher marketable surplus. Inclusiveness in terms of access to markets, storage and processing is also captured through secondary research.
- **Sustainability** is assessed at three levels for pigeon pea and *chana* value chains
  - sustainability of production growth through increased productivity
  - environmental sustainability in terms of the impact of increasing production on water and soil
  - financial sustainability in terms of cost of cultivating pigeon pea and *chana* and the price received (MSP or wholesale market price)
- **Scalability** is assessed in terms of the potential to diversify to other pulses in addition to *chana* and pigeon pea; diversify production of pulses to states other than Maharashtra and Madhya Pradesh that are agro climatically suitable for growing pulses and have the scope for improving yield levels.
- **Access to finance** is assessed in terms of farmers availing loans or subsidies in general and those targeted to the pulses growing farmers. Also, financing of the value chain particularly, milling in the case of pulses, is also studied.

8.1.4 Study Approach and Methodology

The study includes pigeon pea/*tur* and bengal gram/*chana* value chains given that these account for more than half of pulses production in India. To study these two value chains, Maharashtra and Madhya Pradesh were chosen as these are the largest producers of pigeon pea and *chana*, respectively. Given the scope of the study, primary research was conducted in these two states. For certain aspects of the study, where information or data specific to these two value chains were not available to the author, the findings have been reported at the aggregate pulses value chain level.

The study methodology includes analysis of secondary data and information to assess the pigeon pea and *chana* value chains on the CISS-F framework. It also includes interaction with key stakeholders such as farmers, wholesalers, millers, commission agents and farmer producer organizations. These interactions were carried out in Latur and Mumbai in Maharashtra and Indore, Dewas and Ujjain in Madhya Pradesh. In addition to the value chain players, meetings with millers' association and marketing committee officials were held. The objective was to understand their perspective of the price and trade policies changing dynamics of the pulses sector in general with improvements in technology, restructuring of marketing operations and increased awareness amongst farmers.

8.2 Competitiveness of Pulses Value Chain

8.2.1 Domestic Competitiveness of Pulses Value Chain

In ascertaining domestic competitiveness of pulses value chain, the analysis includes farmer's share in end consumer price as well as the extent to which actual price received by the farmer covers his cost of production. Increasing the share of the farmer's price in the end consumer rupee indicates the efficiency of the value chain. In addition to the real costs incurred in terms of processing, transportation, marketing charges and legitimate fees for intermediation, if supernormal margins do not accrue to the other players in the value chain, then the value chain is more competitive. It is also important to ensure that farmers earn a remunerative price covering their cost of production such that pulses farming is profitable for them. To further assess the domestic competitiveness of the pulses value chain, the spread between wholesale and retail prices has been analyzed.

As observed in pulses marketing season of 2017–18, market price fell below minimum support price (MSP) of pulses, and hence, farmers could not recover their production costs. Under such circumstances, a farmer receiving higher share of the consumer rupee does not make much difference because anyway he is unable to cover the production cost. In pulses value chain, processing and value addition and storage requirements for longer time periods add to the costs and margins in the chain. Since farmers interface the chain only during arrival months, in situations of glut, they suffer from lower prices and so do other stakeholders. However, most often, everyone except the farmer is able to recover their losses or enhance their margins once the arrivals have ended, and the value chain moves on stored pulses. From millers to wholesalers and retailers, everyone is able to sell at a much higher price compared to what the farmer received. Hence, comparing farmer's price to a prevailing wholesale or retail price months after arrival further brings down his share in the end retail price, significantly.

Domestic Price Formation in Pigeon Peas/Tur Value Chain

In assessing farmer's share in consumer price, a pigeon pea value chain starting from a wholesale market in Latur to Vashi (wholesale market in Mumbai) and further retail outlets in Mumbai, Maharashtra has been mapped. The analysis illustrates the different stages of the pigeon pea value chain specific to Maharashtra under which price formation takes place right from the price paid by the miller to the farmer; price of milled dal sold to wholesale traders in Vashi, Mumbai; price at which wholesale traders in Vashi sell to other bulk buyers (including other wholesale traders, retailers, and individuals); followed by price at which retailers sell in retail market close to the Vashi wholesale market. It should be noted that the price formation from miller onto wholesalers and retailers is weighted average of the various products derived from raw pigeon pea sold by the farmer. In other words, the price received by the farmer for 1 quintal of pigeon pea is not compared to the price of a single variety of processed dal but to weighted price of the different varieties of processed dal, broken and cattle feed, excluding wastage (3%). As observed from Fig. 8.2, a farmer earns

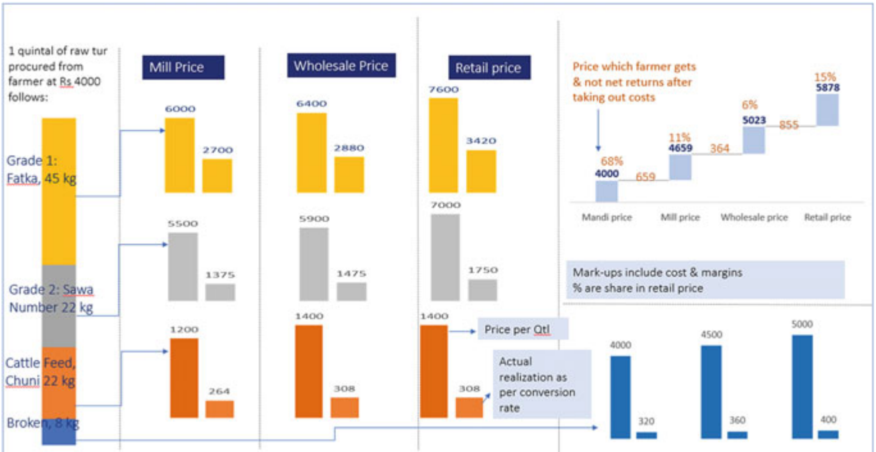


Fig. 8.2 Price formation in a domestic value chain of pigeon peas/tur from Latur to Vashi and Mumbai city. *Source* Authors' calculation based on field visit

about 68% of the consumer price and remaining accrues to the miller, wholesaler and retailer. This is higher than the data often reported about farmer's share in consumer price which hovers around (50–57)%, which perhaps typically takes into account the consumer end price of one variety of processed dal. RBI (2019), reported farmers' average share in retail price of pigeon pea to be 60%.

Figure 8.3 shows the wholesale price in Maharashtra as a percentage of the retail price in selected cities. This is an approximately close indicator of the price received by the farmers selling whole pigeon pea as a percentage of the split pigeon pea or tur dal purchased by the retail consumer. Between (Jan–Apr) 2014 and 2018, the wholesale price was about (44–67)% of the retail price, in the selected cities. The average for the above period varied between (53–59)%. On ground, the farmers receive less than this amount given a range of marketing charges that are recovered from the farmers, officially or unofficially. Of course, the wholesale price received by the farmers, as observed in 2016–17 fell short of MSP by 16% and did not cover the cost of cultivation of pigeon pea for the farmers.

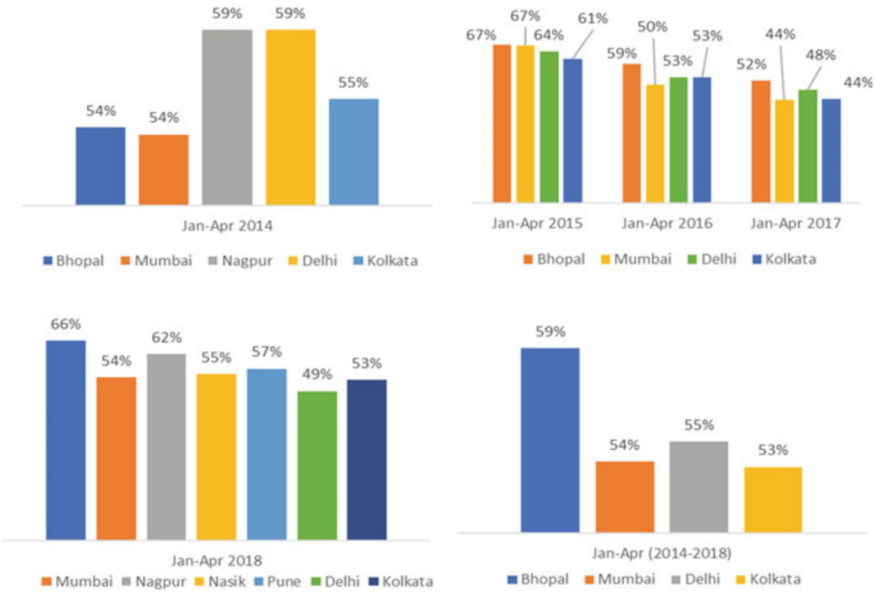


Fig. 8.3 Wholesale price as a percentage of retail prices of pigeon pea/tur in selected cities. *Source* Agmarket for wholesale price data, Government of India (2018a) and retail price information system, Government of India (2018b)

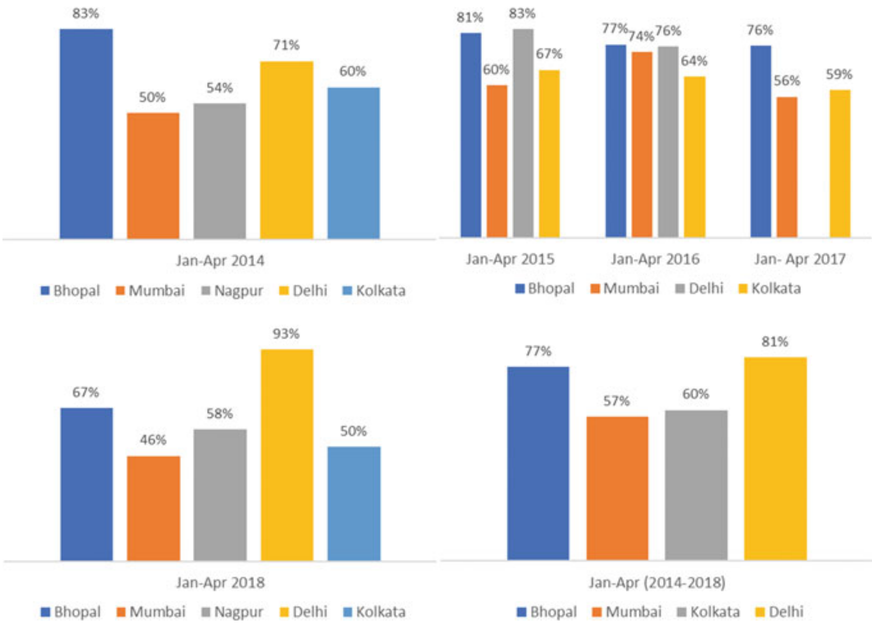


Fig. 8.4 Wholesale price as a percentage of retail prices of Bengal gram/chana in selected cities. *Source* Agmarket for wholesale price data, Government of India (2018a) and retail price information system, Government of India (2018b)

Domestic Price Formation in Bengal Gram/Chana Value Chain

Figure 8.4 shows the wholesale price as a percentage of the retail price in selected cities. This is an approximately close indicator of the price received by the farmers selling whole bengal gram/chana as a percentage of the whole bengal gram/chana purchased by the retail consumer. Between (Jan–Apr) 2014 and 2018, the wholesale price of chana in Madhya Pradesh was about (46–93)% of the retail price, in the selected cities. The average for the above period varied between (57–81)%. On ground, the farmers receive less than this amount given a range of marketing charges that are recovered from the farmers, officially or unofficially. The share of wholesale price as a percentage of retail price in the selected cities has higher compared to that of pigeon pea.

Trends in Wholesale and Consumer Price Indices

Analyzing the trends in the price indices, it was observed that both wholesale price index (WPI) and consumer price index (CPI) fell from the peaks of October–December 2015 to negative percentage change since September 2016 until April 2018 (the period studied), touching the lowest in July 2017, followed by some recovery but in the negative zone. During the peak inflation period of pigeon pea, consumer

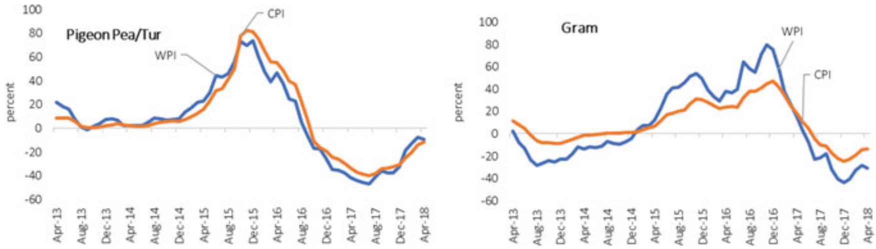


Fig. 8.5 Per cent change in wholesale price index and retail price index of pigeon pea/tur and gram. *Source* Office of Economic Advisor, Government of India (2018c) (for wholesale price index) and Labour Bureau, Government of India (2018d) (for retail price index)

price inflation shot up more than wholesale price inflation. During peaking inflation, the supernormal gains are restricted to the wholesalers and retailers without anything significant passing on to the farmers because of their limited window of participation in markets. In the absence of access to negotiable warehouse receipt system and/or future trading, farmers lose out on the gains from price recovery during the year. In contrast to pigeon pea, WPI and CPI inflation in gram/chana was somewhat lower (Fig. 8.5).

Price Support and Procurement of Pulses

Although there has been an year-on-year increase in MSP for pulses, the same has not been very effective in delivering higher incomes to the farmers due to lack of assured procurement unlike rice and wheat. In the case of pigeon pea/tur in particular, wholesale prices crashed below MSP in 2016–17 and 2017–18 and several APMC regulated markets reported selling below MSP. Chana wholesale prices crashed below MSP in 2017–18.

Recurrent price volatility in horticulture crops like potato and onion resulted in setting up of a price stabilization fund (PSF) in 2014–15. Subsequently, pulses were added to this scheme. PSF was designed with the objective of maintaining strategic buffer stock (2 million tonnes of pulses) through direct procurement from the farmers through NAFED and SFAC; farmer groups at the farm gate or *mandi*; as well as pigeon pea import of 50,000 tonnes. The same would be then released to meet domestic demand and moderate fluctuations in retail prices.

The government also set up a price stabilization scheme (PSS) under which it would procure directly from the farmers at MSP, when the ruling market price fell below MSP. The number of procurement agencies under PSS is decided by the central agencies in consultation with state-level agencies and government, depending upon what is economically viable. Under PSS, any losses occurring to the central agencies are fully reimbursed by the government, and profits earned are credited to the government. Working capital to central agencies in the form of bank guarantees for procurement is provided by DAC&FW under which a standing government guarantee of INR 2500 crores is available with NAFED and INR 150 crores with SFAC. Also, DAC&FW issues letters of comfort to financial institutions for providing short-term loans to central agencies to provide the adequate financial bandwidth to undertake large-scale procurement, storage and processing (GoI 2016).

During Kharif 2016–17, NAFED undertook about 75% of the domestic procurement of pulses under PSF and PSS compared to other agencies like FCI and SFAC. Such bulk procurement needs to be backed by adequate storage and processing capacity. Pulses procured by NAFED are stored in central warehousing and state warehousing corporation warehouses. NAFED is in a position to hire such godowns by negotiating the warehouse rent at par with the rent offered by the private warehousing service provider or can hire private warehouses accredited by warehousing development and regulatory authority (WDRA) through a competitive bidding process. NAFED has over 200 empanelled millers to undertake milling and supply milled pulses according to specified quality and packaging as well as destination, provided by any particular state or central government agency. Milling and supply of milled pulses are assigned to millers through e-auction portal on the basis of highest out-turn ratio of milled pulses offered by the empanelled millers. This portal includes all services in the supply chain right from assaying of raw pulses in the godowns to delivery of milled pulses at the given destination. The same portal is being used for e-auction of raw/whole pulses. Pulses procured under PSF or PSS are being disposed through the e-auction portal of NCDEX e-Market Limited (NeML) who have a large base of empanelled buyers. It is further possible to include more buyers onto the NAFED portal to absorb the increased supply (NAFED, Annual Report 2016–17).

Given a bumper production of pulses and declining market prices, the Department of Food and Public Distribution removed all restrictions on stocks with effect from 17th May 2017 following which nearly 10 states removed stocking limits (CACP, March 2017). Considering the demand-supply situation, stocking limits have been subject to change over time. Ironically, farmers have not been able to benefit as much due to lower price realization at the wholesale markets, except for the procurement undertaken by the government through agencies like NAFED and SFAC.

8.2.2 Global Competitiveness of Pulses Value Chain

Trends in Imports of Pulses

In TE 2015–16, share of pulses in total agricultural imports was 15%. As aggregated from the pulses categories (based on HS codes) provided by DGCIS, Government of India, import of pulses increased from 0.8 million tonnes valued at USD 0.3 billion in TE 1998–99 to 6.1 million tonnes valued at USD 3.7 billion in TE 2017–18 (Fig. 8.6). Increasing domestic demand for pulses resulted in rising imports of pulses in India.

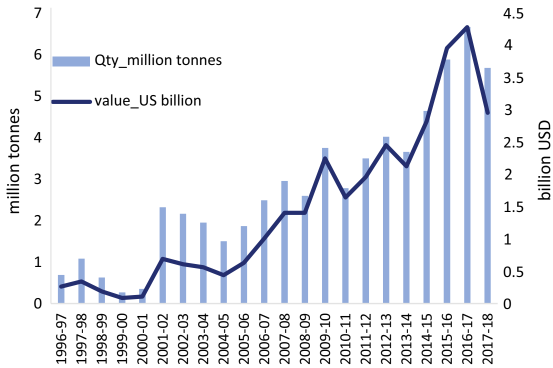


Fig. 8.6 Import of pulses by quantity and value, 1996–97 to 2017–18. *Source* Export Import data, Ministry of Commerce, Government of India (2018e)

Peas and chickpeas are the major import items. These together accounted for half of pulses import during TE 1998–99 and about 48% in TE 2017–18. Pigeon peas accounted for 15% of pulses import in TE 1998–99 and declined to 12% in TE 2017–18. During this period, import of lentils (*masur*) and *moong* took off, accounting for 19% and 15%, respectively, in TE 2017–18. India has been a consistent importer of peas and chickpeas. Imports of pigeon peas resurged in 2013–14 and increased by 47% in 2014–15, when domestic production of pulses took a hit and imports had to be increased. Import of lentils (masur) started from 2003–04 and was the third-largest pulse imported in TE 2017–18 (Fig. 8.7).

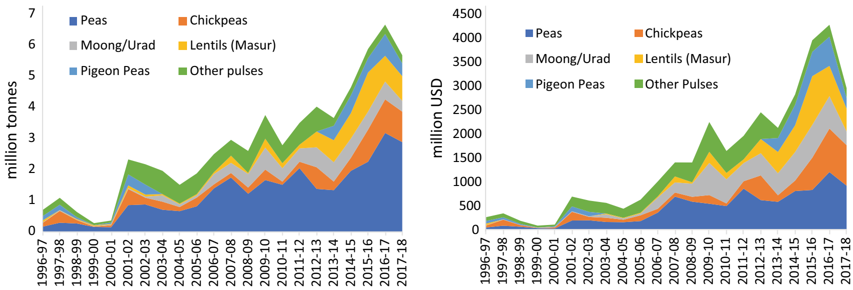


Fig. 8.7 Import of pulses by types, 1996–97 to 2017–18. *Source* Export Import data, Ministry of Commerce, Government of India (2018e)

Major Import Origin Countries for Pulses

India is dependent on very few countries for import of pulses and nearly on single country for a particular pulse. This leaves India quite vulnerable to thin global markets and fluctuations in prices. For instance, Canada is the major source of importing peas with nearly 53% of the imports sourced from Canada during TE 2017–18 followed by Russia and Ukraine (replaced US as the third-largest country for sourcing peas in 2017–18). For chickpeas, Australia is the leading source of imports for India accounting for 81% during TE 2017–18. Myanmar is the leading source of import of moong/urad bean and accounted for 76% of the imports in TE 2017–18. Again, Canada is the largest destination for sourcing lentils (masur) accounting for 76% in TE 2017–18. During TE 2017–18, India imported 47% of pigeon peas from Myanmar and remaining 53% from six African countries, viz, Mozambique, Tanzania, Malawi, Kenya, Sudan and Uganda. Earlier during 1996–97 to 2002–03, Myanmar was the sole country supplying pigeon pea to India.

The widening demand-supply gap in pulses before 2016–17, led to government to government (G2G) dialogues and private sector collaboration for producing pulses in the African continent for imports to India. Indian companies like Mahindra and Mahindra, Tata, among others invested in Africa to grow pulses leveraging their existing presence in agribusiness sector and/or through greenfield investment given the abundance of land and favourable climatic conditions. The government of India also pursued dialogues to develop a roadmap to ensure that India is able to source enough pulses for meeting domestic demand. These efforts resulted in stepping up import of pulses from different African countries, particularly, Kenya, Tanzania, Mozambique, among others and most notably, pigeon peas since 2013–14. Considering a perpetual deficit situation around pulses, India has been importing pulses consistently to meet the domestic demand and tame inflation. This has resulted in lowering of tariffs to incentivize import of pulses over several years. With the bumper production of pulses recorded in 2016–17 and 2017–18, tariffs have been raised to control import of pulses and exports freed up. Like in the past, the decision to control or stop imports of pulses or its implementation came in too late when the harvest was already in the market and farmers could not fetch the minimum support price for their produce.

Trends in Export of Pulses from India

India is not a major exporter of pulses. In TE 2017–18, India exported USD 224 million worth of pulses of which USD 167 million was chickpeas (*kabuli chana*) accounting for 74% of the export value (Fig. 8.8). Between 2007–08 to 2013–14, more than 95% of pulses export was chickpeas. In later years, India exported pigeon peas, lentil and moong/urad with increasing domestic production.

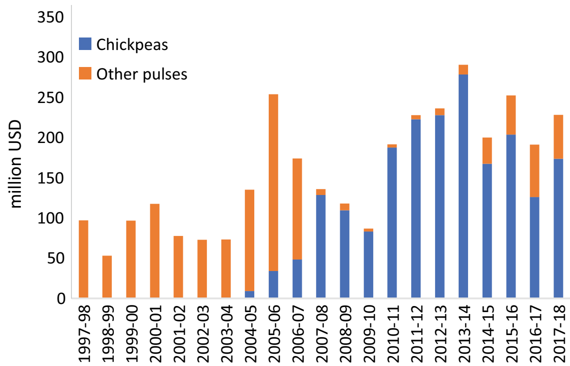


Fig. 8.8 Rising sharing of chickpeas in export of pulses: TE 2017–18. *Source* Export Import data, Ministry of Commerce, Government of India (2018e)

Trade Competitiveness of Chickpea/Kabuli Chana

Saini and Gulati (2017) estimate that India's kabuli chana has been a net exportable commodity since 2006–07, except 2004–05 and 2005–06. Since 2005–06, nominal protection coefficients (NPCs) have been consistently below 1, except in 2012–13, when NPC exportable was 0.96 due to rising domestic prices following a bad crop in 2011–12. In 2006–07, despite higher world prices, exports declined, due to ban on pulses exports. However, the ban was removed later in 2006–07, and exports revived. Increasing trade liberalization, favourable export policy and domestic incentives to improve yields and production contributed to increase in export of gram.

Tariff Regulations in Pulses Trade[1]

India has been consistently dependent on imports to meet the domestic consumption of pulses and hence, time and again, incentivized imports by keeping import duty at (0–10)%, although there exists bound duty rate of 100%. In June 2006, import duty on pulses was brought down to zero to ease out supply. The glut starting 2016–17 resulted in bringing back import restrictions by gradually raising import duty and quantity ceilings.

- In December 2017, government increased the import duty on chana and masur by 30% and yellow peas by 50% while that on pigeon pea/tur continued to be 10%.
- Further in February 2018, import duty on chana was hiked to 40% and 60% in March 2018, to curb cheap imports.
- Import of yellow peas has been restricted with effect from 01st April to 30th June 2018.
- During this period, 1,00,000 tonnes of peas import less the amount already imported until 01 April 2018, was allowed against licence, as per procedure required by DGFT.
- Import quota restrictions were announced in the case of import of green gram (moong) and black matpe (urad) at 300,000 tonnes and pigeon peas (arhar) at 200,000 tonnes. However, this restriction would not impact any previous bilateral

[1] Tariff notifications obtained from www.dgft.gov.in and www.cbec.gov.in.

or regional agreement or MoU between India and trading country. This raised concerns amongst key countries like Canada, Australia, US and other WTO members, as well as countries like Myanmar, Tanzania, Ethiopia, among others, jeopardizing trade relations and putting at risk the livelihood of farmers in these countries.

- Further in May 2018, import of urad and moong in split form in addition to moong/urad listed under HS 07133100 were all restricted to an annual fiscal year quota of 300,000 tonnes in total. This restriction is not applicable for existing government commitments under bilateral/regional agreement/MoU.
- In 2011, export of up to 10,000 tonnes of organic pulses per annum, including lentils was also allowed, which was raised to 50,000 tonnes per annum. As per government notification on 22 November 2017, export of all varieties of pulses including organic pulses was freed up without any quantitative ceilings.

India is the largest consumer of both pulses and edible oils, and hence shortfall in domestic production has resulted in massive imports. High import dependency together with a short-sighted trade policy have not worked in the interest of the farmers in the long run. Cheaper imports in the wake of shortfall in domestic production and spiralling prices have helped contain consumer prices on several occasions, but with a definite lag and resulted in glut situation in the next crop cycle, leaving the farmers further distressed. Inability of trade policies to signal when imports should be allowed or restricted, has time and again resulted in severe losses for the farmers and drained the central and state exchequer of serious financial resources without any commensurate gains. Typically, entry of cheap imports at the time of market arrivals has resulted in crashing of domestic prices followed by a bigger mess of mounting heaps of pulses and government stepping in to bail out farmers through public procurement. How much the farmers gain from such crisis management in the absence of a long-term strategy is not clear. Hence, there is need to focus on aggregate supply chain management including trade to ensure that total availability is adequate to meet increasing demand for pulses.

8.3 Inclusiveness of Pulses Value Chain

8.3.1 Irrigated Area under Pulses

The fact that 86.1% of farmers are smallholders, i.e. operating on less than 2 hectares of land; by default, farmers cultivating pulses are marginal and small in size. About 65% of gram and 68.8% tur farmers are small and marginal (Agri Census 2015–16, Government of India 2020). Pulses are less water intensive, more climate resilient, require less crop care, making it easier for a resource poor smallholders to cultivate the crop. About 18.1% of the area under pulses was irrigated in TE 2013–14 and about 4% and 35.1% of area under pigeon peas and gram were irrigated, respectively, (Fig. 8.9). Between TE 1952–53 to TE 2013–14, irrigated area under pulses nearly

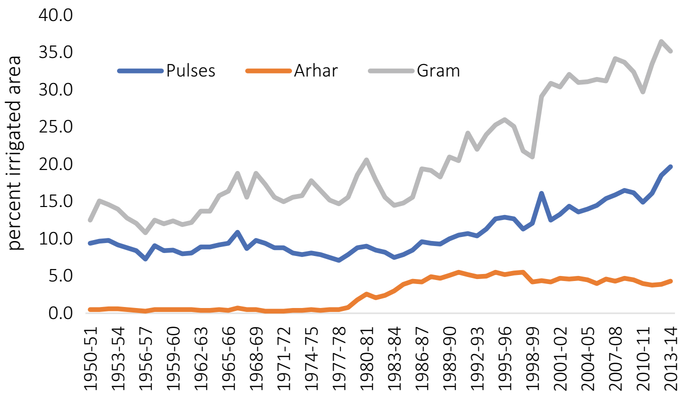


Fig. 8.9 Percentage irrigated area under pulses, gram/chana and pigeon pea/arhar. *Source* Agricultural statistics at a glance 2016, GoI (2017)

doubled from 9.6% to 18.1%. Irrigated area under pigeon pea increased from 0.5% to 4% and that of gram from 14.1% to 35.1% between the period 1950–51 to 2013–14. Madhya Pradesh has more than 43% of area irrigated under pulses and 60% of the area irrigated under gram. In Maharashtra, 11.9% area under pulses is irrigated, and only 1.6% of pigeon pea and 24.3% of gram areas are irrigated. Pigeon pea is largely unirrigated, making it more amenable for cultivation by small and marginal farmers.

Enhancing irrigation and water use efficiency can increase yield of pulses. Irrigation technologies such as micro irrigation, better access to farm machineries, and crop management practices can enable farmers to improve crop yields. Since majority of pulses growers are small and marginal farmers, ensuring affordable access to such technologies and practices will be important. Farming of pulses can be made inclusive by making technology and resources accessible to the farmers. However, this does not automatically ensure that the small and marginal farmers will benefit from higher incomes, particularly, in the absence of assured pricing and market linkages. Participating in production is the first step of the value chain, and as one goes up the pulses value chain, it is observed that it is not as inclusive and smallholders do not benefit from the way it is structured.

Given that pulses undergo processing, require storage facilities, are extremely price sensitive, and much of the trade happens through traditional channels, all stakeholders (millers, wholesalers and retailers), but farmers are able to play the markets and at times make significant gains. Also, their ability to undertake risks is much higher than the farmers. Over a period of time, they are able to recover losses incurred when prices crash due to huge arrivals as observed during the study period (2016–17 and 2017–18). In pulses value chain, there is no provision for farmers to sell directly to the millers or the traders, and they are caught in the web of intermediation. Pulses value chain operates on bulk milling and trading, and has been thriving on huge investments and trading relations, which for a farmer to break into is extremely difficult, without institutional reforms. Unless there is a farmer aggregation model like the farmer producer companies, whereby they are able to undertake value addition and marketing at their end or transact directly with the miller, ensuring farmers reap a modest return on their produce, is difficult.

8.3.2 Inclusiveness in Marketing

In India, sizeable share of food crops is retained for self consumption. Crops which are backed by assured procurement and remunerative price support are largely marketed through regulated markets. In this context, public procurement for pulses is weak compared to that of sugarcane, groundnut, soyabean, among others. Also, in typical marketing channels, it is observed that small and marginal farmers with low marketable surplus are less likely to have direct interface with the wholesale markets, and usually trade through village-level aggregators, transporters and other intermediaries. Hence, economic gains to farmers are limited where marketable surplus is low, and farmers have limited direct interface with the market channels. At an aggregate level, (32–53)% of different types of pulses produced are marketed (Fig. 8.10).

For most of the food crops including pulses, the most popular agency is local private trader except for sugarcane, where co-operative and government agency are most active. In pulses, about 79% of *moong*; 63% of *urad*; 50% of lentils (*masur*); and 44% of *tur* are marketed through the local private trader which restricts farmers' direct

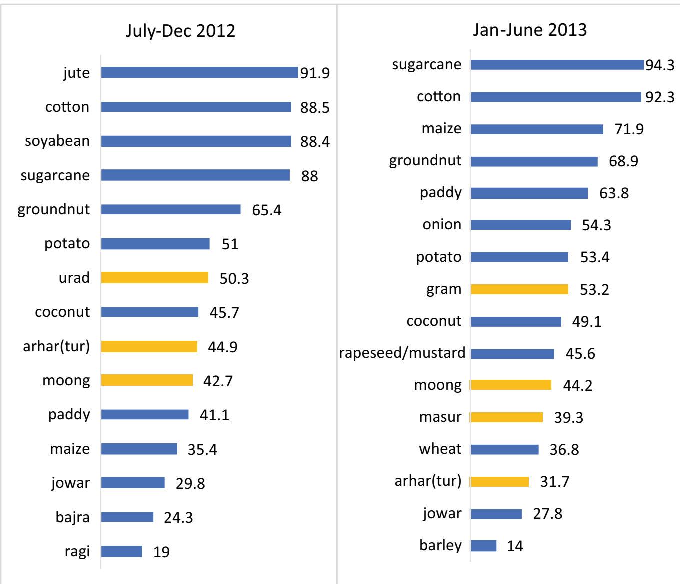


Fig. 8.10 Per cent share of production marketed through different agencies. *Source* NSS KI (70/33): Key Indicators of Situation of Agricultural Households in India, Government of India (2014b)

interface with the wholesale market and hence, chances for higher price realization (Government of India 2014b). It is observed that general awareness about MSP and procurement agency is quite low among households reporting sale of crops—about 40% in the case of sugarcane, more than 30% in paddy; and only (5–18)% in pulses.

Unlike wheat and paddy, public procurement system is not functional in the case of pulses, except during crisis, when due to price crash, farmers are unable to sell their produce at MSP or high retail price inflation, when the procuring agencies buy directly from farmers and sell at affordable prices to the consumers. Time and again, both central and state governments have tried to bail out farmers by adding bonus on MSP, stepping up public procurement, but it is not clear whether such crisis management has really benefitted the farmers. Often, in such government initiatives, the monetary benefits accrue to the farmers after a significant lag of time, or they are unable to fulfil the paperwork and prove their entitlement, causing a lot of resentment among the farmers. Needless to say, marginal and small farmers are the worse off, because in most cases, they are either unaware of the such initiatives or even if they know, getting across various hurdles is difficult for them.

8.3.3 Inclusiveness in Access to Risk Mitigation and Financing

Majority of the farmers lack any access to formal risk mitigation tools and are unable to hedge against the risks of either crop failure or price crash, and the situation is worse for tenant and sharecropper who do not have any land title. The flagship agricultural insurance program, Pradhan Mantri Fasal Bima Yojana (PMFBY), launched in 2016 replaced the National Agricultural Insurance Scheme (NAIS) and the Modified National Agricultural Insurance Scheme (MNAIS). The Weather-Based Crop Insurance Scheme (WBCIS) continues to exists with premium rates made at par with those of PMFBY, and a particular state can decide whether it wants PMFBY or WBCIS or both. In the design of the program, it is inclusive to some extent as the premium rates are lower compared to erstwhile schemes—2% for kharif crops and 1.5% for rabi crops that include pulses and 5% for horticulture and other commercial crops. However, given that the scheme is compulsory for loanee farmers and voluntary for non-loanee farmers to a large extent, excludes the latter from benefitting from the scheme. CSE (2017) reports that less than 5% of non-loanee farmers availed the scheme in 2015 and 2016 kharif season. There have been reports about the reluctance of farmers to avail the insurance scheme because of the automatic linking of their loan account with insurance. Issues related to delays in settling claims due to red tapism, slack attitude of states in providing data from crop cutting experiments on time, determining the threshold yield, low indemnity, etc., have not resulted in PMFBY to work in the interest of farmers and more so, the marginal and small farmers. Gulati and Hussain (2018) point out that the target of bringing 50% of the gross cropped area under insurance coverage by 2018–19 remained a distant dream considering significant inter-state variations and existing coverage of 30%. Other estimates show that gross cropped area covered under insurance declined from 30% in 2016–17 to 24% in 2017–18 against a target of 40% for 2017–18 (Business Standard 2018).

8.3.4 Inclusiveness in Access to Storage and Warehouse Facilities

Despite the negotiable warehouse receipt system being available, it has not reached the farmers who could make better use of it to avoid distress sale by availing pledge finance and marketing credit. Also, this gives farmers the freedom to hold onto legitimate stocks in the event of bumper market arrivals. The integrated scheme for agricultural marketing includes warehousing as an integral component, and efforts have been made to augment warehouse capacity as well as upgrade and modernize existing facilities. Further, under the Agricultural Produce and Livestock (Promote and Facilitate) Marketing Act, 2017, warehouses by notification can be declared as a market sub-yard. With e-NAM being the future of agricultural marketing in India, electronic negotiable warehouse receipt system has immense scope. It is aimed at avoiding high cost of intermediation by facilitating electronic transactions and delivery of products at the final destination of the purchaser. In addition to strengthening marketing infrastructure for greater value realization, policy efforts must be made to ensure that the provisions are accessible to the farmers for their benefit. In pulses, most of the storage and warehousing is operational at the millers' and wholesalers' end. Hence, they are able to benefit from appropriate stocking and offloading during the course of time.

8.4 Sustainability of Pulses Value Chain

8.4.1 Environmental Sustainability

Pulses are environmentally more benign, less water intensive and more climate resilient, compared to many other crops. Hence, increasing production of pulses in an environmentally sustainable manner is feasible. Considering the low yield levels, it is possible to push the production frontier in pulses through technology breakthrough. Pulses accounted for 15.3% of the gross cropped area in 1950s which declined to 12% in 2000–01 to 2010–11 and 12.3% during 2011–12 to 2013–14. Area irrigated under pulses increased from 8.9% in 1950s to 14.7% during 2000–01 to 2010–11 and 18.1% during 2011–12 to 2013–14 (Fig. 8.11).

In Madhya Pradesh, about 44% of the area under pulses is irrigated followed by Uttar Pradesh (27%) and Haryana (23%), according to 2013–14 data. Rajasthan and Maharashtra being the second and third largest producer of pulses have 18% and 12% of the area irrigated, respectively (Fig. 8.12).

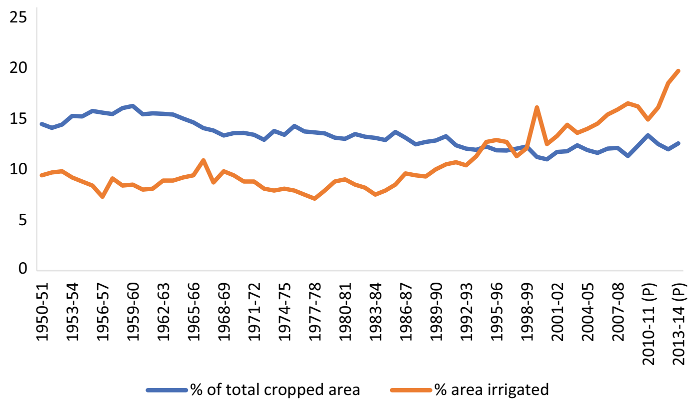
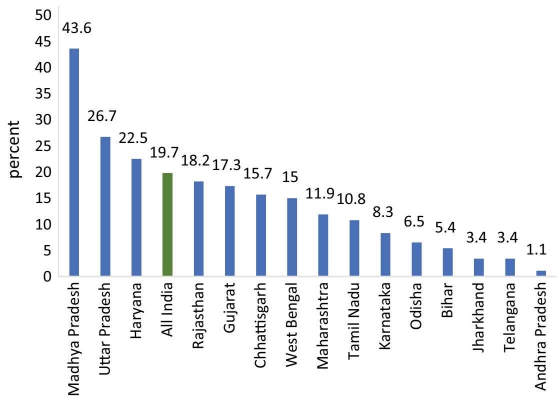


Fig. 8.11 Area under pulses—per cent irrigated and per cent of gross cropped area: 1950–51 to 2013–14. *Source* Agricultural statistics at a glance 2016, MoA&FW, Government of India (2017)

Fig. 8.12 Statewise per cent area irrigated under pulses: 2013–14. *Source* Agricultural statistics at a glance 2016, MoA&FW, Government of India (2017)



Irrigated area under gram increased from 14.1% in TE 1952–53 to 35.1% in TE 2014–15. Tur being a largely rainfed crop suited for semi-arid climatic conditions, per cent irrigated area increased from a meagre 0.5% to 4% during the same period. There is enough potential to increase the irrigated area under tur to augment production through productivity breakthrough. ICRISAT has been successful in developing climate smart cultivars that are high yielding, drought tolerant, disease resistant, short duration (75–80 days) lines and hybrids. These cultivars are customized to suit the needs and preferences for farmers and consumers across the world. Various on-farm practices like intercropping of pulses with cereals, crop rotation, ridge planting, among others are being tested on farmers' fields to improve water and soil health as well as enhance yield levels. In pigeon pea cultivation, ratooning to support zero tillage has been developed in order to minimize soil erosion particularly in cases of intense rainfall (ICRISAT, no date). There are proven successes of adopting innovative methods of pulses cultivation both in India and beyond. For instance, 80%

expansion of area under chickpeas in rice fallows of Prakasam district in Andhra Pradesh benefited smallholder farmers. Pigeon pea used as land cover to manage soil and water in China helped reverse soil erosion, land degradation as well as provided quality fodder for cattle. Pulses intercropping with other crops have helped farmers diversify their production basket as well as income opportunities (ibid).

Seeds play an important role in realizing the productivity potential of the crops. The organized sector comprising of private sector players and public sector agencies accounts for (30–35)% of the total seeds distributed in the country, while the remaining comprises of farm-saved seeds which comes under the unorganized sector. The Sub-Mission on Seeds and Planting Material (SMSPM) under the National Mission on Agricultural Extension and Technology (NMAET) was launched during the 12th five-year plan with an objective to strengthen the seed supply chain in India. Focus was put on increasing seed replacement ratio from 25% to 33% in self-pollinated crops, 33% to 50% in cross-pollinated crops and 100% in hybrids. Between 2007–08 and 2014–15, distribution of certified and quality seeds grew substantially for pulses, followed by cereals and fibres at 97%, 64% and 47%, respectively. In the case of open-pollinated crops, improvement in seed quality can be attributed to a larger participation of the public sector. Hence, there is a scope and need to enhance the participation of the private sector in further strengthening the seed supply for this crop sector. Also, it is important to develop varieties that are high yielding, drought and pest-tolerant.

8.4.2 Financial Sustainability of Pulses

Wholesale Price Inflation

Pulses have undergone massive price fluctuations measured in terms of per cent change in wholesale price index (WPI) since April 2016 until December 2017. The volatility in prices has been sharper compared to cereals and food articles in general. Inflation in pulses soared in 2015–16 when production of pulses took a hit owing to severe drought, and touched the lowest in 2017. In 2017–18, inflation in pulses was at an unprecedented low of (−) 26.7% compared to 34.6% in 2015–16 and 18.3% in 2016–17.

In 2017–18, tur suffered the steepest decline in prices by 40% followed by urad by 36%. Wholesale price index of masur fell by 23% and moong by 20%, respectively. These price trends are in sharp contrast to the situation in 2015–16 when production shortage resulted in steep escalation of prices of tur by nearly 50%, urad by 45% and gram by 35%. WPI of tur and urad has been on a negative trend since September and November 2016, respectively, and reached the lowest levels in July 2017 (Fig. 8.13).

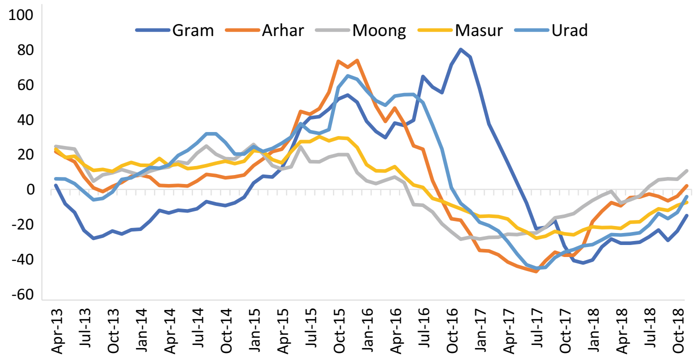


Fig. 8.13 Percent change in wholesale price index of pulses by types, April 2013 to November 2018. *Source* Office of Economic Advisor, Government of India (2018c)

Minimum Support Price for Pulses

In order to incentivize pulses production, government announced an increase in minimum support price (MSP) for kharif pulses, i.e. tur, moong and urad, adding a bonus of INR 425 each and INR 200 for rabi pulses, i.e. gram and lentil (masur) each in 2016–17. The effective increase in MSP in 2016–17 over 2015–16 for tur was 13.5%; moong was 12%; urad was 12.4%; gram was 22.6%; and lentil was 23.3%, respectively (Fig. 8.14).

The increase in MSP in 2016–17 was particularly aimed at reviving production of pulses, which suffered a setback due to two consecutive bad monsoon years of 2014–15 and 2015–16. Area under pulses increased by 23% from 11.3 million hectares to 13.9 million hectares (CACP, Kharif 2017–18 report, Government of India 2018f). Also, production increased as a result of the price incentive at the rate of 73% for kharif pulses, 25% for rabi pulses and at 41.5% for all pulses (as per second advance estimates released by DES on 27 Feburary 2018).

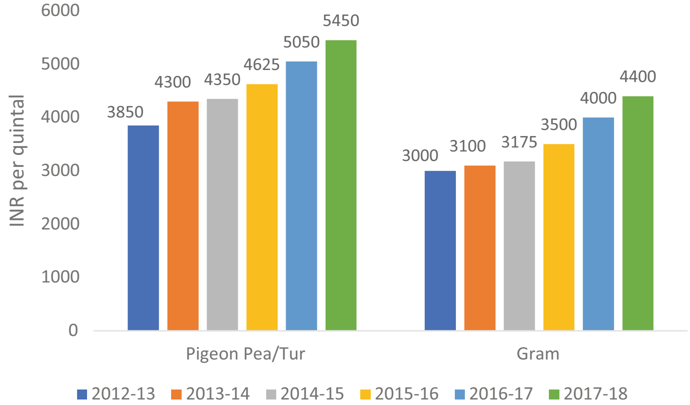


Fig. 8.14 MSP for pigeon pea/tur and chana: 2012–13 to 2017–18. *Source* MSP data, CACP, GoI (2018f)

Comparing Minimum Support Price, Domestic Price and International Price
Domestic prices of pulses falling below the MSP have been a concern given that farmers are unable to cover their cost of production. Domestic price of gram fell below its MSP of INR 3000 per quintal during Q3 of 2013 to Q4 of 2014 due to bumper production. After which prices recovered and reached a peak in Q4 of 2016; prices fell thereafter. During Q1 and Q2 of 2018, domestic prices were less than the MSP of INR 4000 and INR 4400, respectively. Between Q4 of 2014 and 2016, both domestic wholesale price and international prices have remained well above MSP for pigeon pea. Since Q1 of 2017, both these prices have fallen below MSP (Fig. 8.15).

Financial sustainability of producing pulses needs to be assessed in terms of the net returns accruing to the farmers. Cost of cultivation of agricultural crops has been increasing over a period of time. Market prices of pulses ruling below MSP, resulted in net income losses for the farmers.

Figure 8.16 shows the increasing cost of cultivation in selected states in terms of costs A2 and C2. While both A2 and C2 increased over the years, the increase in C2 cost is steeper than A2 cost in case of both pigeon pea and gram. For farming of pulses to be sustainable for the farmers, it is important that they are able to at least recover the cost of production from the MSP or market price at which they sell their produce. In the absence of such conditions, as observed in the study period, it is not sustainable for the farmers to continue with pulses farming.

With the increasing need to optimize water usage, improve the quality of crop care including pest management and nutrient applications and enhance productivity at the same time, farming has become an expensive activity for the farmers. This is observed in the increasing trends in cost of cultivation. Hence, it is even more important that farmers' have adequate access to markets in order to be able to market their products and earn their livelihoods. Increasing production without the appropriate market linkages will dampen the objective of sustainable farming of pulses.

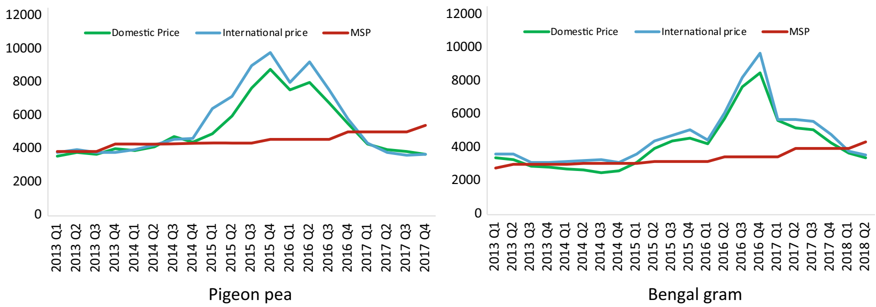


Fig. 8.15 Mapping domestic wholesale prices, international prices and MSP of pigeon pea and bengal gram: 2013–2018 (quarterly). *Source* CACP, Government of India (2018f)

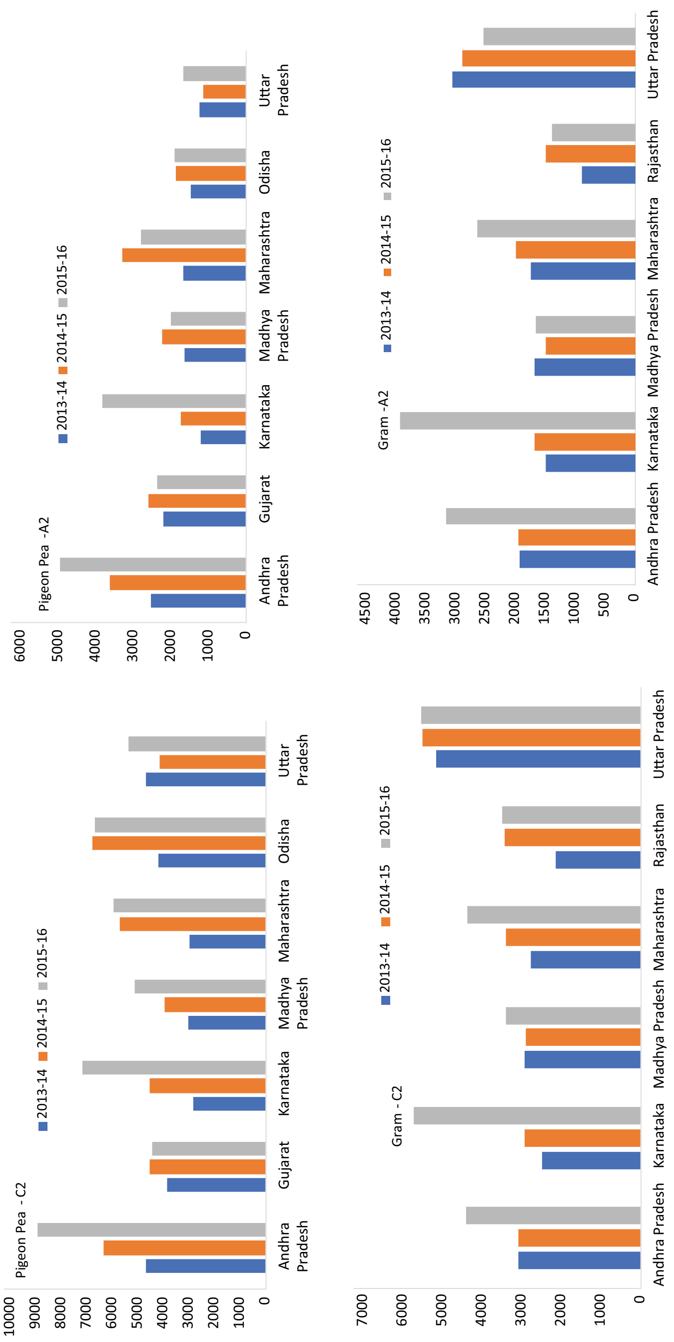


Fig. 8.16 Trends in cost of cultivation (A2 and C2) in INR per quintal for pigeon pea and gram. *Source* Cost of Cultivation data, MoA&FW, GoI (2018g)

8.5 Scalability of Pulses Value Chains

8.5.1 Scope for Diversification in Pulses Production

Common types of pulses grown in India are pigeon pea (tur); bengal gram (chana); lentil (masoor); black gram (urad); green gram (moong), among others. In TE 2015–16, gram accounted for 36% of the area and 45% of the production of pulses. While tur (pigeon pea) accounted for 16% of the area and production, respectively. Moong and urad accounted for 14% of the area each and 11% of the production each (Fig. 8.17).

While the all India average yield of pulses for TE 2015–16 was 713 kg per hectare, that of Madhya Pradesh was 875 kg per hectare, Rajasthan was 559 kg per hectare, and Maharashtra was 608 kg per hectare. Three of the top five states producing pulses had yield levels lower than the all India average (Fig. 8.18).

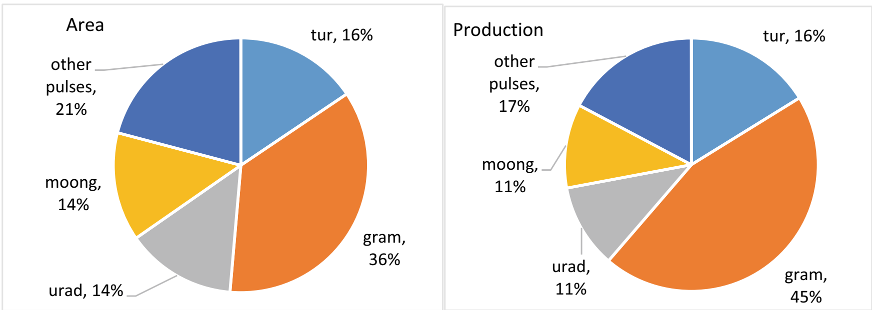


Fig. 8.17 Per cent share of major pulses in total area and production: TE 2015–16. *Source* Agricultural statistics at a glance (2016), MoA&FW, Government of India (2017a)

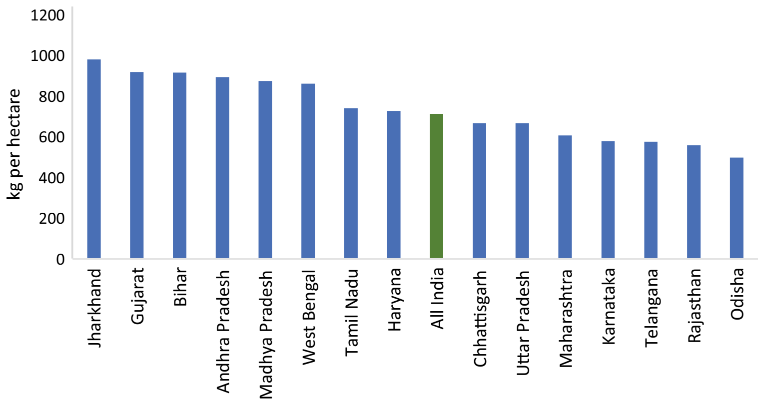


Fig. 8.18 Statewise yield of pulses: TE 2015–16. *Source* Agricultural statistics at a glance (2016), MoA&FW, Government of India (2018c)

8.5.2 *Scope for Scaling up Production across States*

In TE 2015–16, the top five pulses growing states were Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Uttar Pradesh accounting for nearly 69% of production (17 million tonnes) and 72% of total area (27.4 million hectares) (Fig. 8.19).

Pulses account for 23% of the gross cropped area in Madhya Pradesh, followed by Karnataka and Odisha at 21% and 19%, respectively. Maharashtra, Rajasthan and Uttar Pradesh being among the top five states producing pulses account for 15% each and 8% of the gross cropped area in the respective states (Fig. 8.20).

Among the top five states producing pulses, gram is the major pulse. It accounts for 65% of the total pulses grown in Madhya Pradesh; 52% in Rajasthan, Maharashtra and Karnataka and 24% in Andhra Pradesh. The next big pulse crop is tur (pigeon pea) which accounts for 34% of the pulses grown in Maharashtra, 30% of pulses

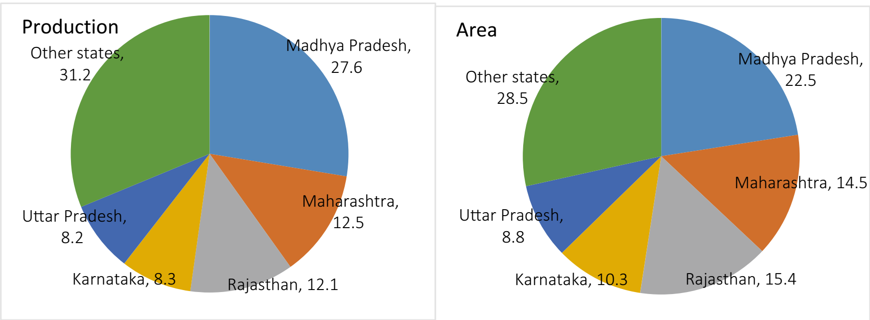
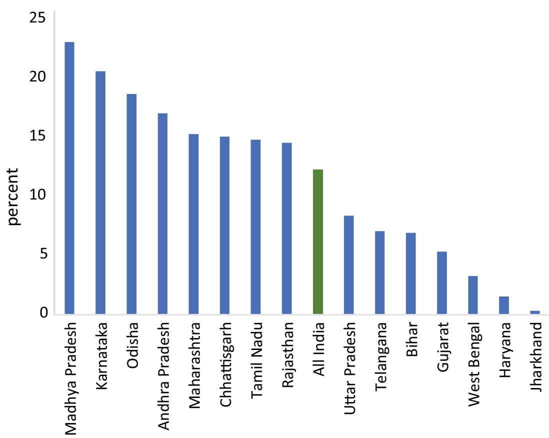


Fig. 8.19 Top five pulses producing states in India, TE 2015–16. *Source* Agriculture—Statistical Year Book India (2017b), Government of India (2017a) and Agricultural statistics at a glance (2016), MoA&FW, Government of India (2017a)

Fig. 8.20 State-wise area under pulses as a per cent of gross cropped area: TE 2015–16. *Source* Agricultural statistics at a glance (2016), MoA&FW, Government of India (2017a)



grown in Karnataka and 14% in Uttar Pradesh. Of the pulses grown in Uttar Pradesh, urad accounts for 18% of the total production. Moong is an important pulse crop for Rajasthan which accounts for 23% of the total pulses grown in the state.

Nearly 60% of tur is produced by Maharashtra, Madhya Pradesh and Karnataka. Maharashtra is the largest tur producing state accounting for 26% of the total production in India followed by Madhya Pradesh at 17% and Karnataka at 16%. Gram is predominantly produced in Madhya Pradesh, with 40% of the all India production. Maharashtra and Rajasthan produce 14% each. Madhya Pradesh is a leading producer of urad as well, contributing to 21% of the total production. Andhra Pradesh and Tamil Nadu produce 16% each, followed by Uttar Pradesh at 14%. Moong which accounts for less than 10% of the total pulses production in India is largely grown in Rajasthan which accounts for 31% of the production. Tamil Nadu and Andhra Pradesh account for 10% each and Maharashtra and Madhya Pradesh at 8% each (Fig. 8.21). While bulk of the production of tur and urad is spread over three states of Maharashtra, Madhya Pradesh and Karnataka; and Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Uttar Pradesh, respectively, production of gram is

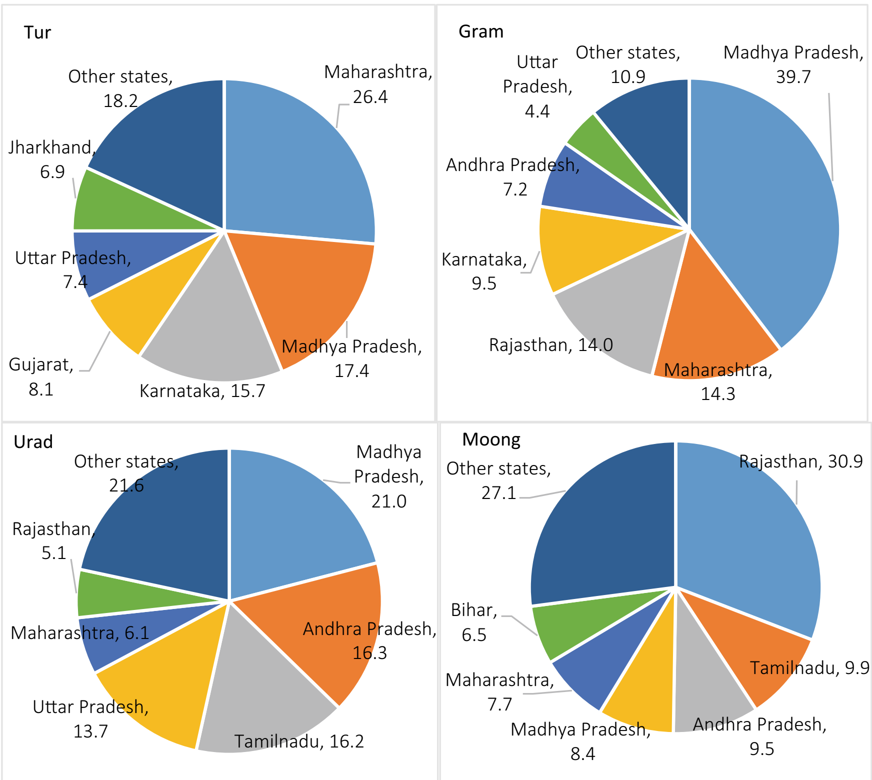


Fig. 8.21 Top five states producing tur, gram, urad and moong pulses, TE 2015–16. *Source* Agriculture—Statistical Year Book (2017b), MoSPI, Government of India (2017c)

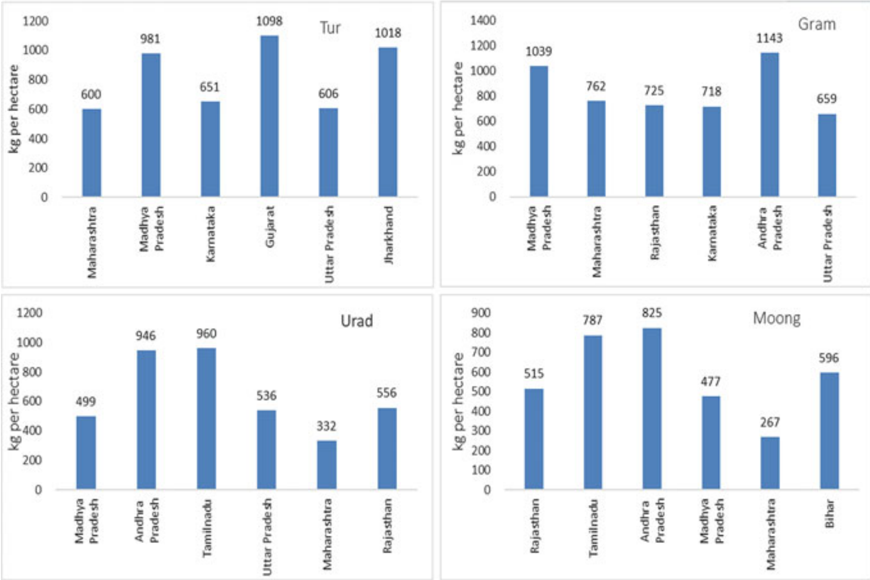


Fig. 8.22 Comparison of yields of types of pulses by leading states, average of 2014–15 and 2015–16. *Source* Agriculture—Statistical Year Book (2017b), MoSPI, Government of India (2017c)

more concentrated in Madhya Pradesh and moong in Rajasthan. Such geographical spread of pulses could be used for developing pulse-specific storage, marketing and milling infrastructure to reduce the cost of transaction. The same can be used to plan any crop diversification interventions as well.

Considering the top six states in order of their contribution to the production of the major pulses types, a wide disparity in yields is observed (Fig. 8.22). Maharashtra with only 12% of the pulses area under irrigation has the lowest yields of nearly all the major pulses such as tur, urad, gram and moong. Maharashtra which is the leading producer of tur has the lowest yield of 600 kg per hectare compared to other states. Gujarat has the highest yield of 1098 kg per hectare. In the case of bengal gram, Madhya Pradesh which is a leading producer has a yield of 1039 kg per hectare compared to 1143 kg per hectare in Andhra Pradesh, which is the fifth-largest producer of gram. In the case of urad, yield levels in Madhya Pradesh (499 kg per hectare) are nearly half of that in Andhra Pradesh (946 kg per hectare) and Tamil Nadu (960 kg per hectare), the second and third largest producer of urad. Rajasthan, the leading producer of moong recorded a yield of 515 kg per hectare, lower than Tamil Nadu, Andhra Pradesh and Bihar, the second, third and sixth-largest producer of moong.

There is considerable scope for improving existing yield levels of the major pulses grown in India, particularly in states which account for a significant share of all India production. This will improve the per unit land productivity as well as allow multiple cropping, where feasible. Also, for states where the yield levels are already high but account for a smaller share of the all India production, efforts can be made to bring more area under pulses in those states. However, incentivising production through increase in yields should be linked with efficient marketing of the same, failing which the farmers will not be able to benefit from increased production.

Agriculture policies have largely focussed on enhancing production with the objective to sustain food security. Among other flagship programs, National Food Security Mission (NFSM) was launched with a focus on augmenting production of paddy, wheat and pulses. Considering the increasing demand supply mismatch, pulses have been a focus crop with nearly 50% of the funds being allocated towards promoting pulses cultivation. In 2014–15, NFSM was extended to include 623 districts in 27 states as well as all the districts in north-eastern and hilly states. In 2015–16, pulses were brought under the initiative of *Bringing Green Revolution in Eastern India* for demonstrations under the cropping systems-based approach to target rice fallow areas (GoI 2016). Emphasis was also placed on area expansion through intercropping of pulses with commercial crops, oilseeds, cereals, etc., and productivity enhancement through frontline demonstrations, integrated nutrient and pest management, popularization and promotion of high yielding varieties or hybrids.

In 2010–11, under Rashtriya Krishi Vikas Yojana with an outlay of INR 300 crore, government initiated a special program for Pulses and Oilseeds in Dryland Areas by organizing 60,000 pulses and oilseeds villages in rainfed areas. The sub-scheme was under implementation in seven major oilseeds and pulses growing states including Karnataka. The states were focusing on developing farm mechanization hubs to extend the services through custom hiring centres to pulses and oil seeds growers. Inputs available under NFSM—pulses program were being used to supplement the efforts for enhancing productivity in identified villages and fields (GoI 2010).

8.6 Access to Finance and Risk Mitigation

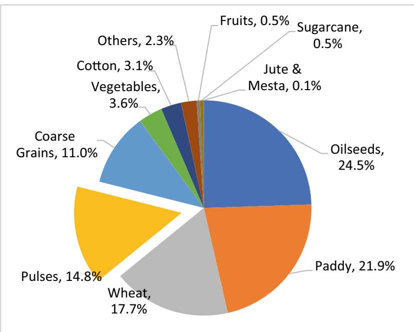
Access to finance is critical for ensuring that agricultural value chains are competitive, sustainable, and scalable, and it also reflects the inclusiveness of the chains. With respect to agricultural finance, the challenge has been to bring increasing number of farmers under the formal channel and thereby reduce their dependence on informal sources. One of the key factors driving strong market intermediation (heavily criticized in all policy discourses) has been the role of intermediaries in extending informal credit and undertaking risks. Of course, these services are not free and farmers bear the burden in terms of unofficial commission fees; not so transparent monetary transactions despite the shift towards digital payments.

Although access to agricultural finance has improved over a period of time, a large number of small and marginal farmers and landless cultivators face challenges accessing institutional finance. Innovative ways of maximizing outreach and delivering benefits to the farmers such as Kisan Credit Cards (KCC), access to digital banking, etc, have improved availability of agricultural credit. Negotiable warehouse receipt systems can be leveraged to improve creditworthiness of the farmers, which has not picked up adequate momentum. Institutional credit accounts for 64% of the outstanding debt of cultivator household and 36% flow from non-institutional sources. Within institutional sources, commercial banks account for the largest share of the credit advanced (Hoda and Terway 2015). In order to boost food processing which includes pulses processing, government has been providing particular incentives in terms of subsidized capital support, incentives for technology upgradation and modernization of infrastructure; creation of mega food parks, developing agro-processing clusters, integrated farm-firm linkages, etc. Food processing got a major boost under the Make in India initiative. In 2017, Pradhan Mantri Kisan SAMPADA Yojana (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters) with an allocation of INR 60 billion for 2016–20 was launched by Government of India.

Agricultural or farming insurance indeed needs to be a compulsory part of the value chain operations of pulses considering the extent of volatility observed. There is considerable lack of awareness amongst farmers regarding crop insurance and given the experience of delays in payments; low compensation; and the paperwork required, farmers tend to shy away from the same. Linking agriculture finance with insurance under PMFBY is perhaps a good move to eventually improve the health of agricultural credit in India but this has been one of the often quoted reason for farmers not choosing insurance. With periodical loan waivers, the general attitude is not to pay upfront and later lose out on the waiver.

In general, crop insurance is availed by a very small section of the agrarian households, and most of them are not aware about the scope of the program. According to a NSSO (2012–13) survey, 58% of urad cultivators and 49% of moong cultivators were not aware of and were not insuring their pulses crops during the specified period (GoI 2014b). Pulses account for 15% of the total area insured across crops. 29% of the area under pulses is insured as against 38% under oilseeds and 30% under vegetables (Fig. 8.23).

So far, insurance schemes address crop losses but do not insure farmers against price fall. In the context of pulses, this has hit the pulses farmers as observed in the 2017–18 marketing season owing to market prices ruling below minimum support price.



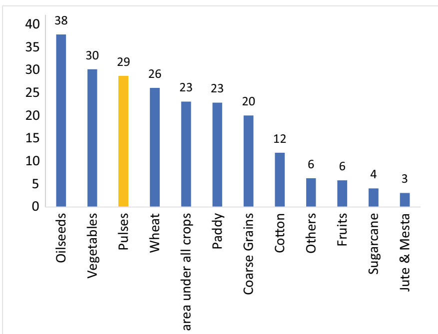


Fig. 8.23 Per cent distribution of insured area under crops and per cent of crops insured. *Source* Agricultural statistics at a glance (2016), Government of India (2017c)

Price deficiency payment scheme such as Bhavantar Bhugtan Yojana (BBY) in Madhya Pradesh was aimed at bridging the gap between MSP and market price through the difference payable by the state government to the farmers. BBY covered eight crops, viz: soybean, maize, urad, tur, moong, groundnut, til and ramtil. Farmers were required to register on the government portal and get their sown area verified by the government in order to be eligible for the benefits of the scheme. The volume of each crop to be covered by BBY was determined based on the average productivity of the particular crop in a district and the area sown by the farmer. The difference between the average sale price (simple weighted average *mandi* prices in the state and adjoining two states) and MSP are paid directly to the farmer in their bank accounts. Gulati et. al. (2018) reported that 32% of urad production in MP was compensated. In moong, as little as 1.3% of the production was compensated under the scheme. Actual compensation for tur was not known.

There have been reports of several other issues related to BBY in terms of delays in processing of payments, issues with registration and verification of area sown to be eligible for the benefits. Also, with the introduction of BBY, it is observed that traders have colluded to keep the market prices deliberately low which has a distorting effect on market functioning. Gulati and Hussain (2018) also analyze the financial viability of continuing with BBY given that if the total production eligible for the scheme was actually covered, it would have cost the government INR 8434 crores and not just INR 1900 crores, which the government claims to have spent, thereby making a huge dent into the state exchequer. Extending such price deficiency payment scheme may not be financially viable. Instead a supply chain mechanism adequately backed by storage, processing and marketing opportunities including exports that are able to clear out excess supply will work better in terms of upward correction of prices.

8.7 Key Policy Suggestions and Way Forward

Policy advocacy for strengthening pulses value chains like many other agricultural commodities cannot be limited to boosting productivity, and thereby production only. Focus should be on strengthening market access for farmers in terms of higher price realization and improved risk mitigation. Even if farmers harvest a bumper crop, there is no guarantee that they will be able to sell the produce at support prices, let alone remunerative prices. This has been the situation with respect to several agricultural commodities in India with bumper harvests leaving the farmers helpless. Also, procurement without means to dispose raw or value-added products, either in the domestic market or export market means losses at the end of the procuring entity. This is observed in the case of public procurement, when market prices crash below support price. It is ironical that neither in the case of higher demand and consumer price inflation nor in the case of bumper production, farmers benefit in terms of higher returns.

Some of the important policy measures pertaining to pulses value chain that need to be undertaken are as follows:

Step up market access for farmers: Indian agriculture has passed the phase when increasing production was a key concern for the policymakers. In recent times, the crisis has been around bumper production without adequate market access. Hence, it is utmost important to step up market access for the farmers be it through direct sale to the millers, bypassing the *mandis* or through e-NAM, futures market, etc. A technology-enabled platform like e-NAM has the potential to aggregate market demand through inter *mandi* or inter-state trading systems which can help signal prices upwards. However, several *mandis* which are enrolled under e-NAM have not been able to take off in e-trading of pulses due to issues related to assaying which is critical for milling of pulses. Also, certain markets are in the process of setting up the infrastructure and services related to e-NAM. Futures market for tur and urad has been banned since 2007 and that of chana which was suspended in 2016 was again revived around June 2017. Given that the prices of major pulses recurringly crash below the MSP, futures market can be beneficial for the farmers in terms of higher price realization and hedging against price risk. However, there are certain constraints with the functioning of the futures market for agricultural commodities as cited by NCDEX that there are not enough delivery centres, and resource constraints make it expensive to reach out to large farmer base (The Indian Express 2017). The real benefits of higher price discovery can accrue to the farmers if they are able to directly trade on the futures platform through FPOs. In the absence of markets, assured procurement of pulses by the government either through central or state-level agencies should be in place for commodities covered under support price. Higher MSP without assured procurement has no meaning for the farmers who are unable to cover the cost of production or earn remunerative prices for their produce. The government procurement options under PSS and PSF should be made available to the farmers in a timely manner so that they do not bear the brunt of selling at market prices lower than MSP.

Strengthen storage and warehouse facilities: The Warehousing Development and Regulatory Authority (WDRA) was established in 2007 under the Warehousing (Development and Regulation) Act, 2007. The primary objective of WDRA was to develop and regulate warehousing, including registration and accreditation of warehousing that intend to issue negotiable warehouse receipts (NWRs) and electronic NWRs (eNWRs). There are 123 agricultural commodities and 26 horticulture commodities notified for negotiable warehouse receipts including cereals, pulses, oil seeds, spices, among others. Strengthening the access to NWRs particularly to the farmers can be extremely beneficial in terms of avoiding distress sale and holding onto stocks for better marketing opportunities. The margins in the pulses value chain accumulate at the miller, wholesaler and retailer levels where each are able to hold on to stocks (within permissible limits) and play the market fluctuations to their benefit. This can be shifted to the farmers by improving access to storage and warehouse facilities at the farm gate level. Access to warehousing will also improve farmer's access to institutional credit through e-NWRs.

Create infrastructure and services for standardised commodity assaying: During excess supply situations, it is easier for the traders to bargain for lower prices on the pretext of poor quality of pulses brought into the *mandi* by the farmers. In the absence of standardization of assaying parameters related to moisture, foreign particles, etc., and lack of infrastructure for proper sorting and grading at the farmer level, fetching higher prices for quality produce becomes extremely difficult for the farmers. The introduction of e-NAM has brought about standardization of commodity assaying and related infrastructure and services at the *mandi* level. However, the pace of implementation is varied across *mandis*. Also, under e-NAM, assaying plays an important role in enabling e-trading, wherein eventually the traders undertaking inter state trading, will have no scope to physically inspect the produce but have to rely on standardized assaying measures. Hence, it is important to create the right infrastructure and services at the farmer or village level for sorting, grading and packaging, which will also help avoid losses due to physical inspection and unpackaging and packaging, at the *mandi* level. This will also involve training and capacity building of the farmers or service providers at the village level to undertake sorting, grading, and packaging and ensure that the quality claims by the farmers in the *mandi* are true, and there is no manipulation. In some cases, it is observed that farmers mix different quality of the same products which often goes against their interest in terms of rejection or lower price realization.

Promote FPOs in pulses value chain: States and within them districts which have natural advantages of growing certain types of pulses should be incentivized. Also, states with higher yields but relatively lower area under pulses could be incentivized to increase area under pulses. Considering farmer aggregation model like FPO to bring about scale in farming as well as post-harvest activities like assaying, storage, value addition, and marketing can be beneficial to the farmers. Also, FPO can interface e-NAM to overcome the challenges faced by the farmers in terms of small marketable surplus and resource constraints in undertaking post-harvest activities. Direct linkage with the millers, particularly in case where pulses variety determines milling efficiency can be achieved through FPO and cluster-based model. FPOs can also undertake dal milling and marketing to enable assured markets and higher returns to the farmers.

Institute dynamic pricing policy that links domestic prices with import tariffs and decisions related to trade of pulses: Advanced production estimates and thereby likely market arrivals should be used to calibrate both import and export of pulses. In the event of bumper production, imports can be discouraged by raising the tariff levels. This will help revert situations of massive price crash, which hurt the interest of the farmers. Prudent decisions related to opening up of exports can help tide over domestic supply shortages and at the same time ease out the inflationary pressures on consumers.

Strengthen risk mitigation and access to finance: While improving market access is key to ensuring that farmers are able to earn the right price for their produce, it is also important to ensure that the risks associated with production and marketing are covered. In the case of pulses, the measures that are available have been either ineffective like the price support system; or not functional at a scale that has any demonstrated impact like the negotiable warehouse receipt system; or populist measures like loan waivers which do not offer long term sustainable solution for the farmers. The outcomes of the price deficiency payment scheme–Bhavantar Bhugtan Yojana in Madhya Pradesh are not studied enough beyond the pilot. While futures offer options for price risk hedging, the market has been subjected to bans and suspensions, thereby limiting its scope.

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Chapter 9
Further Strengthening Agri-Value Chains in India—Way Forward

Ashok Gulati, Pravesh Sharma, and Kavery Ganguly

The value chain analysis undertaken in this study reveals their varying performance against the conceptual framework of CISS-F. This research has helped understand the functioning of the value chains and implications of key policy reforms on the ground. There are examples of successful agricultural value chains, which clearly indicate how policies have worked in the interests of the farmers and contributed towards making the chain more efficient. However, there are several challenges confronting these value chains that need further policy attention. Each value chain study concludes with a proposed list of desirable interventions, and way forward, very specific to the commodity. These proposed interventions are by no means exhaustive. Rather, they represent a set of critical and urgent actions which are necessary for the growth and development of that particular value chain.

This chapter provides the broad spectrum of certain macro-policy challenges pertaining to agricultural technology, markets, institutions and finance, which are relevant to this study. The objective is to look at the ecosystem which supports agricultural value chains and suggest measures to plug the gaps that prevent the rapid and inclusive growth of these value chains. Policy efforts in this direction have been underway since the 1990s, and a lot of the discussion and debate reiterated the need to expand the horizon of agricultural marketing in India. With a clear policy statement and enabling legislative framework, high value chains can be incentivized. Quite clearly, huge investments in production technology, infrastructure, storage, value addition and human resources will be necessary, if large-sized value chains are to be a reality in the agriculture sector. The majority of these investments will have to be made by private players, including farmers. Therefore, it is of utmost importance that there is bipartisan political buy-in to the new policy reform. The significance of

A. Gulati (✉) · K. Ganguly
Indian Council for Research on International Economic Relations (ICRIER), New Delhi, Delhi, India

P. Sharma
Former Senior Visiting Fellow, ICRIER, New Delhi, Delhi, India

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the recent Farm Laws 2020 should not be considered any less than the one which was made in 1991 to announce the end of industrial licensing. These laws allow for a transparent legal pathway to further strengthen the efforts towards developing high-value agricultural value chains.

9.1 Technology

This section discusses the role of technology in a crop-neutral manner and presents some macro-steps which are relevant from the point of view of building efficient and inclusive value chains.

- If indeed India aspires to be a major player in world agriculture trade, then the current ad hoc, episodic approach towards technology development and acquisition will have to be abandoned. Instead, technology will have to be seen as a strategic investment which enables the development of global agricultural value chains. The quickest and most cost-efficient means of accessing technology and its widespread dissemination then becomes an important element of policy-making.
- The commodity-specific value chain studies present specific instances of major technology gaps and lack of adequate research in varietal diversity, disease control and other areas which stunt value chain development. Given the fact that India invests a mere 0.37% of agriculture GDP (Government of India 2019), it is unlikely that any major technological breakthrough will emerge. While experts call for investing at least 1% of the agriculture GDP in research and highlight the high economic and social returns of such investments, budgetary outlays have remained more or less stagnant. Private sector research is held back on account of policy uncertainties and a sclerotic regulatory regime, besides weak enforcement of intellectual property rights (IPR).
- The noisy nature of Indian democracy and the multiple stakeholders that exercise competing pressures on the central and state governments will impact investments in agricultural R&D. In the short run, India is unlikely to allocate significant public resources to agricultural R&D, provide quick regulatory approvals to foreign players to bring in best-in-class technologies or even facilitate domestic private sector players to invest in promising agricultural research. The practical approach should be for the government to go out and make an outright purchase of the necessary technology packages that can trigger productivity improvements. Once acquired, the technology can be shared in an affordable and inclusive manner to penetrate the target value chain rapidly.
- The history of how breeder seed of high yielding varieties of wheat and paddy was acquired by the government and disseminated is a good pointer to the success of such an approach. And we are not alone in taking this road. In 2016, ChemChina, one of China's largest agrochemical companies, announced the acquisition of Basel-based Syngenta for a whopping USD 46 billion. It was the Chinese government, acting through its PSU, which took ownership of proprietary technologies

developed by Syngenta, for meeting its food security objectives in the coming decades.

- Therefore, a mechanism must be put in place for the identification and acquisition of vital agricultural technologies from both domestic and foreign R&D players. This should cover not just seeds but planting material in general, besides agrochemicals and farm machinery. Once the government becomes the owner of these technologies, it can decide the terms on which they will be shared with both public and private sector entities for multiplication and further development. For a period of time, government may choose to offer select technologies at token or very low costs to developers and farmers alike such that these technologies can be multiplied and adopted extensively in a short time frame.
- However, this can be at best a short-term solution which helps us to close the existing technology gap. We still need a long-term investment policy to promote the development of home-grown agricultural technology. In a developing country like India, with multiple calls on the public exchequer, it will always be a challenge to provide an optimum level of taxpayer funds for agricultural R&D. Even as the country moves towards the goal of investing 1% of agricultural GDP in a (3–5) year framework, government can incentivize private investment in agricultural research through an appropriate package of incentives. This will require going beyond the obvious tax breaks and addressing the current misgivings on regulation and IPR issues.
- A balance will also have to be found between encouraging private sector investments in this area while recognizing the role of farmers and traditional communities in preserving seed varieties and germplasm. Sharing of benefits with those who have helped to preserve biodiversity should be an essential component of the new approach to technology. This innovation-driven approach can help foster a vibrant environment for farm-level research which besides producing location-specific technologies will also create widely dispersed employment opportunities.
- This is not to reduce the importance of public research in agriculture. Investment in agricultural R&D must remain a priority area for the government. However, there needs to be an overall strategic framework for agriculture research, clearly demarcating core areas for public and private sector focus. Some long-term themes, like climate change adaptation, rearranging cropping patterns in view of fast developing natural resource constraints and the agricultural education framework, are best addressed by large national systems. However, the government agricultural R&D institutions have to develop easier norms for collaboration with private sector and international research players for greater effectiveness.

• Related to technology acquisition and development is the challenge of extension. The agriculture extension system in the crop husbandry segment is seriously weakened and is practically non-existent in high-value sub-sectors such as horticulture and dairy. This weak lab-to-land link has resulted in even on-the-shelf technologies (especially in the horticulture sector) not penetrating deeply into the value chains examined. Private sector players, almost without exception, promote their own products (like seed, agrochemicals, etc.) and the related use-case technology. Thus, huge information asymmetry exists in awareness and adoption of available technology options in most of the crops we studied.

– A manpower-centric extension system, as was set up in many states during the spread of Green Revolution technology, may not be affordable or even effective in the current context. Instead, the attempt should be to create choices and easy access to digital technology for farmers by encouraging a multiplicity of players in the extension arena. The potential of information technology remains to be harnessed in a scalable and impactful manner, even though many successful models exist at the level of small pilots. Here again, what is needed is an inclusive framework which embraces multiple players to support specific value chains. The example of grapes investigated in this study clearly shows that if there is a clear identification of markets and their requirements, multiple stakeholders in the value chain create collaboration networks to achieve highly demanding quality norms. Farmers can be empowered to choose between various options through a direct income support option, rather than tied down to specific channels as per current practice.

9.2 Markets

- The absence of integrated agri-value chains is primarily the outcome of adopting a fragmented approach to markets. The centrality of the Agriculture Produce Marketing Committee (APMC)-controlled market yards or *mandis* has led to the existence of more than 7500 highly restricted primary market yards in the country. At one level, these small market areas cater to the prevalent production model which is dominated by small holdings. More than 86% of all agricultural holdings are small and marginal, i.e. less than 2 hectares. The marketable surplus from these millions of small farms is typically too small and varied in quality terms to enable aggregation into viable lot sizes. This also means that large processors, retailers, exporters, etc., have little incentive to work with farmers and source produce directly from farms. Thus, the value chain comprises of multiple tiers of traders, from the village to the national level, who aggregate the produce, sort into different quality categories and ultimately supply to the bulk buyers. However, the result is that economies of scale in production, harvesting, sorting, grading, transportation and storage cannot be leveraged, except for a handful of crops (grape is a good example of an alternative model, where exporters work closely with farmers).

- Therefore, building of agricultural value chains will require a completely different policy approach to markets. For each and every agricultural product generated in India, policy has to consider the world, not even the country, as the natural target market. As an opening move, a central legislation, on the lines of Goods and Services Tax (GST) enabling law, will be needed to create a single, unified market for all agriculture produce at least within the country. Agricultural markets need to be more competitive, and farmers should be free to market their produce to any entity on mutually agreed terms. Competition is a key to building value chains, and anything which restricts competitive practices, protects monopolies and reduces transparency should be identified and removed.
- Since the early 1990s, there have been several attempts to liberalize agricultural markets to ensure these markets are more competitive as well as inclusive. Important reforms were initiated in the beginning of 2000s, the key provisions of which included diluting the monopoly control of the Government over marketing practices, allowing farmers the freedom to sell to anyone and any place that they desire, and creating a level playing field for the private players. Given that agriculture is a state subject, the central government's role was limited to proposing policy reforms without any control over the adoption and implementation of the same by the states. Hence, all the major reforms proposed since the early 2000s that include Model Act 2003, APLM 2017 and Contract Farming 2018 have been adopted partially by few states. This resulted in market inefficiencies and poor implementation of flagship programs like e-NAM as well as other reforms related to rationalization of cost of marketing, relieving farmers the burden of paying commission fees, among others. Agricultural markets continue to be fragmented in structure and operations, pose a heavy burden of fees and service charges to the users and discourage direct marketing between farmers and buyers. This adversely impacts farmers' income as well as scope for value addition and growth of the agricultural sector.

- In the wake of the COVID-19 pandemic, the central government made an unprecedented move of clearing the legal hurdles that impede agricultural marketing. First, on 5 June 2020, the central government announced three ordinances—Farmers' Produce Trade and Commerce (Promotion and Facilitation) Ordinance, 2020; Farmers (Empowerment and Protection) Agreement of Price Assurance and Farm Services Ordinance, 2020; and Essential Commodities (Amendment) Ordinance, 2020, that allowed direct marketing, contract farming and abolished stocking restrictions, respectively. This was indeed a historic move given that the central government bypassed the states in bringing about these important legal reforms which was critical to keep agriculture moving amidst the lockdown and realize the long-term vision of one nation, one market. Subsequently, the Farmers' Produce Trade and Commerce (Promotion and Facilitation) Bill, 2020, and the Farmers (Empowerment and Protection) Agreement of Price Assurance and Farm Services Bill, 2020, were passed by

Lok Sabha on 17 September 2020 and by the Rajya Sabha on 20 September 2020.

- The Farm Laws 2020 provide a legal pathway for liberalization of agricultural markets, wherein wholesalers, retailers, exporters and processors have equal opportunity to participate and farmers have the choice to sell his/her produce for the highest price. This provides the opportunity for farmers to benefit from higher income in two ways. One, farmers can trade directly with the buyers without having to go through the market intermediaries and hence save on the cost of market intermediation fees, transportation and market fees. Two, this legislation will enable creation of integrated markets for agricultural commodities, which will allow farmers to leverage higher aggregate demand.
- It is well researched that price setting (in the form of minimum support prices) and government procurement, especially of cereals like wheat and paddy, have played a role in distorting markets and inhibiting value chain development. The monopolistic procurement model often adopted by government agencies also discourages competition in primary markets and keeps away private players. At the same time, MSP and government procurement are vital tools in the food security architecture of the country and are linked to key welfare objectives.
- However, we feel that the needs of food security and providing a minimum guarantee of food grains to vulnerable households need not be at the cost of competitive markets and integrated value chain development. Measures such as revised (and lower) norms for buffer stocking, engagement of private players for procurement, commitment to purchase a minimum volume directly from private trade, as well as a combination of deficit price reimbursement and acreage-based direct income support can be used to meet the desired objectives. Some of these ideas have been tried out at the local level in the past few years with mixed results. It requires the leadership and support of the central government to enlist the cooperation of state governments to choose from a menu of options most suited to their specific needs.
- Portal-based trading in agricultural commodities is another completely underdeveloped marketing channel, which holds the potential of promoting integrated, pan-India agricultural supply chains. Much hope was invested when the Government of India launched e-NAM, the electronic trading portal which offered screen-based spot trading in agricultural goods. However, having completed five years in July 2021 since its launch, progress of e-NAM has been very sluggish. A combination of poor design, opposition by APMC trader lobbies, lack of awareness among farmers and weak implementation has rendered the initiative infructuous. Given the challenge of uneven spread of buyers and demand, e-NAM linked to warehouse-based trading (including e-NWRS) and engagement of FPOs have the potential to transform agriculture marketing. The role of futures market in higher price discovery and improved price risk management needs to be revisited for potato and piloted for onion and other commodities, which potentially impact a large farmer base. With infrastructure already in place, greater transparency and fair regulation can further strengthen futures market. To get this together, a strong political and

administrative will is needed to push back against entrenched lobbies in the larger interests of farmers.

9.3 Institutions

- *Better co-ordination and consultation between various ministries, central and state levels*
  – Sustainable agricultural value chains need a clearly defined regulatory framework to succeed. While there are dozens of promotional and regulatory agencies, both at the centre and in some states, there is little attempt to coordinate their respective roles for common objectives. While Ministry of Agriculture and Farmers' Welfare (MoA&FW) exhorts states to increase acreage under various fruits and vegetable crops, Department of Commerce in the same government imposes ad hoc and sudden bans on export as is common in the case of onion. This is done with a perfunctory consultation with the promoting ministry and without an attempt to ascertain the views of major producing states. Another body of the Ministry of Commerce, the Agriculture Produce Export Development Agency (APEDA), meanwhile pushes for increasing exports of horticulture produce, largely in isolation of any co-ordination with the MoA&FW or the state governments. On the sidelines, the Ministry of Food Processing Industries launches its own schemes, often overlapping with those of other ministries, and everyone seems to be engaged in small turf wars. These are but a few examples among what is commonly observed. Sub-optimal performance of many of these regulatory and promotional bodies, both at the centre and state levels, is partly responsible for the absence of serious private sector investor interest in value chain development.
  – What clearly emerges is the need for coordinated planning and implementation, which is by no means easy, given the primacy of states in implementing agriculture policy. Therefore, it is important to reiterate the need for a standing mechanism to discuss and adopt policies with clear goals in the agricultural sector. The lead for setting up such a mechanism has to come from the central government on the lines of the body consisting of State Finance Ministers which ultimately helped to usher in the Goods and Services Tax (GST). Even after the necessary legislation, it has been seen that the GST Council continues to play a role in ironing out implementation issues and addressing new challenges. Something on similar lines must be adopted for agriculture as a prerequisite for expecting meaningful policy reform which can incentivize private investment in agriculture value chains.

- *Reforming land lease markets*
  - The primary factor of production, i.e. availability of land, remains a bottleneck to promote integrated value chains. With millions of fragmented holdings and individual title holders, creating economies of scale in the production, aggregation, storage and value addition of high-value agricultural commodities are impossible. Most importantly, while markets demand consistent quality and volumes, the current production system simply cannot deliver. Large land parcels cannot be created by leasing-in of land, as most states do not legally permit such tenancies. Unless a solution is found to incentivize large land parcels, either through direct purchase by amending the land ceiling laws or through a leasing model which is sanctioned by statute, production of consistent quality agricultural produce is not feasible. This is one of the most critical interventions which should be taken up urgently to kick-start the consolidation of land.
- *Promoting aggregation at farm level*
  - The principle of aggregation equally needs to be applied in the case of producers. With over 140 million farm households, India cannot viably reach out to individual farmers for technology upgradation, services and market linkage. The answer is producer collectives in all forms: co-operatives, producer companies, associations, etc. Here again, policy should provide positive incentives for individual producers to become members of collectives, linking such membership to cheaper and easier credit, access to common infrastructure and joint marketing.
  - With the announcement in the Union Budget 2019 (MoF, 2019) to promote 10,000 additional FPOs, a good beginning has been made. However, merely registering these bodies will not suffice. An entire ecosystem of support, including linking these institutions to equity and working capital, easing licensing and compliance, creating back-end infrastructure for procurement and storage as well as making it attractive for bulk buyers to purchase directly from these bodies, has to be created. This will require coordinated action between central and state-level agencies so that millions of producers can become meaningfully linked to large value chains. The Farm Laws 2020 recognize the role of FPOs in mobilizing and strengthening the bargaining power of the farmers in trading with private buyers or entering into contract farming agreements.
- *Food Safety and Quality Standards*
  - The lack of commonly applied standards or quality control, and weak to non-existent enforcement of the few that exist, is another lacuna which has inhibited market players from investing in efforts to promote them. A mistake frequently made by policy-makers (witnessed recently again in the agricultural export policy) is to advocate separate standards (usually stricter) for export markets

while being casual (which means lax) towards domestic consumers. Thus, grapes destined for Europe must conform to high norms of food safety (typically, low chemical residues from spraying), while domestic consumers enjoy no such attention and protection. The argument often heard in policy circles is that mandating global norms for domestic produce will drive up prices. It begs the argument why health and safety of Indian nationals should be compromised when we can quite easily achieve the same standards.

– Thus, adoption of food safety standards for all agriculture produce in a phased manner and alignment to globally accepted norms is an essential component of value chain development. This will require sustained efforts to assist farmers to adopt practices to achieve the desired standards, developing capacity for testing, regulation and enforcement, as well as consumer education to help society accept higher costs for agricultural produce. However, a clear articulation of social and economic cost–benefit analysis will smoothen the transition and lay the foundation for integrating Indian farmers into global supply chains. The transformative impact of such a move on the agricultural economy in particular and the national economy in general is too obvious to be repeated here.

- *Creating a Multi-Agency Centre (MAC) for building value chains*

  – The final piece in this mosaic would be a dedicated agency at the centre, with counterparts in each state, which is tasked with coordinating all actions related to building value chains. While a large cast of actors will need to play their roles to build global agriculture value chains, the big picture must be kept in view by a central champion. No single agency in the present landscape has the mandate or capacity to play this role. Perhaps, it is also not practical to propose such multidimensional role under one umbrella. What is required is to create a Multi-Agency Centre (MAC), drawing upon the resources of several ministries and bodies, to undertake this task. So, while the MAC may have a small permanent secretariat, it should have senior representation from key ministries, agencies, financial institutions, states and, most importantly, the private sector. One model to build upon is the National Capital Region Planning Board (NCRPB), which has achieved some modicum of success in coordinating with multiple central and state-level authorities to achieve certain desirable infrastructure outcomes in the NCR.

9.4 Finance

Lack of access to institutional finance has emerged as a major cause for the fragmented and often stunted value chains for all the commodities studied in this book. This constraint is felt most acutely by individual farmers, nearly 80% of whom rely on informal sources of credit for investment and working capital needs. With traditional sources of informal credit (moneylenders, *mandi* traders, big landlords, middlemen, etc.) charging interest rates in the range of (36–120)%, it is hardly surprising that investments in technology, basic farm machinery, storage infrastructure and other stages of the value chain are abysmally low.

The situation is only marginally better for co-operatives and farmer producer organizations (FPOs). With no dedicated development finance institution supporting agricultural value chains, most collectives (especially in dairy and poultry) rely on commercial bank finance for their requirements. Serious gaps in the outreach capacity of banks limit the financial outlays as observed in the value chains studied here. The only exception seems to be private dairies and poultry units, which find it relatively easier to attract bank finance and, increasingly, private equity. This is possibly due to the physical assets that these units acquire and are able to offer as collateral to the lenders. However, no significantly scaled-up and replicable financing model has been discovered so far in products in the crop husbandry and horticulture sectors.

Given this scenario, there is an urgent need to address the financing gap that constrains the development of agricultural value chains. The following recommendations provide a direction towards addressing the financing gaps.

- The agriculture sector requires an investment policy which is targeted towards building global value chains. This would require going beyond the current approach of producing and consuming locally or regionally produced commodities. Typically, aggregation of agricultural commodities takes place at either the local *mandi* or state level, as in case of milk. Fruits such as banana and mango are at most regional crops. It is impossible to find varieties of these crops grown, in southern states, in the northern markets, just as those popular in the northern and western parts barely make it to southern markets. To make the value chains global, it will be important to shortlist products where India has a competitive advantage and identify specific need for investments and policy action. Such a policy will need to consider the complementary competence of farmers, co-operatives and FPOs as well as public and private sector players.
- Creating the pipelines through which credit for investment and working capital will flow to players in different stages of agriculture value chains is another important step. Enabling institutional credit flows to farmers, co-operatives and FPOs who are at the first stage of the value chain is the centrepiece of this arrangement. Experience shows that leaving the task to banks and legacy financing systems will not work. Therefore, policy needs to facilitate new-generation non-banking finance companies (NBFCs) or the so-called fin-tech sector, to address this problem. With their flexible products and deeper integration of digital technologies, NBFCs can step in to fill the gap left by traditional banks.
  - However, given that NBFCs are presently not allowed to raise low-cost capital (such as public deposits, unlike banks), their loans are significantly more expensive. They are also exposed to a greater risk of collapse in case of massive borrower delinquency. Hence, it is critical to mitigate their risks in two possible ways: one, through a dedicated refinance facility (managed by NABARD, SIDBI, NCDC, etc.) for loans advanced to identified priority value chains at a fixed cost, and two, through a first loss default guarantee (FLDG) offered by

the same set of institutions to cover, say the first (10–15)% of default on their agriculture value chain loan portfolio.

- Equity capital has played a key role in meeting the initial investment requirements of technology-led start-up. These ventures have been reticent about entering the agriculture sector, largely owing to policy uncertainties and poorly understood risks. However, this form of risk finance is an essential ingredient for the future sustainable growth of agriculture value chains. While clarity on the policy approach to building integrated value chains will be helpful, some initial comfort may be required to kick-start the investment cycle in this category.
  - An idea worth trying is the launch of a dedicated agriculture equity investment vehicle, targeting both start-ups and growth stage enterprises which are seeking to build agriculture value chains. This investment vehicle can be initially floated by a group of public entities (NABARD, SIDBI, NCDC, SFAC) with financial and management contribution from private equity funds. Eventually, after a few years, the portfolio of investments can even be hived off entirely to private sector players. But the initial presence of public entities will help to crowd-in private equity capital.
- Collateral financing solutions, hedging and futures contracts, typically, provide both risk mitigation and liquidity solutions in developed agricultural markets. These are conspicuous by their absence in India, barring a narrowly traded list of commodities. This is an outcome of our wider policy ambiguity on giving market instruments greater role in the agricultural economy. However, if the policy objective is to build agriculture value chains, the introduction of tried and tested hedging and other products widely used in other countries is essential. It will provide a risk management framework, as even the biggest and most integrated agriculture value chains will face periodical shocks on supply, price, quality issues, etc. Once a core set of market-oriented instruments are introduced, innovation can be encouraged for more context-specific products to be developed in an appropriate regulatory environment.

9.5 Summing Up

For agricultural value chains to be more competitive, inclusive, sustainable and scalable, an enabling policy environment supported by strong institutions is most important. The success of agricultural value chains has been a mixed bag, and there is enough scope to strengthen these value chains further to deliver higher returns to the farmers as well as contribute to the overall growth of the agricultural sector. The COVID-19 pandemic ushered in some major policy reforms which were much awaited. These reforms are aimed towards liberalization of agricultural markets, infusing greater competition and choice for the farmers, which are important factors for developing high-value chains.

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