



Scoping study on fruits and vegetables; results from India

An assessment of investment opportunities for the Bill and Melinda Gates Foundation

Xuezhen Guo, Thomas Tichar, Balraj Sikka, Agarwal Bhoormal, Kumar Gesh, Narula Sapna, Kumar Anand and Singh Kshyama



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Wereldwijd lijdt een op de drie mensen aan een of meer vormen van ondervoeding. De teams van de Bill & Melinda Gates Foundation die zich bezighouden met landbouw en voeding, in samenwerking met het Britse Department for International Development (FCDO), willen het potentieel van groente- en fruitketens onderzoeken om het aanbod van voedzame voedingsmiddelen te vergroten en te versterken, en om de lokale marktkansen voor meer inkomsten te vergroten, speciaal voor vrouwen. Dit rapport belicht de conclusies van een onderzoek in India en identificeert verschillende oorzaken en mogelijke interventies om de fruit- en groentesectoren te verbeteren en daarmee de consumptie te verhogen.

Currently, one in three of the world's population suffer from one or more forms of malnutrition. The Agricultural Development and Nutrition teams at the Bill & Melinda Gates Foundation, in collaboration with the UK's Department for International Development (FCDO), seek to investigate the potential of vegetable and fruit supply chains to increase the supply of and strengthen demand for nutritious foods, as well as increase local market opportunities for increased income, especially for women. This report highlights the conclusions from a study in India, and identifies several root causes, as well as opportunities for interventions to further develop the fruit and vegetable sectors, and with that enhance consumption.

Key words: fruit, vegetables, food system, nutrition, supply chains

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Preface

The world's population is expected to increase by 2 billion persons in the next 30 years, from 7.7 billion currently to 9.7 billion in 2050. In spite of progress made in the past decades, the number of people being undernourished is on the increase again. Globally, 462 million are underweight, while 1.9 billion adults are overweight or obese. This contrast highlights well one of the most prominent global challenges imposed on our food systems, which is: how to make available, accessible and affordable healthy food to all.

To meet the growing demand for food and improved nutrition, food production and its nutritional value need to be enhanced. Compounding this issue is the pressure that existing agricultural systems place on the environment. Although there is scope to bring new land under cultivation, for example in Africa and Latin America, this has the knock-on effect of damaging the climate, biodiversity, natural habitats and more generally the integrity of the Earth's environmental system. The challenge of achieving global food and nutrition security is underscored by Sustainable Development Goal (SDG) 2: "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture."

Fruits and vegetables play a key role in achieving above mentioned goals. This was acknowledged by the Bill and Melinda Gates Foundation (BMGF) and the Foreign, Commonwealth & Development Office (FCDO) which realised that more knowledge on the current state of fruit and vegetable consumption, trade, processing and production worldwide, and notably in low- and middle-income countries, is needed. For that purpose, Wageningen University & Research was contracted to conduct a global scoping study including deep dives into selected countries. After more than a year and a half of research, we are happy to present a number of research outputs that address comprehensively the state of art and main challenges associated with fruits and vegetables. The reports take us through all aspects of food systems in which fruits and vegetables play a role, from consumption to production, but also around the world, from Nigeria to Nepal. The study provides BMGF and FCDO with a clear set of recommendations as to priorities for philanthropical investments that have the goal of enhancing consumption of and economic benefits from fruits and vegetables.

Fruits and vegetables play a key role in meeting current and future food system challenges. With this research we know better where we are and what is needed to address these challenges. I hope our work contributes to setting in motion food system changes urgently needed.



Prof.dr.ir. J.G.A.J. (Jack) van der Vorst
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Summary

Background

The Agricultural Development and Nutrition teams at the Bill and Melinda Gates Foundation (BMGF), in collaboration with the UK Foreign, Commonwealth & Development Office (FCDO), seek to investigate the potential of vegetable and fruit supply chains to increase the supply of and strengthen demand for nutritious foods, as well as improve market opportunities for increased income, especially for women.

A global scoping study of the horticultural sector in West Africa, East Africa and South Asia was conducted. The Phase I study was based on available literature and secondary data and resulted in the identification of so-called leverage points for interventions in the food system to promote the production, trade and consumption of fruits and vegetables. To test the validity and feasibility of the identified leverage points in specific contexts, seven deep-dive country studies have been performed in seven countries in Bangladesh, Burkina Faso, Ethiopia, India, Nepal, Nigeria and Tanzania.

This country study has the objective to further investigate and validate the leverage points identified in Phase I of the study for India. The ultimate goal of the country study is to understand what kind of investments can be made to accelerate systemic changes in the food system for healthier diets for all and more economic opportunities in particular for women. As a result of this study, BMGF and FCDO intend to identify potential investment options for enhancing the sustainable and inclusive development of the horticulture sector in India.

Approach

We investigated key questions on the fruit and vegetable sectors identified during Phase I. Since India is a large country, four states were selected for this study based on BMGF's suggestions, Andhra Pradesh, Bihar, Odisha and Uttar Pradesh. Seven fruit and vegetable products including eggplant, litchi, mango, onion, orange, pea, and tomato were chosen for in-depth analysis in this research. The crop selection was based on opportunities for 1) an uptake of consumption among poor and middle-class urban and rural consumers; 2) economic importance and income generation for farmers; 3) importance for nutrition; and 4) economic empowerment opportunities for women.

We applied a mix of 20 focus group discussions (FGDs), 12 key informant interviews (KIIs) and literature review to provide an answer to the key questions identified, allowing for in-depth information gathering as well as cross referencing and triangulation.

Key findings

The fruit and vegetable sector contributes 4.7% of India's GDP and is of significant relevance for people's livelihoods, especially in the rural areas. The state of Uttar Pradesh produces the largest share of the horticulture crops in India, accounting for 12.6% of the country's total production, followed by West Bengal and Madhya Pradesh at 10.4% and 8.5%, respectively. The per-capita daily consumption of fruit and vegetables is calculated at 262 g per day per person, which is well below the World Health Organization recommended daily intake.

Although progress has been made, the Indian fruit and vegetable sector are still not developed to their potential. The increases in fruit and vegetable production during the last decade was mainly achieved by land expansion instead of productivity enhancement. The domestic value chains, characterized by

poor infrastructure and technology applications, lead to high losses, unstable productivity and fluctuating prices.

We found that reduction of the cost price will not affect the farm gate price of the products because smallholder farmers are the price takers; however, it can improve the profitability of fruit and vegetable farmers. A more efficient fruit and vegetable supply is likely to reduce post-harvest losses and can potentially lower consumer prices. A more secure market can benefit smallholder farmers and provide them with incentives to sustainably intensify their fruit and vegetable production. This is especially the case when farmers have long-term contracts with larger retailers, such as supermarkets, that they will get better farm gate prices and experience fewer market risks. Moreover, removing the intermediaries in the fruit and vegetable supply chains by adopting direct (online) sales platforms is also an effective approach to reduce transition costs and improve value chain efficiency. However, when applying this strategy, we should not ignore the potential losses of the job opportunities for the middlemen in the fruit and vegetable supply chain. Therefore, a transformation of intermediaries' role from traders to supply chain service providers should be facilitated. In terms of women empowerment, the different business models identified provide a more flexible approach to benefiting women, depending on the market context, as well as their own specific preferences. Becoming recognized as a pioneer in agribusiness, whether at local, regional or national scale, is important and has the effect of removing the social stigma for women.

1 Introduction

1.1 Background

The Agricultural Development and Nutrition teams at the Bill and Melinda Gates Foundation (BMGF), in collaboration with the Foreign, Commonwealth & Development Office in the UK, seek to investigate the potential of vegetable and fruit value chains to increase supply of and strengthen demand for nutritious foods, as well as increase local and export market opportunities for increased income, especially for women. Wageningen University and Research was assigned to conduct this study.

First, a global scoping study of the horticultural sector in West Africa, East Africa and South Asia was conducted. This phase I study was based on available literature and secondary data and resulted in the identification of so-called leverage points for interventions in the food system to promote the production, trade and consumption of fruits and vegetables. These potential leverage points and related research questions were formulated in general terms only. To test the validity and feasibility of the identified leverage points in specific contexts, seven deep-dive country studies have been carried out in seven countries in Bangladesh, Burkina Faso, Ethiopia, India, Nepal, Nigeria and Tanzania. This report describes the findings of the India country study.

1.2 Objective of this report

The objective of the study is to identify opportunities for action and investment in the fruit and vegetable sector of India to guide future engagement by the BMGF.

The potential leverage points that were identified in the global phase I scoping study serve as an entry point to contribute to this objective. The potential leverage points and associated research questions are further introduced in Chapter 3 of this report.

1.3 Approach

To answer the research questions, we combined different approaches, allowing for in-depth information gathering as well as cross-referencing and triangulation:

- Desk research: This was focused on academic publications describing the situation in the Indian horticultural sector, with special attention to the selected crops and states wherever possible. We complemented this with additional secondary data sources like FAOSTAT and the Indian National Horticulture Board Database.
- Focus group discussions (FGD): To collect views on recent development and to gather expert and actors' opinions on the horticultural sector, local consultants organized a total of 20 focus group discussions. Participants included representatives from privately-owned businesses, non-governmental organizations (NGOs) government bodies, and stakeholders along the fruits and vegetables supply chain from producers to consumers, spread across the selected states Andhra Pradesh, Bihar, Odisha and Uttar Pradesh. A detailed overview of the focus group discussions is presented below:
 - One focus group discussion related to gender (NGOs involved)
 - Six focus group discussions with farmers
 - One focus group discussion with mixed public and private companies and NGOs
 - Six focus group discussions with intermediaries
 - Six online focus group discussions with consumers from each selected value chain
- Key informant interviews (KII) were conducted with various actors including experts in the field of horticultural production, the development sector, public sector and private sector, with actors

located in Andhra Pradesh, Bihar, Odisha, and Uttar Pradesh. In total, we conducted 12 key informant interviews.

- Both the focus group discussions and the key informant interviews provide interesting cases and novel approaches emerging from the Indian fruit and vegetable sector. These cases are described in boxes throughout the report.

In addition, we made crop budget calculations for each crop. This was based on typical farm costs like seeds, fertilizers, crop protection, labor — including family labor valued at the daily wage of a typical laborer — and the revenues coming from the foreseen harvest. As input for these calculations, we used various sources including relevant literature, information from the field FGDs and the key informant interviews.

2 State of play

2.1 Country profile

India is the second most populated country in the world with nearly a fifth of the world's population. In addition, India's population is expected to grow by 25% (using 2011 as the reference) to 1.52 billion by 2036, according to the newly issued "report of the technical group on population projection (July, 2020)". It projects that up to 70% of this increase will be in urban areas. India's urban population will therefore increase from 377 million in 2011 to 594 million in 2036 — a growth of 57%. In other words, while 31% of Indians were living in urban India in 2011, this will grow to 39% by 2036. According to the 2019 revision of the World Population Prospects, India's population was about 1.35 billion. More than 50% of the population is below the age of 25 and more than 65% is below the age of 35. Only 40% of the population can be classified as workers. A large percentage of the population is below the age of 15, and the labor participation rate among women is low, which explains the high percentage of the non-working population. About 72% of the population lives in rural areas (Chandramouli, 2011). This has created a massive dependence of the Indian population on agriculture and other rural industries. Agriculture has been the mainstay of the Indian economy with a 14% share of the GDP, and a large share of the population (over 50%) depending on it for their livelihoods (Agriculture Economy in India, 2018). Furthermore, it has been reported that the proportion of female labor in agriculture in India ranges from 32-43% (FAO, 2011) and around 32% of women are economically active in agriculture (FAO, 2011). Women's participation in rural labor markets shows considerable heterogeneity between regions, with the majority of women's jobs characterized as underpaid, seasonal, and part-time work.

India, with its wide variety of climate conditions and soil, is highly favorable for growing a large range of fruits and vegetables. At present, horticulture in India contributes about one third of Indian agriculture GDP and its expenditure shares of the total Indian GDP are 4.7% (IPC, 2017). Horticulture production reached 311.71 million t in 2017-18 (FAOSTAT). Although India is the world's major producer for many fruits and vegetables, average fruit and vegetable consumption in India is still relatively low and highly unequal. This is largely due to underdeveloped supply chains for the distribution of fruits and vegetables. Supply chain management plays an important role in reducing food losses and improving profitability. It has been observed that up to 50% of fruits and vegetables produced in India are lost in the supply chain between harvest and consumption (Negi and Anand, 2015). The main reasons for food wastage in India are poor storage, poor transportation and poor chain management. Poor or even absent storage facilities lead food to be eaten by insects or left to rot in the open grounds. There are very limited cold storage capacities in India and these can only accommodate 10% of perishable foods (Negi and Anand 2015). Moreover, at the primary production end, factors like the lack of irrigation and lack of good-quality inputs result in high production seasonality and high price volatility. This in turn restricts farmers, especially smallholders, from intensifying their business. At the consumer end, low purchasing power, cultural barriers and personal preferences are among the factors leading to low fruit and vegetable consumption.

Despite the previously mentioned weaknesses in the Indian fruit and vegetable sectors, some progress has been made. In the following subsections, we present an in-depth analysis of the country's fruit and vegetable sector profile from a range of different perspectives.

2.2 Overview and trend analysis for fruits and vegetables in India

2.2.1 Fruit and vegetable consumption

The WHO's Global Strategy on Diet, Physical Activity and Health recommends that per capita fruit and vegetables consumption (excluding tubers) should exceed 400g/day. Indian diets are traditionally cereal-dominated and limited in their diversity (Shankar et al., 2017; Tak et al., 2019). Analysis of the 2011-12 National Nutritional Monitoring Bureau data for 29 selected Indian states showed average vegetable consumption to be 143 g/person/day for men and 138 g/person/day for women (Shankar et al., 2017). An analysis of the nationally-representative National Sample Survey (2011–2012) indicated that household per capita consumption of fruit and vegetables was 160 g/person/day for rural India and 184 g/person/day for urban India (Minocha et al., 2018).

A growing trend in fruit and vegetable consumption is being observed. Whereas per capita consumption of fruits and vegetables was only 281g/day in 2005-06, it has increased to 397 g/day in 2017-18 (FAOSTAT). One main reason for the increase in horticulture is a change in food consumption patterns whereby people are increasingly shifting from cereals like wheat and rice to more health-conscious items like fruits and vegetables.

2.2.2 Area and volume of fruit and vegetable production

In this section, for the production and area of fruit and vegetables, we used data from the National Horticulture Board Database (2020) for India rather than FAOSTAT (2019) data. This is because the FAOSTAT data is not as detailed as the National Horticulture Board Database (2020) in terms of item coverage. For example, FAOSTAT does not provide the item-specific production data for litchi which is a selected crop in this study.

According to the National Horticulture Board Database (2020), the total horticulture production in 2019-20 was expected to be 287 million t, about 3.5% higher than the 280 million t in 2018-19. Fruits and vegetables increased by 1.1 and 4.7% respectively. The items with the largest increase in absolute volume were onions, tomatoes and potatoes. Onion production was expected to be 26.7 million t (an increase of 17.13%) compared to 22.8 million t in 2018-19. Tomato production was expected to be 19.3 million t (an increase of 1.68%) compared to 19 million t. Those increases are largely dependent on the expansion of growing areas. The growing areas for onion and tomato in the period 2019-20 were increased by 17.54% and 3.97% respectively compared to in the period 2018-19. Those rates are higher than the rates for the growth of production.

Detailed breakdowns of areas and production per fruit and vegetable items are listed in Table 2.1 and Table 2.2 below.

Table 2.1 Area and production of fruit crops in India

	2018-19		2019-20	
	Area (1,000 ha)	Production (1,000 t)	Area (1,000 ha)	Production (1,000 t)
Almond	10	11	10	9
Gooseberry (aonla)	92	1,046	95	1,107
Apple	308	2,316	308	2,734
Banana	866	30,460	878	31,504
Ber	50	539	52	539
Lime/lemon	305	3,482	317	3,717
Mandarin	469	6,243	480	6,368
Sweet orange (mosambi)	187	3,266	190	3,483
Custard apple	40	339	41	347
Grapes	140	3,041	140	3,125
Guava	276	4,253	287	4,304
Jackfruit	185	1,764	189	1,835
Kiwi	5	13	5	13
Litchi	96	721	96	730
Mango	2,296	21,378	2,291	20,444
Muskmelon	57	1,266	59	1,330
Papaya	149	6,050	142	6,011
Passion fruit	12	81	12	76
Peach	19	118	19	125
Pear	42	300	42	306
Pecan nuts	1	0	1	0
Pineapple	104	1,711	107	1,799
Plum	23	85	19	77
Pomegranate	253	2,915	261	2,315
Sapota	89	1,059	83	1,003
Strawberry	1	5	1	8
Walnut	108	299	107	296
Watermelon	100	2,495	110	2,787
Others	248	2,298	255	2,268
Total	6,531	97,554	6,597	98,660

Source: National Horticulture Board Database (2020).

Table 2.2 Area and production of vegetable crops in India

	2018-19		2019-20	
	Area (*1,000 ha)	Production (*1,000 t)	Area (*1,000 ha)	Production (*1,000 t)
Beans	236	2,356	215	2,080
Bitter gourd	99	1,205	101	1,214
Bottle gourd	187	3,011	181	2,977
Eggplant	727	12,680	736	12,777
Cabbage	400	9,127	397	9,207
Capsicum	34	497	33	514
Carrot	109	1,893	104	1,838
Cauliflower	465	9,083	458	8,840
Cucumber	105	1,588	104	1,603
Chilies (green)	377	3,783	364	3,851
Elephant foot yam	33	817	32	808
Mushroom	0	182		201
Okra/ladyfinger	513	6,176	519	6,371
Onion	1,220	22,819	1,434	26,738
Pointed gourd (parwal)	55	757	56	760
Peas	552	5,562	563	5,703
Potato	2,173	50,190	2,158	51,300
Radish	200	3,143	204	3,107
Pumpkin (sitaphal/kaddu)	94	2,043	99	2,117
Sweet potato	110	1,156	116	1,186
Tapioca	163	4,976	164	5,043
Tomato	781	19,007	812	20,573
Others	1,441	21,118	1,504	22,962
Total	10,074	183,169	10,354	188,796

Source: National Horticulture Board Database (2020).

In addition to the absolute numbers of production, we are also interested in the production changes for fruit and vegetables in India during the last decade as well as the productivity (yield per ha) changes in the same period. For this, we use FAOSTAT as the data source. Fruit production has increased from 76 million t in 2010 to 104 million t in 2019 with a 10-year growth rate of 36.3%. In the same period, fruit productivity has grown from 11.8 t/ha to 14.7 t/ha with a 10-year growth rate of 25%. Vegetable production has increased from 99 million t in 2010 to 132 million t in 2019 with a 10-year growth rate of 32.9%. In the same period, vegetable productivity has grown from 13.8 t/ha to 15.6 t/ha with a 10-year growth rate of 12.6%.

It is clear that the growth rates for fruit and vegetable production are larger than the growth rates for fruit and vegetable productivity. This indicates that the increase in fruit and vegetable production is largely due to land expansion, the extent of which is higher for vegetables than for fruits.

2.2.3 Production areas by state

The state of Uttar Pradesh produces the most horticulture crops in India, accounting for 12.6% of the country's total production, followed by West Bengal and Madhya Pradesh at 10.4% and 8.5% respectively.

Total fruit production is highest in Andhra Pradesh at 15.2 million t, followed by Maharashtra at 11.7 million t). In India, mango is termed the king of fruits. Both the total production and planting area for mango is much larger than other fruits. For example, mango is 3.6 times larger than papaya which is the second largest fruit produced in India. India's main fruits within the major producing states are provided in Table 2.3 below.

Table 2.3 State wise distribution of area and production of India's most important fruits

Sr. No.	Commodity	State	Production ('000 t)	Production in proportion to country total (%)	Production area ('000 ha)	Production area in proportion to country total (%)
1	Apples	Jammu & Kashmir	1,808	77	159	53
		Himachal Pradesh	447	19	113	38
		Uttarakhand	59	3	25	8
2	Guava	Uttar Pradesh	928	23	50	17
		Madhya Pradesh	687	17	35	12
		Bihar	428	11	28	9
		Andhra Pradesh	227	6	10	3
		West Bengal	215	5	16	5
3	Grapes	Maharashtra	2,286	78	106	76
		Karnataka	524	19	27	19
		Tamil Nadu	59	2	2	1
4	Litchi	Bihar	234	40	31	37
		West Bengal	94	16	9	11
		Jharkhand	58	10	5	6
		Assam	48	8	5	6
5	Lime/lemon	Gujarat	606	19	46	16
		Andhra Pradesh	562	18	35	12
		Madhya Pradesh	307	10	20	7
		Karnataka	306	10	13	5
6	Mangoes	Uttar Pradesh	4,552	21	266	12
		Andhra Pradesh	4,374	20	363	16
		Bihar	2,443	11	149	7
		Karnataka	1,761	8	183	8
7	Mandarin	Madhya Pradesh	2,104	41	121	28
		Punjab	1208	24	52	12
		Maharashtra	797	16	107	25
		Rajasthan	318	6	23	5
8	Orange	Andhra Pradesh	2003	61	83	45
		Maharashtra	685	21	55	30
		Telangana	369	8	25	14
		Madhya Pradesh	112	3	6	3
9	Papaya	Andhra Pradesh	1,687	28	18	13
		Gujarat	1,257	21	20	15
		Karnataka	594	10	9	6
		Madhya Pradesh	422	7	11	8
		Maharashtra	408	7	10	7
10	Pineapple	West Bengal	345	20	11	11
		Assam	297	17	16	16
		Karnataka	164	10	3	3
		Meghalaya	145	9	12	12
11	Pomegranate	Maharashtra	1,789	63	148	63
		Gujarat	462	16	31	13
		Karnataka	268	9	26	11
		Andhra Pradesh	139	5	9	4
12	Sapota	Gujarat	326	28	30	31
		Karnataka	315	17	25	26
		Tamil Nadu	170	14	7	7

Source: National Horticulture Board Database (2020).

During 2017-18 the area for growing vegetables was 18.17 million ha with a yield of 349.68 million t in India. For this period, the total vegetable production was highest in Uttar Pradesh (283.16 million t) followed by West Bengal (276 million t) (see Table 2.4 below). Onion is the largest grown vegetable in India in terms of both production quantities and growing areas which are much larger than other crops.

Table 2.4 State wise distribution of area and production of important vegetables

Sr. no.	Commodity	State	Production ('000 t)	Production in proportion to country total (%)	Production area ('000 ha)	Production area in proportion to country total (%)
1	Eggplant	West Bengal	3,028	24	163	22
		Odisha	2,013	16	118	16
		Gujrat	1,423	11	71	10
		Bihar	1,242	10	58	8
2	Cabbage	West Bengal	2,289	25	79	20
		Odisha	1,058	12	38	10
		Madhya Pradesh	687	8	30	8
		Bihar	673	7	38	10
3	Carrot	Haryana	446	27	27	28
		Punjab	197	12	9	9
		Uttar Pradesh	161	10	6	6
		Bihar	148	9	14	14
4	Cauliflower	West Bengal	1,939	22	74	16
		Madhya Pradesh	1,008	12	46	10
		Bihar	936	11	62	14
		Haryana	699	8	40	9
5	Cucumber	Haryana	274	22	17	21
		Madhya Pradesh	155	12	9	11
		Karnataka	132	10	8	10
		Andhra Pradesh	99	8	4	5
6	Okra	Gujarat	921	16	75	14
		West Bengal	915	15	78	15
		Bihar	787	13	57	11
		Madhya Pradesh	639	11	44	9
7	Onion	Maharashtra	8,554	37	508	40
		Madhya Pradesh	3,701	16	151	12
		Karnataka	2,987	13	195	15
		Bihar	1,411	6	54	4
8	Peas	Uttar Pradesh	2,511	46	221	41
		Madhya Pradesh	962	18	95	18
		Punjab	394	7	38	7
		Jharkhand	347	6	16	3
		Himachal Pradesh	295	5	24	4
9	Tomato	Andhra Pradesh	2,732	14	62	8
		Madhya Pradesh	2,419	12	85	11
		Karnataka	2,082	11	64	8
		Gujarat	1,357	7	47	6

Source: Compiled from various reports from the National Horticulture Board and Ministry of Agriculture & Farmers Welfare, GoI-2017-18.

2.2.4 Export market

The vast production base for fruits and vegetables offers India opportunities for export. According to FAOSTAT, in 2019, India exported fruits and vegetables worth US\$2.09 billion, comprising fruits worth US\$1.03 billion and vegetables worth US\$1.06 billion. Grapes, pomegranates, mangoes, bananas and oranges account for a larger portion of fruits exported from the country while onions, mixed vegetables, potatoes, tomatoes and green chili contribute largely to the vegetable export basket. The major destinations for Indian fruits and vegetables are Bangladesh, United Arab Emirates, the Netherlands, Nepal, Malaysia, the United Kingdom, Sri Lanka, Oman and Qatar.¹

There is increasing acceptance of Indian horticulture produce. This has occurred due to developments in cold chain infrastructure and quality assurance measures. Apart from investment by the private sector, the public sector has also taken initiatives. With the Agricultural and Processed Food Products Export Development Authority (APEDA) assistance, several centers for perishable cargoes and integrated post-harvest handling facilities have been established in the country. Capacity building initiatives at the farmer, processor and exporter level have also been made.

2.2.5 Gender and women's roles

Like in other low- and middle-income countries, women play a key role in agriculture and especially in production. Based on the literature and interviews, women involved in the fruit and vegetable sector seem at first glance to have few opportunities to move beyond largely subsistence-based agriculture given the multiple barriers they face. Time remains a major constraint given their existing workloads. Social stigma regarding their contribution to income generation and business acumen is another, and employed women consistently report earning less than their male counterparts. There are nevertheless a number of examples of women bucking this trend to establish micro-, medium- and large-scale businesses, and becoming recognized for their contribution to household income. The noteworthy insight is that, once women gain this recognition, the stigma that previously held them back can shift to become the wind in their sails (or sales) as they are promoted as pioneers. Of the women that have been able to overcome gender-based barriers, only a few have done so without external support. For the majority, barriers to entry have been lowered through a number of national or state public policy programs.

These findings portray the situation of women in rural India with less access to education. For women with higher education, access to credit and based in urban areas these barriers may still exist but are relatively low; the evidence shows that these women can, and do, establish and scale up agribusinesses in the formal sector. For lower-educated, rural-based women, opportunities for starting and scaling up in- and semi-formal agribusiness are typically only available through self-help groups and producer groups.

In terms of nutrition, there are a similar variety of publicly funded programs targeting women and girls, which aim to overcome the various social barriers they face gaining access to a balanced diet.

¹ http://apeda.gov.in/apedawebwebsite/six_head_product/FFV.htm

3 Identified research questions

3.1 Introduction

The criteria for the selection of fruit and vegetable value chains for this scoping study is based on the information drawn from existing sources of literature and data to reach a conclusion on the best choices for value chains in the four states. Two approaches were followed: an “absolute approach” and a “relative approach”. An “absolute approach” indicates that the chosen chain must comply with the minimum requirements. Using a “relative approach”, the value chain with the highest ranking across a set of criteria is selected. The rationale for the selection of these crops is based on:

- Dominant crops based on data as presented in the National Horticulture Statistics Report (NHB, 2018), and its contribution to food and livelihood security of local communities particularly small and marginal farmers both male and female.
- Existing market demand (Pandit and Kumari, 2020) for a given or improved product and nutritional values (Sachdeva et al., 2013).
- There is potential to apply/adopt available/improved knowledge and technology.
- Resources, capacities, infrastructure and raw materials are available and can be used more efficiently.
- The potential to benefit women.
- Agroecological suitability with respect to resilience to climate change.

Relative approach: Ranking of crops in states based on the weighted scores of respective crops as per detailed analysis.

The final selection of the states is based on the suggestions from BMGF.

3.2 Selection of fruit and vegetable supply systems for the different crops in the selected states

Since India is a large country, four states were selected for this study based on BMGF’s suggestions, Andhra Pradesh, Bihar, Odisha and Uttar Pradesh. Seven fruit and vegetable products including mango, litchi, orange, eggplant, pea, tomato and onion were chosen for in-depth analysis in this research. The details for selected food supply systems by state and crop are presented in the tables below with the corresponding rationale behind the selection.

Table 3.1 Andhra Pradesh

Selected crop	Rationale
Orange	<ul style="list-style-type: none"> Andhra Pradesh is top-ranked among the orange producing states (<i>Horticulture Statistics at a Glance-2018 -Government of India</i>). Contributes >60% of national orange production. Women's participation is 30-40% (Tripathi, 2012) particularly in intercultural operations such as weeding, picking, assembling, grading and in marketing. Women have a limited role in decision-making processes but a stronger part in influencing decisions. Nutrition value: Oranges are a good source of several vitamins and minerals, especially vitamin C and thiamine (National Institute of Nutrition, 2017). Maximum demand in southern states. Potential for processing (RBI, 2020; Tiwari et al., 2015).
Tomato	<ul style="list-style-type: none"> Andhra Pradesh is top-ranked among the tomato producing states (<i>Horticulture Statistics at a Glance-2018 -Government of India</i>). Contributes >14% of national tomato production. Women's participation is >70% particularly in transplantation, intercultural operations such as weeding, picking, assembling, grading and in marketing. Women also have a limited role in decision-making processes but a stronger part in influencing decisions. In high demand and growing (APEDA, 2013). Nutrition value: Rich in vitamins A and C (National Institute of Nutrition 2017). Tomatoes are the major dietary source of the antioxidant lycopene, which has been linked to many health benefits, including reduced risk of heart disease and cancer. (Burton-Freeman and Reimers, 2011).

Table 3.2 Bihar

Selected crop	Rationale
Litchi (lychee)	<ul style="list-style-type: none"> Bihar is top-ranked among the litchi producing states (<i>Horticulture Statistics at a Glance-2018 - Government of India</i>). Contributes >60% of national litchi production. Women's participation is 40-50% particularly in picking, assembling, grading and in marketing. Women have a limited role in decision-making processes. Opportunities for small-scale beekeepers to keep honey boxes in litchi orchards as there is a huge demand for litchi honey (GAPL, 2020). Major demand in northern India. Nutrition value: Litchis are known for their antioxidant properties and show anticancer and immunomodulatory activities. Litchis are also known for their vitamin C and potassium content (Zhao et al., 2020).
Onion	<ul style="list-style-type: none"> Bihar ranks the fourth among onion producing states (<i>Horticulture Statistics at a Glance-2018 - Government of India</i>). Contributes >13% of national onion production. Women participation is >70% particularly in weeding, picking, assembling, grading and marketing. Women also have a limited role in decision-making processes but a fairly better part in influencing decisions. Nutrition value: Onions are excellent sources of vitamin C, antioxidants and phenolic substances. Experimental studies have shown that the consumption of onion reduces blood pressure and protects against certain cancers (Bystrická et al., 2013). Very high domestic demand as it is an essential part of daily meals of both urban and rural population. Potential government support for summer varieties.

Table 3.3 Odisha

Selected crop	Rationale
Eggplant	<ul style="list-style-type: none"> • Eggplant is a very low-calorie vegetable. It is popularly known as aubergine in the western world. It is a perennial plant native to the Indian subcontinent and grown in many tropical and semitropical regions as a popular vegetable all around the year. • Odisha ranks the second among eggplant producing states (<i>Horticulture Statistics at a Glance-2018 -Government of India</i>). • Contributes >16% of national eggplant production. • Women's participation is >80% particularly in inter-culture operations such as weeding, picking, assembling, grading and in marketing. Women have a limited role in decision-making processes but a stronger part in influencing decisions. • Nutrition value: Eggplants are a great source of thiamine and vitamin B2 (National Institute of Nutrition, 2017). Eggplant has antioxidant health benefits reducing the risk of chronic diseases, especially cancer. • Year-round demand in the state due to consumption patterns, particularly in rural areas.

Table 3.4 Uttar Pradesh

Selected crop	Rationale
Mango	<ul style="list-style-type: none"> • Uttar Pradesh is top-ranked among mango producing states (<i>Horticulture Statistics at a Glance-2018 -Government of India</i>). • Contributes >60% of national mango production. • Women's participation is <40% particularly in picking, assembling, grading and in marketing. Women are also involved in making mango pickle which is consumed by rural households throughout the year. Women are also involved in processing and marketing activities and have a limited role in decision-making processes. • Domestic demand is high (APEDA 2015). • Nutrition value: High in the antioxidants beta-carotene and vitamin C and A (National Institute of Nutrition, 2017), and polyphenolic compounds working mainly as antioxidant, with the potential to protect against heart disease and cancer (Masibo and He 2008). • Consumed both in raw and processed form. • Government support for high-density plantation (MIDH, 2014).
Fresh peas	<ul style="list-style-type: none"> • Uttar Pradesh is top-ranked among fresh pea producing states and contributes >45% of national fresh pea production (<i>Horticulture Statistics at a Glance-2018 -Government of India</i>). • Women's participation is 70- 80% particularly in inter-culture operations such as weeding, picking, assembling, grading and in marketing. Women also have a limited role in decision-making processes but a stronger part in influencing decisions. • Nutrition value: Peas are a good source of vitamins B1, B6, C and niacin (National Institute of Nutrition, 2017). Peas are also known for their antioxidant and anticarcinogenic activity (Dahl, Foster, and Tyler 2012). • Government support for commercial-hybrid green pea varieties in India (MIDH, 2014). • Higher demand in IQF² units (RBI, 2020; MoFPI, 2020) and higher participation of women.

3.3 Research questions

In Phase I of this study various leverage points, assumptions and associated research questions were identified that have served as guidance during this country case study. For each question we used a mix of literature research and primary data collection using focus group discussions and key informant interviews. Leverage points, assumptions and related research questions are shown in Table 3.5.

² Individual Quick Freezing.

Table 3.5 *Leverage points and related research questions*

Leverage point	Assumptions	Guiding research question Phase II
Production	Increase in production leads to lower fruit and vegetable consumer prices.	<p>How does seasonal variation in weather influence fruit and vegetable production, yields and market prices (disaggregated by fruit and vegetables category)?</p> <p>What are the main causes and volumes of production losses, and where do they occur?</p> <p>What are the main barriers for farmers to increase the production of fruits and vegetables?</p> <p>What keeps farmers from intensification? Do female producers face greater barriers than male producers, and are there examples that have lowered these?</p> <p>Are quality inputs and services accessible and is the enabling environment supportive to intensification?</p> <p>Does the intensification of fruits and vegetables offer additional opportunities for women? Does it overburden women? How do women balance working on fruit and vegetable production with household tasks? Are the latter 're-negotiated' or mitigated by other strategies?</p>
Cost price	Reduction in cost price will make fruit and vegetable production more profitable to smallholders.	<p>How much are the production costs and can we compare them across the seven countries?</p> <p>What happens to the farm gate price when costs are reduced?</p> <p>What happens to the income of farmers when farm gate prices are lower?</p>
Fruit and vegetables supply chain efficiency	More efficient fruit and vegetable supply chains can lead to lower fruit and vegetable consumer prices.	<p>Does fruit and vegetable supply chain efficiency result in lower farm gate prices and/or consumer prices? Data on prices: farmgate and consumer prices. What are the risks, costs and types of coordination for the key fruit and vegetable categories? How can more efficiency be achieved and are there examples of such enhanced efficiencies?</p>
	More secure fruit and vegetables markets increase fruit and vegetable supply efficiency and farmers' incomes, and reduce wastage.	<p>Are there examples that more secured markets (more formal) are beneficial to smallholder farmers?</p> <p>How should farmers benefit from such arrangements?</p>
Communication	Intermediary actors communicate consumer needs to producers and jointly develop innovative food products.	<p>How do traders and processors (male and female) connect to consumers? Are they organized to support each other? Do they impose standards on producers?</p> <p>What examples are there of women succeeding? Are these exceptions or at scale in the different levels of the food value chain?</p> <p>Are there examples of traders and processors (male and female) that are capable of responding to consumer needs by developing innovative food products?</p> <p>What are conducive conditions for information sharing and what is the role of trust (as social construction of exclusivity)?</p>
Diversity	Increasing the volume and diversity of fruit and vegetables crops produced and traded leads to more diverse fruit and vegetables in the food environment.	<p>Has the introduction of new fruit and vegetables varieties contributed to more fruits and vegetables consumed?</p> <p>What are the trends in fruit and vegetable consumption, are these dependent on season and geographical location (production/non-production areas)? Can these trends be disaggregated by different types of fruits and vegetables?</p>
Consumer prices	Fruit and vegetable prices are always higher than other food categories.	<p>Why are consumer prices of fruits and vegetables higher than other domestically produced food crops? Are there differences between categories of fruit and vegetables and what explains these differences?</p>

Leverage point	Assumptions	Guiding research question Phase II
Women's participation	Women's participation in fruit and vegetable production and supply chain operations leads to higher income and empowerment for women.	Are there examples of successful integration of women in profitable fruit and vegetable production and supply chain operations? What explains these successes and is there evidence of them being scaled up? What business models work best for women's inclusion and leadership?
	Higher incomes for women lead to increased fruit and vegetable consumption.	If fruit and vegetables become more commercial or scaled up will the income be controlled by women?
Consumer participation	Public enforcement of standards will enhance food safety for fruit and vegetable consumers.	Inventory of relevant standards (public/private). How are they enforced? Do consumers trust standards? How are they appreciated by other stakeholders in the food system?
	Nudging and public extension will improve fruit and vegetable consumer awareness and consumption preferences.	Are there specific policies and strategies formulated and implemented for improving diet quality among different consumer categories and do they include strategies on fruits and vegetables? Is there evidence of their impact? How have policies enabled women to address systemic constraints that they face, and to successfully access sufficient nutrition? Who is implementing the inventory of innovative examples? Are consumers motives being taken into account?
	Increased food safety, consumer awareness and responses to consumer preferences lead to higher acceptability of fruits and vegetables.	What are consumers' motives and barriers to consuming specific fruits and vegetables such as indigenous vegetables, for different household members?
	Improved availability, affordability and acceptability leads to fruit and vegetable intake that meets the recommendations.	If everything is as planned (available, affordable, acceptable) will consumers increase fruit and vegetable intake in their diet according to the recommendations?

4 Research results

4.1 Introduction of the selected fruit and vegetable supply systems

4.1.1 Value chain actors

The major value chain actors are input suppliers, producers, aggregator/pre-harvest contractors, transporters, wholesalers, traders/middlemen/commission agents, processors, retailers and consumers.

Input suppliers are the first actor in the fruit and vegetable supply chain to provide inputs (e.g., seeds and fertilizers) for producers. Producers are the main value chain actors who cultivate and produce fruit and vegetables on farms. There are different types of producers co-existing but most are smallholder farmers. Small and marginal farmers with less than 2 ha of land account for 86.1% of all farmers in India according to provisional numbers from the 10th Agriculture Census 2015-16. In comparison, semi-medium and medium land holding farmers owning between 2-10 ha of land account for 13.4% of all farmers and large farmers account for 0.6%. Overall, the Census showed that Indian farms became more fragmented between 2010 and 2016. The details for different types of farmers in India and the four targeted states in 2015-16 are summarized in Table 4.1 below. It can be seen that all four states have a higher proportion of small and marginal farmers than the national averages. State-wise data from the Census showed that Uttar Pradesh accounted for the largest number of operational holdings or farmers at 22.1 million, followed by Bihar (15.9 million farmers), Andhra Pradesh (7.5 million farmers) and Odisha (4.5 million farmers).

Table 4.1 Proportion of farmers according to size of holding in selected states

Classification of farmers	Andhra Pradesh	Bihar	Odisha	Uttar Pradesh	India
Total farmers (number in '000)	8,524	16,425	4,866	23,822	146,452
Small and marginal (number in '000)	7,550	15,915	4,524	22,108	126,060
Percentage (%)	88.57	96.89	92.97	92.80	86.08
Medium (number in '000)	959	495	338	1691	19554
Percentage (%)	11.25	3.01	6.95	7.10	13.35
Large (number in '000)	15	15	4	23	838
Percentage (%)	0.18	0.09	0.08	0.10	0.57
Average size of holding (ha)	0.94	0.39	0.95	0.85	1.08

Source: Compiled from Agriculture Census 2015-16 Phase-I.

In addition to the relatively old data from the Agriculture Census 2015-16, an estimation for the current situation is also made based on expert opinions and the local consultants' knowledge. The numbers by farm type are listed below:

- Smallholder mixed fruit or vegetable farming with irrigation: 44%
- Smallholder mixed fruit or vegetable farming without irrigation: 42%
- Smallholder specialized fruit or vegetable farming: <4%
- Medium-large specialized fruit or vegetable farming: 10-11%
- Export farming: <1%

Transporters carry the produce to the market or Agricultural Produce Market Committee (APMC). Transporters play a crucial role in maintaining the shelf life of the produce. Traders are the middlemen or commission agents in the market where they procure the products from the farmers at 7%

commission. Traders play an important role in grading and sorting the products. Then they resell the products to the wholesalers, retailers and consumers. They also use their financial resources and their local knowledge to procure bulk products from the surrounding area. Wholesalers are known for the purchase of bulky products with better financial and information capacity. They are major actors in the channel, and they purchase products either directly from the farmers or local collectors. They procure and consign large fruits and vegetables that are produced in remote villages but consumed in semi-urban and urban areas in addition to the local areas where they are produced. Different agencies and functionaries are involved in marketing between producers and consumers.

Several key challenges in the upstream, midstream and downstream chains exist. First, at the upstream level (farm production segment) of the value chain, the numerous, widely dispersed and unorganized small farms that dominate the fruit and vegetable production are characterized by poor production systems and low productivity. At the midstream level (processing), food processors lack reliable supply of quality fruits and vegetables from farms. They generally find it difficult to deal with numerous and widely dispersed small farm producers. The majority of food processors are informal and largely unorganized small and medium-sized enterprises (SMEs), which impedes specialization and agglomeration. SMEs use antiquated equipment because of the lack of access to finance, do not meet the international standards for food safety and quality, and are not linked effectively to the urban domestic and foreign markets as well as large agro-processors. Finally, at the downstream level (marketing and distribution), there are no dedicated regional trade hubs and logistics platforms for perishable products such as fruits and vegetables. Logistics infrastructure (e.g., refrigerated storage) and services (e.g., trucking, freight forwarders, etc.) for transit of exportable food-related products are generally inadequate for perishable products. Facilities in the domestic markets (bazaars) are unsanitary and lack appropriate logistics facilities and services for perishable products. These logistics bottlenecks, exacerbated by unreliable supply, have increased transaction costs of transporting products and inputs of the agrofood sector.

Although challenges are still significant, it has been recently observed in India that modern supply chains are growing and getting longer as most of the farmers' outputs go to urban areas and as food systems expand and lengthen, particularly due to urbanization. The midstream has transformed quickly with a huge volume expansion. It has been observed not only by a proliferation of small and medium enterprises (SMEs) but also a sign of concentration and multi-nationalization with technology upgrades and incipient emergence of branding, labelling and packaging. There are also new organizational arrangements in procurement and marketing interfaces with farmers and retailers. On the one hand, large processors reduce transaction costs for modern retailers by facilitating disintermediation and delivering directly to the distribution centers or retailers' stores. Large processors can adapt packaging and variety to the needs of the retailers and their inventory management systems reduce the chance of retail stock-out. On the other hand, modern retailers facilitate the development of market size and scope economies for large processors. Supermarkets tend to carry a limited set of brands per product category, and these tend to be mainly from medium and large processors, and a smattering of small company brands for non-commodity products. Modern retailers develop markets for processed products as they tend to sell them cheaper than traditional stores once procurement systems are modernized for India (Minten et al., 2010). Additionally, large processors and supermarket chains provide the initial key markets for modern wholesalers (the 'dedicated wholesalers') and modern logistics firms. These firms are competing with traditional wholesalers to serve the modern retailers and processors and do so by offering often better transport services (with modern cross-docking and refrigerated vehicles), warehousing management, and services not usually found in the traditional distribution segments. Such services include operating packing houses, packaging, ICT systems and cold chains, and managing contract farming, merchandise inventory and international networks. In addition to the commercial actors, there are also NGOs in India to facilitate the development of India's fruits and vegetable sectors. A list of active relevant NGOs was identified and listed in 4.2.

Table 4.2 A list of active NGOs in India (Details annexed in Annexure-I)

❖	CARE India
❖	Bill and Melinda Gates Foundation (BGMF)
❖	SHARE & CARE FOUNDATION
❖	Aga Khan Foundation
❖	VAAGDHAR
❖	Tata Trust
❖	Adarsh Mahila Griha Udyog
❖	Dharma Bharati Mission
❖	Sammaan Foundation
❖	The Akshaya Patra Foundation (TAPF)
❖	LEPRA Society
❖	CREA
❖	MAKAAM
❖	Shikshan Ane Samaj Kalyan Kendra (SSKK)
❖	The Self-Employed Women's Association (SEWA)
❖	AZAD Foundation
❖	SNEHALAYA
❖	SWANTI
❖	SAFETY
❖	VIMACHANA
❖	GURIA
❖	Action Aid India
❖	MITTI KE RANG
❖	Manav Vikas Seva Sangh (MVSS)
❖	Seven Sisters Development Assistance (SeSTA)
❖	Ashadeep Mission
❖	MAITRI
❖	APANALAYA
❖	PRADAN
❖	BAIF
❖	Syngenta Foundation, India

4.1.2 Description of major actors

It is difficult to obtain data on the numbers of different actors in the Indian fruit and vegetable supply chains. Instead, in this sub-section, rough descriptions of the major actors as well as their importance are provided.

Farmers: Producers are involved in all the pre-production-related activities and play a major role in Indian society. Responsibility and commitment go way beyond their farms to ensure a nutritious and healthy diet for Indian people. Since 72% of the Indian population lives in rural areas and relies on agriculture for their livelihood, it is of high importance to help farmers, especially the smallholders, to develop their business.

Aggregator/pre-harvest contractor: Aggregators collect the produce from the farmers and take it to the market yard. Pre-harvest contractors are a special type of aggregator. Pre-harvest contractors operate in the Uttar Pradesh, Bihar and Odisha regions for mango and litchi crops. Each contractor leases around 50-100 acres of orchards from farmers for the duration of 1-3 years. When an orchard is leased to the contractor for more than a year, the price is fixed every year at the time of fruit setting. The cost of maintenance is also borne by the farmer. As the contractors are the interface between the farmer and other stakeholders in the chain, they play an important role in the value chain. When fruits attain maturity, the contractors hire local laborers for plucking, pooling, grading and packaging, and its cost is borne by the contractor. Pre-harvest contractors, who handle relatively fewer volumes (50-70 t), operate in the local market. Contractors who deal with larger volumes (150-200 t) have strong linkages with commission agents from distant markets, local wholesalers within the state, processing units and packhouses. The contractors send the product directly to them in trucks. The cost of interstate transportation, as well as commission at outstation markets, is borne by the contractor. Therefore, the existence of pre-harvest contractors can reduce the risk faced by smallholder farmers.

Input suppliers: Input suppliers supply appropriate improved seeds and inputs to farmers. Interviewed farmers reported long and stable cooperation with input suppliers and the majority of them do not plan to change their dealers. It is also interesting that the relation between farmer and input supplier is usually not formal, over 90% of farmers do not have any written contract. There are significant differences in the farms' characteristics, obtained discounts and possibilities of price negotiations, depending on the channel of the input supply. Farmers reported that the dealers give them inputs on credit, and they pay the dealer after the harvest. Therefore, farmers are satisfied with the relationship they have with their dealer.

Forwarding agents: A large number of forwarding agents exist in Indian fruit and vegetable value chains. A forwarding agent performs the function of collecting produce from small growers who may not have a full load of produce as an individual. Forwarding agents in producing areas facilitate the small farmers by arranging trucks or vans to forward their produce to desired destinations and charge a fee as a return.

Commission agent: Commission agents, also known as Arthias provide two major services to the farmer: firstly, they provide credit to farmers at the time of sowing of a particular crop, and secondly, they act as the sale agents for the farmers and facilitate the sale of the harvested crop in the market. They also provide credit to contractors, who in turn provide advance payment to farmers. Since they bear the financial risk as well as facilitate trade between contractor and wholesaler, they charge a commission of 6-8%.

Wholesaler: Wholesalers play an important role in the distribution of products to various locations in the country. Wholesalers deal with large volumes of produce, and own the title of produce after buying, thus bearing the marketing risk.

Mashakhori: A mashakhori acts as a sub-wholesaler who buys the produce either through the commission agent or wholesaler and sells to retailers and consumers. He usually sells at least a full box/bag/pack and settles the price by negotiation. This intermediary is only observed in APMC markets in Delhi where this practice is common.

Retailers: The retailer is an important functionary, usually licensed, who undertakes the job to cater to the needs of the consumer. The traditional retailers keep small quantities of fruits and vegetables, and procure from wholesalers on a daily basis. They own the risk of spoilage and wastage, and price fluctuations. Recently, retailers have started taking orders on mobile phones to facilitate consumers through home delivery. As opposed to traditional retailers, organized retailers are modern and it is assumed that they are able to pass on the reduced prices to their customers. Since India is a price-sensitive market, this certainly helps them pick up sales. However, the organized retailers also depend mainly on APMC markets to source the bulk stocks of fruits and vegetables. Moreover, the penetration rate for organized food retailers in India is expected to be only 6% in 2021.³

4.1.3 The main types of value chains

Marketing channels have a great influence on the costs of the products which include transport, service charges and market margins received by intermediaries such as pre-harvest contractors, forward agents, commission agents, wholesalers and retailers. Thus, the price to be paid by consumers and the share of it received by the farmers is determined by the market channel involved. A channel is considered good or efficient if it makes the products available to the consumers at the cheapest price and ensures the highest share to the producers.

The main types of fruit and vegetable value chains in India, based on expert estimation, FGDs and interviews, are the informal value chains which account for about 78% of the product volume. The formal value chains' share is about 20% with very little contract farming (<1%) and direct selling (<1%).

³ Source: <https://www.statista.com/statistics/1043919/india-organized-food-and-grocery-retail-market-penetration-rate/>

Most of the farmers in India sell produce to the aggregators, who in turn takes it to the market (Mandi) where a wholesaler purchases it through commission agents. From the wholesaler, the produce goes to retailers and finally to consumers. In other cases, procurement from farmers is done either by the pre-harvest contractor or the commission agent. These two intermediaries sell the produce at the local market yard or 'mandi' after undertaking some preliminary sorting and grading where it is auctioned to the highest bidder. It is generally purchased by a wholesaler, who undertakes further sorting, grading, and packing as required and sells it to retailers or processors. In some cases, the processors or exporters buy directly from the producers through agents and do the sorting and grading at the factory. Increasingly, growers are getting together to form co-operatives or producer companies and market their products directly to processors or exporters. The marketing channel for fruits and vegetables depends upon various factors such as distance between producer and consumer and the nature of the market.

Taking the mango value chains in Uttar Pradesh and Odisha for example, many processors/exporters purchase mangos from farmers either directly or through forwarding agents. The products are brought to the processing centers where after sorting, grading and packing, the products are either processed in the factory or transported to a foreign country to be sold to the consumers by retailers. Some pre-harvest contractors purchase the products directly from the farm and sell to commission agents in the market (Mandi) where it is next sold to wholesalers and then to consumers via retailers. Most farmer cooperatives and Farmer Producer Companies (FPC) procure the products directly from their members and prefer to sell their produce to processing factories or export it themselves to foreign markets.

4.1.4 Consumers

India is one of the largest fruit and vegetable producing countries in the world, but Indians are still relatively lacking adequate intake of horticultural products, which just merely reaches the minimum level of daily intake suggested by WHO. Though availability is an issue due to barriers in the supply chains, the lower intake of fruits and vegetables is also largely determined by the dietary choice of individuals in India which is skewed towards cereals. In a largely vegetarian country, vegetables account for only 9% of the total calorie intake in the country (Mukherjee et al., 2015). Consumption patterns, however, vary from region to region with people living in south Indian cities consuming more fruits and vegetables than those in the north. Fruit and vegetable consumption is abysmally low among middle-and high-income groups in urban India, according to a survey conducted by the Indian Council for Research on International Economic Relations (ICRIER) in five Indian cities NCR (New Delhi, Delhi; Gurgaon, Haryana and Noida, Uttar Pradesh), Mumbai (Maharashtra), Chennai (Tamil Nadu), Hyderabad (Telangana) and Kolkata (West Bengal) (Mukherjee et al., 2015). The survey shows that younger generations are consuming even less nutritious food than older people, primarily due to lifestyle choices. Indian consumers across all income groups are consuming less than the 'recommended' quantity of at least 400 g (or five daily servings with an average serving size of 80 g) of fruits and vegetables per day. As per the study (Mukherjee et al., 2015), the average fruit and vegetable intake is 3.5 servings per day, which comprises 1.5 servings of fruit and two servings of vegetables. The average intake of younger generations is even lower. For 18-25-year-olds, the average intake is 2.97 servings per day and for 18-35-year-olds, it is 3.3 servings per day. The average intake among students is extremely low at 2.94 servings per day. Housewives do better in terms of fruit and vegetable intake with an average intake of 3.65 servings compared to working persons — which is 3.5 servings per day. It has been reported (Choudhury et al., 2020), that household fruit and vegetable consumption is also higher where households are headed by females. It has been further stated that the distribution of fruit and vegetable consumption across caste categories shows that Scheduled Tribes, long-recognized as the most socio-economically disadvantaged group in India, consume fewer fruits and vegetables than others, particularly the 'Other/Upper' caste group.

Consumption and perceptions of fruit and vegetables at different moments and in diverse contexts diverge significantly across various segments such as fresh and processed fruits and vegetables for both snacks and main meals, and both domestically and outside of India. Fruit and vegetable consumption greatly differs across regions, across contexts in terms of both moment and location of consumption, and across consumer groups. Different consumption segments are targeted by different farming systems (4.3).

Table 4.3 *Consumer's segmentation vis-a-vis farming system*

Fruit and vegetable segment	Point of consumption	Where and to whom	Farming system
Domestic market fresh	Individuals, households, institutional buyers, hotels, restaurants, procurement agencies, cooperatives, FPOs and organized supply chains Retailers, wholesalers, and online and offline traders.	Local consumers, distant consumers within and out of state, online grocery shopping through own portals or through third party portals.	Quality produce from precision farming/protected cultivation such as greenhouses, net-house and hydroponics; fresh organic fruits and vegetables, and fresh off-season fruits and vegetables from open cultivation.
Domestic market processed	Processors, assemblers and procurement agencies.	Local and out of state processing units and industries.	Contract/corporate farming, cooperatives and FPOs.
Exports fresh	Traders and exporters.	International markets for fresh produce, and as raw material for processing industries.	Corporate farming.
Processed exports	Processors, traders and exporters.	International markets.	Contract/corporate farming.

4.1.5 The seed system

India is a country with a relatively mature seed sector among low-income countries, and within the seed sector vegetable seed is prominent and a driver for its development (Schreinemachers et al., 2021). A favorable enabling environment, including the existence of the Protection of Plant Varieties and Farmers' Rights Act 2001, has encouraged rapid development of the seed sector. The liberalization of the seed sector has made it relatively easy to bring new vegetable varieties to the market and when varieties are in the market, they are relatively well protected. The private sector involves a wide array of global, national and local seed companies. The value of the Indian vegetable seed industry is about US\$630 million and is predicted to grow rapidly in the coming years (Schreinemachers et al., 2021). Private seed companies invest heavily in research and development, and technological innovation, which is evident from the extensive company activity in the country. An indicator for this is that the age of varieties among both global and national companies is relatively low, illustrating the vitality and competitiveness of the industry. Seed companies cater to varied markets, with the global and national companies with premium hybrid varieties targeting commercial vegetable production. Some of them cater also to small-scale farmers, adapting the non-premium — and therefore less expensive — hybrid varieties and size of the packs. Where the global and national companies have their own breeding programs, local companies mostly depend on vegetable varieties from the public sector. The thriving private sector is complemented by a competent and relatively well-financed public sector engaged in varietal development and seed supply. Many of the Indian seed companies are active in the region as well as in other vegetable markets in Asia and Africa.

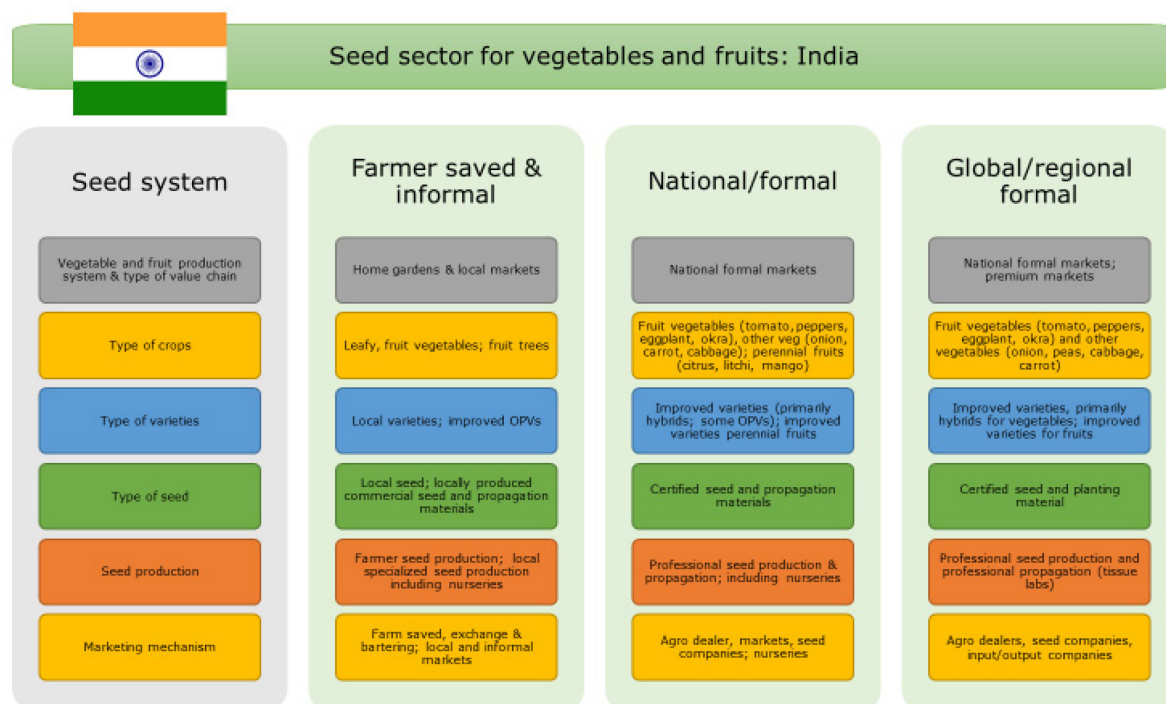


Figure 4.1 Seed sector for fruits and vegetables in India
Source: Authors' compilation, based on Louwaars et al. (2013).

For commercially less attractive vegetable crops and basically all fruit trees, national and state-level agricultural research institutes and universities are critical for varietal development. Subsequently, they engage in different types of public-private partnerships in to produce early generation seed for vegetables, tissue culture labs and other propagation schemes for perennials. It should be noted that this applies to those vegetable crops if hybrid seed varieties as technology are not available, or when reproduction systems and limited markets do not favor private sector investments. The public sector is responsible for the development of new varieties — mostly open-pollinated varieties (OPVs) for seed crops — which then through the private sector but also through NGOs and extension services to reach farmers. In those cases, research institutes and universities are linked for seed supply with more commercial seed value chain operators, such as local seed companies, tissue culture labs and nurseries, each with a distinct production and marketing system. In this manner, the seed sector provides a variety of commercial vegetable and fruit producers with quality seed and planting materials of improved varieties.

Farmers for home gardens or engaged in some informal marketing of vegetables and fruits use multiple seed sources. They may use farmer saved seed or planting material such as fruit trees, that originates from neighbors or informal markets or nurseries. For some vegetables, they may purchase small packs from regional or national companies. In this case, they typically opt for the quality seed that may be open-pollinated or hybrid varieties, basically depending on the investment they are willing and are able to make in purchasing vegetable seed. With a wide array of seed systems from farmer saved to global commercial seed systems, the Indian seed sector particularly for vegetables is well-developed, but the role of the continued public sector and informal seed systems remains highly pluralistic.

4.2 Increase in production and intensification

4.2.1 Seasonality and price volatility

Seasonality is a big issue faced by Indian farmers. While fruit and vegetable production is often seasonal and regional, consumption is year-round and across the country. Market prices of agricultural commodities therefore tend to be volatile. Among these agricultural commodities, fruits and vegetables display a much higher degree of intra-year volatility compared to others as the prices of fruits and vegetables appear to be driven mainly by demand-side factors. During a discussion with traders in the market, they highlighted that during the summer, the heatwaves that sweep through large swathes of India generally set vegetable prices on the boil with some parts of the country seeing a 25-40% rise in bills during this period. Traders also said that prices generally remain volatile during summers until monsoon rain covers the main growing areas in the country. However, even within the rainy period, the uneven spread of rainfall remains a risk for stable fruit and vegetable production, which in return hampers consumption. In the past it was observed that households responded to a sudden and dramatic increase in onion prices by reducing the quantity they consumed.

The seasonality situations for different fruit and vegetables products are presented below:

Vegetables

Eggplant is vulnerable to many pests and diseases. Eggplant production is extensively affected by the eggplant fruit and shoot borer (FSB). Eggplant, pea, tomato and onion are all sensitive to chilling temperatures. The water deficit impacts fruit splitting and results in lower yields. They are all perishable products but with different price volatilities. The price of eggplant is not volatile because it is available throughout the year. It is also considered one of the most important vegetables in India and consumed locally on regular basis. The price of peas is more fluctuating because it is known as the cash crop. It is mostly consumed fresh but also frozen and it is marketed locally as well as to distant markets throughout the year. The price volatility for tomatoes is also high due to the short shelf life of the products. Onions are consumed throughout the year both as onion and processed onion (dehydrated flakes, onion paste for cooking, etc.). Seasonal variation in weather seriously influences the production of onion and contributes to price fluctuations.

Fruits

Mangos are grown in almost all regions of the country. Temperature, rainfall, wind velocity and altitude are the major climatic factors that influence its growth and fruiting, and cause seasonality. The time distribution of rainfall rather than the amount of rainfall is a more important factor in determining the seasonality. Rainfall during the flowering stage generally has an adverse impact on the crop as it interferes with pollination. However, rainfall during fruit development is considered positive. Alternate bearing is a serious problem prevailing in many varieties; rhythm of 'On' (heavy crop) and 'Off' (lean or no crop) years occur consecutively. Commercial varieties from Uttar Pradesh, Dashehari, Langra, Chausa, Bombay Green and Lucknow Safeda are all alternate bearers. As a result, the profitability of mango orchards is affected. The characteristics of mango fruits make them normally ripen after harvest. Mango fruits are commercially harvested at their maturity stage before the onset of ripening to prevent damage and injury during handling and storage. Applying ethylene to mangos after harvest results in faster and more uniform ripening. Mango is also a high price-volatility fruit. The market price depends on the varieties and seasons as they are in high demand by far-away consumers and by international markets.

Litchi is one of the most environmentally sensitive fruit tree crops. It is adapted to the tropics and warm subtropics between 13° to 32°N and 6° to 29°S. The abnormal rains and high velocity of wind during 2020 affected litchi trees which resulted in less yields and production in Bihar. Yields vary widely with cultivars, seasons and irrigation conditions. Under irrigation, average yields have increased by 50% in Bihar as reported by farmers. The short span of fruit availability coupled with poor shelf life limits the duration of availability of litchi fruits. Their shelf life varies from 2-3 days under ambient conditions. With proper post-harvest treatment (pre-cooling, sulfuring, acidification and storage at a low temperature), the shelf life can be extended up to 2-3 weeks as reported during discussions with stakeholders. In Northern India, Litchi fruits mature in May and June. In South India, litchis are produced in the off-season for crop diversification and income enhancement for farmers. These litchi

trees flower from August to September, and the fruits mature in December and January. Because this is the off-season, farmers get higher prices during this period. Lichi is a high price-volatility fruit in high demand by medium- and high-income non-local consumers.

Oranges are grown across Indian states and have seasonality. Price variation is affected by a range of factors including transportation costs, regulatory barriers and the local market power of intermediaries or retailers. As these factors impede farmers to gain higher prices and consumers to buy low-price food, they decrease the overall welfare. In arid regions citrus trees are highly vulnerable to heat, leading to burning and defoliation of leaves, burning and death of bark, and slight discoloration of the fruit skin. The high seasonality of orange fruits results in high price volatility and wide price variations in different local markets throughout the year. It is also observed that the seasonal variations in one industry are transmitted to other related industries through supply and demand channels. This pattern reflects the synergies between the supply chain players. In general, decreased seasonal variations in prices indicate better supply management.

4.2.2 Barriers for farmers to increase production

Based on the literature and interviews, there are many barriers for farmers to increase the fruit and vegetable production. The major barriers for eggplants, peas, onions, tomatoes, mangoes, litchis and oranges are listed in Table 4.4.

Table 4.4 The main barriers for farmers to increase production by product

Eggplant	Peas	Onion	Tomato	Mango	Litchi	Orange
1. Unavailability of healthy seedlings.	1. Inadequate skill for seed treatment and non-availability of timely technical advice for crop cultivation.	1. High cost of onion seeds, fertilizers and pesticides.	1. Unavailability of improved seed and fertilizers at the time of sowing.	1. Initial investment towards traditional orchard (which are alternative bearers)	1. Initial investment towards orchard establishment.	1. Shortage of irrigation water during summer and lack of capital.
2. Resource limitations such as high production costs due to frequent and heavy use of insecticide spraying to kill destructive pests.	2. Non-availability of labor at the time of harvesting of crop.	2. Dependence on monsoon and water shortage in summer.	2. High cost of seed of high yielding varieties.	2. Lack of knowledge and affordability to adopt high density mango plantations.	2. Prone to insect pest attacks, biotic pressure and temperature and heat pressure.	2. High labor costs.
3. Lack of timely technical advice for crop cultivation.	3. Lack of water for irrigation.	3. Non-availability of labor at the time of harvesting.	3. Lack of proper knowledge about plant protection measures.	3. Forced to sell to pre-harvest contractor due to lack of financial resources and uncertainty of market.	3. Lack of access to water for irrigation results in low yields due to wide fluctuation in temperature.	3. Access to water for irrigation and modern drip irrigation systems.
4. Poor extension facilities.	4. High input costs.	4. Lack of post-harvest facilities.	4. Access to water for irrigation and modern drip irrigation systems.		4. Very short production period and highly perishable. Therefore, post-harvest losses are very high.	4. Poor extension facilities.
					5. Forced to sell to pre-harvest contractor due to lack of financial resources and uncertainty of market.	5. Forced to sell to pre-harvest contractor due to uncertainty of market.

As shown in Table 4.4, the unavailability or high cost of quality inputs such as seeds and fertilizers are the largest barriers to increasing vegetable production, while for fruits, the largest barrier is the high initial investment needed. Lack of irrigation is a common barrier for both fruits and vegetables. As per data available from the Directorate of Economic and Statistics, Ministry of Agriculture and Farmers' Welfare, only about 35% of agricultural land in India was reliably irrigated. In addition, about two thirds of cultivated land in India is dependent on monsoons. Uttar Pradesh is the most irrigated state in India with 17.6 million ha under irrigation. Tube wells and canals are the major sources of irrigation in Uttar Pradesh. Rainfall is adequate with an annual average of 1,025 mm. There are currently 28,626 state tube wells in Uttar Pradesh, each commanding an area of about 100 ha. However, the average irrigated area per tube well is quite low, with 15 ha for kharif (monsoon crop) and 32 ha for rabi (winter crop). As most of the fruit and vegetable crops such as peas, tomato, mango and guava grown require irrigation, about 76% of these farmers practice irrigation.

In addition to lack of irrigation, lack of knowledge, facility and labor are also barriers to increasing fruit and vegetable production. Uncertainty of the market is listed as the major barrier for fruits but not for vegetables, which indicates a higher risk associated with the fruit market than the vegetable market.

There are also secondary barriers that require attention. Those secondary barriers are:

- Fragmentation and small size of landholding: The small size of holdings limits the possibility for farmers to adopt diversification and mechanization. Small farms produce a wide range of food, often wider than larger and commercial farms. Smallholder farmers who find it difficult to connect to the markets tend to choose to produce their own main staple food, rather than going for commercialization. They generally practice multi-diversified farming and grow a number of crops even on small acreage and fragmented plots. However, this type of farming does not yield enough returns for the sustenance of small farm families.
- Poor agricultural practices and low productivity: Indian agriculture is characterized by its subsistence nature, i.e., most of the product is directly consumed by the producers, and the surplus, if any, is generally low. This is because most Indian farmers, being of low-income, do not have access to good agricultural practices due to a lack of extension services. These farmers also tend to use outdated equipment and technology, and are not able to afford costly inputs. This results in low levels of returns and meager incomes, which in turn means low savings and low levels of reinvestments. Thus, a vicious circle operates and stagnation in agriculture prevails.
- Fruits and vegetables are capital intensive crops and affordability is limited: In view of the highly capital-intensive nature of some high-value crops, smallholder and marginal farmers may find it difficult to invest in these crops.
- Poor access to market and market information.
- Poor credit availability.

4.2.3 Production loss

Food loss is segmented into two categories: production loss and post-harvest loss. There are many factors affecting pre- and post-harvest losses, from harvesting losses on farms to the handling of produce when it reaches the shop. In this section, we will first introduce the pre-harvest and harvest management practices that are related to production losses. Post-harvest management practices will be discussed in Section 4.4.3.

Production losses at the farm level are from two sources: yield gap and harvesting losses. Based on the focus group discussions, in India, the yield gap and harvesting losses for fruits are 40-47% and 2-7% respectively. For vegetables, the numbers become 40-45% and 2-7%.

Crop management practices have a critical role as they impact not only productivity but also the quality of produce. Timely adherence to the crop calendar, use of integrated pest management, use of micronutrients, improved moisture conservation and fertilizer application not only increase productivity but also reduce the chances of quality deterioration in terms of both physical and visual characteristics of most fruits and vegetables. Cultural practices also affect the post-harvest quality of crops. Timely cultivation, moderate use of nitrogen fertilizer, adequate watering and control of fungal infection all increase storage potential. Since crops are prone to pests and diseases in the field, the timing of

harvest is another critical point which good management practice takes care of. Harvesting should ideally be done in the early morning hours or later in the evening to minimize field heat.

Fruits harvested at the appropriate time give the highest quality. For example, in certain fruits such as mango, the date of harvest is based on size rather than maturity, because the fruit can be ripened as required through exposure to ethylene. Market standards dictate the size at harvest. Similarly, fully mature fruit can be harvested for farmers' own consumption and local markets, and less mature fruit can be sold to distant markets. In the case of mangoes, fruits should be harvested with a 1 cm stalk or above the first node of the stalk as it prevents sap oozing. Fruits should never be harvested with a stick or by shaking the tree or branch as fruits falling to the ground can be damaged.

4.2.4 Gender barriers to agricultural intensification

Beyond the constraints that all smallholders are challenged with in agricultural intensification, women face a variety of specific barriers. Women play an active role in production and processing in different fruit and vegetable sectors, and to a limited degree in marketing. External supports, be it from national or regional publicly-funded programs, NGO work, or businesses engaging women, are the primary drivers of lowering the barriers that women face.

Production

During the focus group discussions held in Andhra Pradesh on tomato crops, women indicated that their daily household tasks such as taking care of the family, cattle rearing, and collecting fodder and fuel wood, meant that their daily routine could run from 4am to 10pm. For a specific group, they noted that because gas prices had gone up more than 30%, they had switched to fuel wood or dung cakes and as a result, needed to spend 8-10 additional hours a week either collecting fuel wood or making the dung cakes. Women also risk being more exposed to physical, social and verbal abuse if their husbands are away. Given this, in response to the option of agricultural intensification, they were sceptical given the busy schedules they already had, especially so if their husbands had migrated to other states to supplement the household income. In such cases, despite remittances helping to boost income, the household workload remained very high.

There are however examples that buck this trend, of women increasing production and income through self-help groups and even starting enterprises, as described in Section 4.8. These have come about through policy and NGO program support, household support (including their husbands) and sheer drive.

Processing and marketing

There are multiple examples of women being involved in fruit and vegetable nurseries, in processing and as retail vendors in multiple sectors. Of the shortlisted sectors for the India report, women are more prominently involved in mango (making pickle in Uttar Pradesh, Odisha and Bihar), and tomato (pulp in Andhra Pradesh). In some cases (see Section 4.8) women control production, processing and marketing, giving them far greater control over the household income as well as managing their time. The drivers of this are, under exceptional circumstances, women's own motivation, and more generally either a public, NGO or social-impact business supporting them to achieve more than they could on their own.

In the case of women being employed, there tends to be a division of labor whereby women are considered more efficient in grading and sorting produce, while men are seen as more effective in the pre-harvest management of land preparation, orchards, plucking, weighing and storage, loading and unloading duties. In multiple interviews it was reported that women earn on average less than men; female daily wages are around 200-250 rupees (US\$2.70-3.36) compared to men who earn 275-350 rupees (US\$3.70-4.71) for 8-9 hours work. This discrepancy is explained by the heavier labor that men engage in. Whether this deters women from seeking this employment, or incentivize employers to seek out more women is unclear.

Social stigma

As reported in the first phase of this report, rural women face sociocultural barriers to taking their own initiative in agriculture. Apart from issues around time and mobility, and lack of access to credit and land, “[a]round 40% are constrained by absence of any sort of structured knowledge of customers, suppliers and market trends [and] 50% struggle with high risk aversion, low self-confidence emerging from lack of education, funds or other alternatives to generate an income. Social permission to work can be difficult to obtain because of cultural practices, social beliefs and safety concerns” (Bain & Company).⁴ As evidenced in the case studies in Section 4.8.1 these social stigmas can be overcome by providing external support and promoting existing women business leaders, though this requires encouraging discussion among men as well as women, and in multiple generations and castes to more systemically address these cultural norms and taboos.

4.3 Reduction in the cost price and profitability of fruit and vegetables farmers

4.3.1 Cost of producing fruits and vegetables and farmgate price

Since the smallholder farmers are the market-price takers, a reduction of the cost price of fruit and vegetable production is expected to improve the profitability given a certain market price. We found that the general trend is that the per unit cost prices for fruits are in general higher than those for vegetables and the farmgate prices for fruits and vegetables are higher than those for cereals. More detailed information is given in Table 4.5 and Table 4.6.

Table 4.5 demonstrates the cost price to produce the seven crops. As we can see, the cost prices for mango, orange, litchi, and pea are the highest. For mango, orange and litchi, the high cost prices are due to high establishment costs which are attributed to the long time period before yield commences and production peaks. Peas also have a high cost price but this is due to the high maintenance costs. On the other hand, although the maintenance costs are relatively high, due to the high yield per ha, cost prices per unit for tomato and onion are low.

Table 4.5 Cost of production for mango, litchi, orange, eggplant, pea, tomato and onion

Fruit/ vegetable	Establishment cost (US\$/ha)	Maintenance cost (US\$/ha/year or season)	Average yield (kg/ha)	Average production cost(US\$/kg)	Remarks
Mango	1,568-1,750	280-420	7,500-12,500	0.182-0.196	Yield commences from 5 th year and peaks after 12 th year.
Litchi	630-840	308-378	3,000-9,000	0.112-0.168	Yield commences from 6 th year and peaks after 15 th year.
Orange	1,834-1,960	490-560	3,000-22,000	0.126-0.196	Yield commences from 4 th year and peaks after 10 th year.
Eggplant	-	1,120-1,330	7,000-17,000	0.098-0.112	Yield varies as per the hybrid variety grown.
Peas	-	1,260-1,400	7,500-8,000	0.168-0.196	Average green pod contains 7-8 seeds and shelling outturn is 50%.
Tomato	-	1,610-1,750	20,000-30,000	0.07-0.098	Under open field conditions.
Onion	-	1,050-1,190	22,000-25,000	0.056-0.07	-

Source: Interviews and analysis.

⁴ Source:
https://www.bain.com/contentassets/dd3604b612d84aa48a0b120f0b589532/report_powering_the_economy_with_her_-_women_entrepreneurship_in-india.pdf

Table 4.6 demonstrates the average farm gate prices for all the selected fruits and vegetables, and cereals during 2020. It is clear that the farm gate prices for fruits and vegetables are higher than those for cereals. It is also shown that the price volatility for fruits and vegetables is much larger than for cereals, except for eggplant, which is consistent to the finding in the seasonality section.

Table 4.6 Average farm gate price of selected fruit and vegetables and cereals in 2020 (US\$/kg)

Eggplant	Peas	Onion	Tomato	Mango	Litchi	Orange	Wheat	Paddy	Maize
0.28-0.32	0.21-0.49	0.25-0.56	0.25-0.28	0.35-0.98	0.35-0.56	0.28-0.35	0.22-0.25	0.24-0.27	0.22-0.25

Source: Authors' analysis based on available reports (compiled from AGMARKNET Portal) and data collected.

4.3.2 Effects of cost reduction strategies

Rising input expenses have imposed additional costs on growers. Fertilizer prices have fluctuated extensively in recent decades as have prices of key production inputs such as natural gas and crude oil. Fertilizer prices are influenced by external factors, including exchange rates, the availability and price of ingredients such as potash, and consumer preferences. Therefore, the key to reducing growers' costs is to improve productivity, which would also increase competitiveness. The cost of production per unit is calculated by dividing the cost of cultivation per acre by productivity per acre. Thus, in cases of high productivity, the cost of production will be less and vice versa.

A minimal relationship between farmgate price and cost of production has been observed. Farmers, due to small marketable surplus, do not have any bargaining power and are dependent on market forces that determine the farmgate prices, particularly for fruits and vegetables. Farmers in the FGD also reported that they have seen a transformational change in farming technologies, market structures, and consumer behavior, but the prices paid to specialty crop farmers at the farmgate have changed very little. If farmers cannot sell all their produce, their potential profits decrease substantially. This highlights the danger of increasing production without confidence that the additional supply can be sold.

Although the cost of production has little impact on the farmgate price, the farmgate price can heavily affect farmers' incomes. Low prices have an adverse effect on net farmers' incomes. For example, in the FGD, tomato farmers in Andhra Pradesh reported that due to a crash in farmgate prices, they do not harvest their crops and instead leave them in the field. The sale of crops usually occurs immediately after harvest, owing to the urgent cash needs of the farmers. When farmgate prices are lower, farmers go for the distress sale. Farmers also revealed that lower farmgate prices forced them to grow alternative short-duration crops. They also revealed that a small decline in price can lead to a large decline in profitability.

Based on our research, we conclude that a reduction in cost price may have little effect on the farmgate and consumer prices even though it can increase the profitability of fruit and vegetable production for farmers. This is due to the fact that farmers are 'price-takers' and traders dominate the price setting.

4.4 Value chain efficiency and fruit and vegetable consumer prices

4.4.1 Value chain efficiency

The agribusiness sector's complex value chain includes input companies, farmers, traders, food companies, and retailers, all of whom should ultimately satisfy the varying demands of the consumer in a sustainable manner. The agribusiness environment is becoming increasingly volatile in the recent years as this volatility comes from different sources such as social change, climate change and political action. The weather has been responsible for fluctuating yields and a supply shortfall which has put

pressure on crop prices. In addition, there has been an important shift in food consumption from fresh to processed produce and from home consumption to out-of-home consumption due to increased incomes and changes in lifestyles of consumers. The shift in consumption patterns is directed to food products in which the processing and distribution trades have a larger share.

Grading and sorting

Once the fruits are harvested, the overall quality of fresh fruits cannot be improved but it can be maintained. It was observed during the field FGDs that cleaning, washing, grading and packaging are the major post-harvest practices that are undertaken to maintain the quality of the fruits and vegetables. The final market value of the produce and acceptance by the consumers depends upon the grower's ability to apply best available pre-harvest technology, and then to apply the best available post-harvest handling practices. During the grading process, produce is sorted according to the fixed grade standard, taking into consideration various quality factors to make a homogenous lot. Post-harvest grading of fruits and vegetables is practiced at the producer level. Fruits and vegetables are sorted based on physical characteristics like weight, size, color, shape and degree of damage on fruits. This type of grading is done by hand in small operations. For packaging, most farmers use plastic bags and crates for vegetables, and wooden and cardboard boxes for fruits.

Dependency of farmers on traders

Traders occupy a pivotal position in the agribusiness value chain and to some extent, their performance can be seen as indicative of the sector as a whole. Traders come in many different shapes and sizes with respect to business portfolios, geographic presence, degree of vertical integration and ownership. Some have significant food processing operations. Traders have a vital role to play in the provision of the infrastructure investment required to meet the growing demand from traditional and emerging markets. It is estimated that more than 90% of fruit and vegetable products in India are distributed through commission agents/wholesalers and a small proportion sell through retailers and directly to consumers.

Most farmers have small and marginal land holdings and therefore, small lots of produce are available as marketable surplus. This poses the challenges including problems in logistics (aggregation to make economic transport lots), variation in quality, non-standard packing and uncertainty from the buyers about supplies. Moreover, due to the lack of financial resources, farmers are unable to make investments in packing materials and infrastructure which lead to poor flexibility regarding the timing of selling and choice on buyers. As a result, farmers are forced to sell the products to the first available buyer or village level aggregator. Farmers who sell their produce to distant markets rely on traders who have networks there.

Enforcement of contracts

There is no credible enforcement mechanism for contract farming in India. Contract farming arrangements are often criticized for being biased in favor of firms or large farmers, while exploiting the poor bargaining power of small farmers. Problems faced by growers include undue quality cut on produce by firms, delayed deliveries at the factory, late payments, low prices and pest attacks on the contract crop which raise the cost of production.

Contracting agreements are often verbal or informal in nature, and even written contracts often do not provide the legal protection in India that may be observed in other countries. Lack of enforceability of contractual provisions can result in the breach of contracts by either party.

Major barriers in value chain transformation

The agricultural system in India has undergone transformations over the past few decades particularly after the economic reforms in the early 90s. The traditional way of food production has gradually been replaced by practices more similar to manufacturing processes, with greater coordination between farmers, processors, retailers, exporters and other stakeholders in the agricultural value chains. There has been an increasing emphasis on the development of efficient agricultural value chains in India. On the other hand, discussions with farmers, traders and other stakeholders, and the available literature highlight that the farmer's share of consumer price is very low due to a large number of intermediaries in the chain, non-transparent trade practices and exploitation in the market. Farmers have no control

on the prices due to low marketable surplus and remote markets from the point of production. This inefficient value chain also results in losses both physically and value-wise. The average losses in fruit and vegetables value chains are depicted in Figure 4.2.

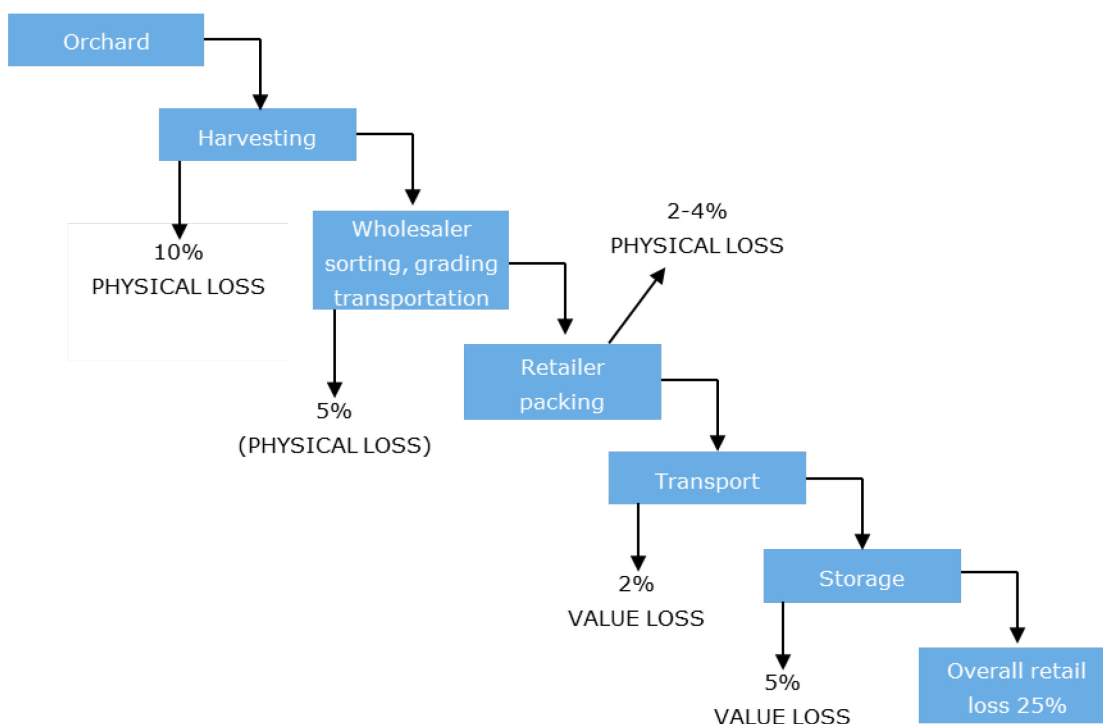


Figure 4.1 Average losses along fruit and vegetables the value chain

Source: Analysis based on FGDs and KII.

In short, many intermediaries increase costs and make the chain inefficient. Farmers are forced by their insecure livelihoods to opt for distress selling in the absence of proper post-harvest facilities. Linkage and integration between the various players in the supply chain play a very important role in making the whole supply chain effective and profitable. However, in the fruits and vegetables supply chain in India, there is a lack of forward and backward integration between the farmers and the other partners. This makes it difficult for the supply chain to deliver fresh goods in a timely manner with proper quality to the customer. Another issue for the value chain is that there is a lack of quality standards and enforcement, leading to poor hygiene and safety, quality degradation, etc.

4.4.2 Coordination

According to the field discussions and available literature, marketing costs vary considerably among crops and across states. However, there were no significant differences between marketing costs of various marketing functions such as storage, transport and handling among the different states/regions for the fruits and vegetables in this study. On the other hand, relatively higher marketing costs were attributed to the various fees, road taxes, tolls and levies along the way to the destination market. Lead time uncertainty exists between consecutive activities of the supply chain with disturbances such as unpredictable climatic conditions, distance from the market, strikes, accidents, curfew, etc. In the case of mango in Uttar Pradesh and Odisha, and litchi in Bihar, in the FGDs, farmers reported selling their standing crops to contractors who do all the remaining operations, which helps smallholder farmers mitigate price and market risks. The farmers also revealed that bringing fruits to the markets involves increased expenses on harvesting, grading, packing, transportation, etc. which amount to INR12-15/kg (US\$0.17-0.21) depending on the distance of the sale point. The highly perishable nature of the fruits results in high losses across the value chain. Farmers also reported that due to lack of funds for production and marketing of their crops, they are dependent on middlemen and traders who give them an advance for maintaining their orchards or farms as well as for their other family needs. However, these middlemen and traders in

return charge high margins. Farmers also revealed that while there are nationalized and cooperative banks operating in their areas, getting a loan is a very tedious and long procedure. Therefore, they rely more on money lenders and traders for loans.

In general, the risks involved in the fruits and vegetables value chain are:

- Smallholder farmers have little marketable surplus for sale, no bargaining power, and hence no control over prices.
- Markets are located in distant places.
- Crash of prices due to gluts in the markets and farmers' opting for distress selling.
- Highly perishable products lead to high losses due to the unavailability of adequate logistic facilities.
- A large number of intermediaries adds to the marketing costs and makes it economically non-viable.
- Nontransparent marketing practices such as undercover trading practices and illegal cartels of middlemen.
- High market fee and commission charges being charged from buyers' and sellers' charges (these charges are to be borne by buyers only as per the APMC Act).
- Undue deductions such as regrading and packing charges, shifting of produce to another shed in the market, etc. resulting in high marketing costs.

4.4.3 Value distribution in the fruit and vegetable supply chain

A large number of channels/intermediaries existing along all channels of the supply chain and poor technology applications (e.g., lack of cold chain, lack of loading and unloading machines) are the major factors that affect the transportation as well as the distribution channels of the supply chain. Due to the numerous intermediaries starting from the collection of the product from the farm level in the form of village-level aggregators to local wholesalers to the commissioning agent, farmers are getting 14-43% of the price that consumers are paying in the market for fruit and vegetables. The detailed overviews for each crop are provided below.

4.4.3.1 Stakeholders' share in consumer price of mango

In the mango value chain, the pre-harvest contractor obtains the maximum share from the amount paid by the consumers. The pre-harvest contractor receives 36%, the wholesaler 20%, the retailer 30%, and the farmer receives only 14%.

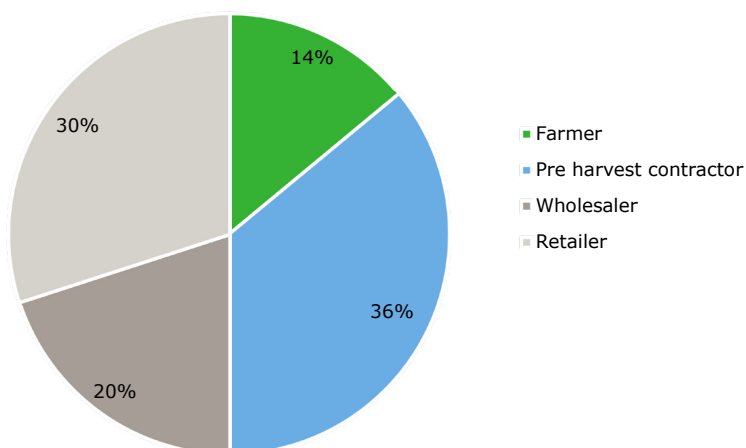


Figure 4.2 Stakeholders' share in consumer price of mango

Source: FGDs and KII.

4.4.3.2 Stakeholders' share in consumer price of litchi

According to the results of the FGDs, the share for farmers in the consumer price for litchi is 26%, pre-harvest contractors 39%, wholesalers 13% and retailers 22%.

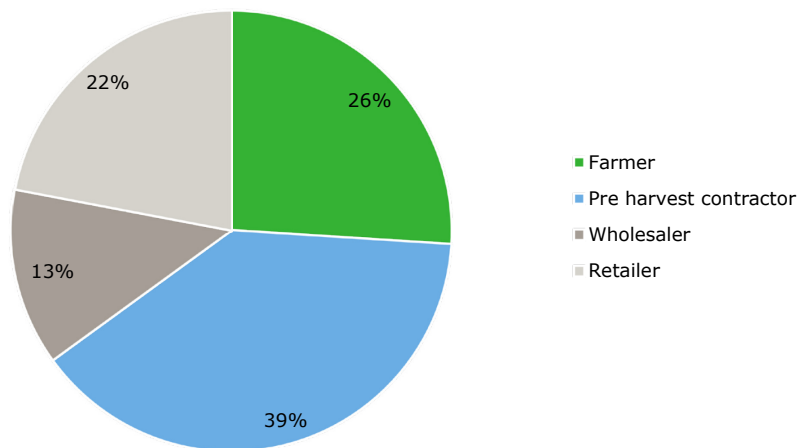


Figure 3.4 Stakeholders' share in consumer price of litchi

Source: FGDs and KII.

4.4.3.3 Stakeholders' share in consumer price in oranges

According to the findings, on average, the producer gets 43% of the consumer price, the trader's share accounts for 29%, the retailer's share is 18% and the wholesaler's share is 10%. The share of each stakeholder includes the marketing cost at each level of the sweet orange marketing chain.

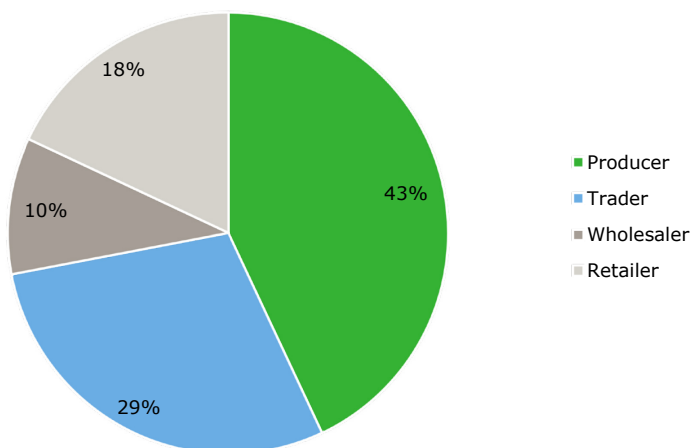


Figure 4. 4 Stakeholders' share in consumer price of orange

Source: FGDs and KII.

4.4.3.4 Stakeholders' share in consumer price of eggplant

The producer gets 48% of the consumer price, the trader receives 29%, the retailer's share is 13% and the wholesaler's share is 10%. The share of each stakeholder includes the marketing cost at each level.

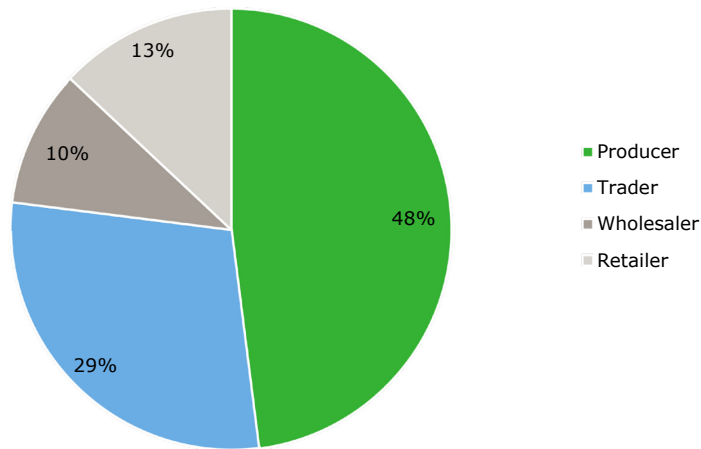


Figure 4.5 Stakeholders' share in consumer price of eggplant

Source: FGDs and KII.

4.4.3.5 Stakeholders' share in consumer price of tomato

The farmer's share in the consumer price is calculated as 55% while the retailer and wholesaler shares are 22% and 6% respectively.

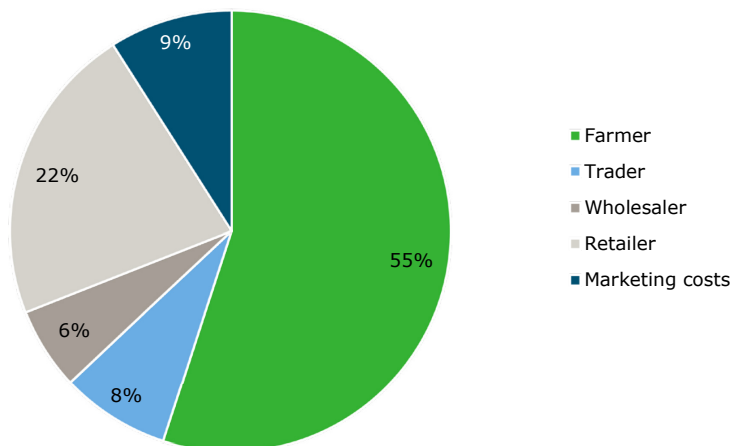


Figure 4.6 Stakeholders' share in the consumer price of tomato

Source: FGDs and KII.

4.4.3.6 Stakeholders' share in consumer price of onion

The producer receives 55% of the consumer price, the commission agent 6%, the retailer's share is 23% and the wholesaler's share is 16%. The share of each stakeholder includes the marketing cost at each level.

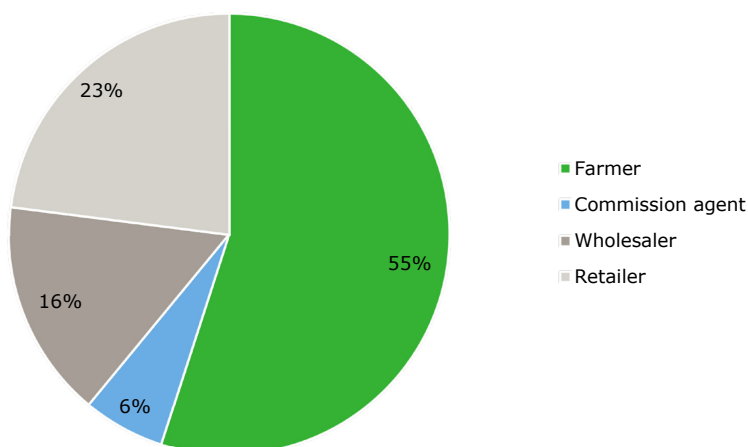


Figure 4.7 Stakeholders' share in the consumer price of onion

Source: FGDs and KII.

4.4.3.7 Stakeholders' share in consumer price of peas

The producer gets 51% of the consumer price, the commission agent receives 8%, the retailer's share is 25% and the wholesaler's share is 16%. The share of each stakeholder includes the marketing cost at each level of the marketing chain.

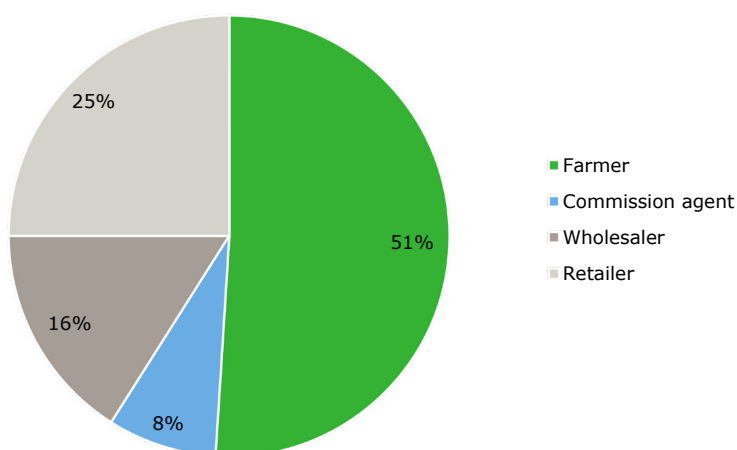


Figure 4.8 Stakeholders' share in the consumer price of peas

Source: FGDs and KII.

4.4.3.8 Margin distribution

For both fruit and vegetables we observe a positive profit margin for all actors in the supply system. See the table below. The typical profit margin ranges between 45% and 55% for the vegetable crops studied and between 35% and 45% for the fruit crops. However, all margins are dependent on the market prices obtained, which are heavily influenced by supply and demand dynamics, and crop losses as a result of pests and diseases. In addition, our calculations did not include fixed costs like land rental since farmers mainly obtain access to land through family inheritance, or associate or government lease. Profit margins per unit for traders are lower but they trade larger volumes.

Table 4.7 Indicative profit margin shares per unit ((sales – costs) / sales) of fruit and vegetable at different levels in the fruit and vegetable supply chain

	Fruit	Vegetables
Margin of farmer	35-45%	45-55%
Margin of trader	6-10%	7-12%
Margin of retailer	18-25%	18- 27%

Source: Authors' estimations based FGDs and KII.

4.4.4 Examples of enhanced efficiencies

To create an income revolution in the fruit and vegetable sector, the entire value chain needs to be upgraded by creating post-harvest infrastructure such as packing and grading facilities, ripening chambers, cool chain facilities, crop-specific transportation and logistics, online trading portals/plate farms, corporate farming, etc. Direct-from-farm platforms shorten supply chains for farmers and provide them with information on prevailing market prices. Although the current market share of the direct channel is still very low, there is a high scale-up potential in the future. This direct-from-farm model enables smallholder farmers to increase their incomes through better market access and lower post-harvest losses. The model also enables farmers to create relevant connections with appropriate buyers and increases the opportunity to ensure better market prices. In addition, these platforms save farmers time traveling to market yards and waiting through prolonged auctions, which is particularly beneficial for female farmers who have a household workload burden. They also reduce the information asymmetry issue for farmers in the traditional wholesale channel. With the increase in the adoption of mobile and internet technology in India, enterprises have adopted the direct-from-farm model to enable disintermediation (see example in the box below).

Box 1: Farmer to end-user journey of mango trade through digital market sales.

India grows over 20 million t of mangoes every year. While a large proportion of them are consumed directly as a fruit, a significant proportion are bought by fruit processors and beverage manufacturing companies. In the last few decades, the mango industry has remained unchanged. Farmers typically sell their mangoes in bulk to wholesalers in nearby wholesale markets. Wholesale businessmen then buy the produce at much cheaper rates and sell the same stock to different major city vendors in the fruit markets. Retail vendors purchase from the city's big warehouses and sell the same mangoes to retail fruit shops or sellers with push carts. During this process, the price of mango increases to almost 2.5 times the farmgate price and has 4-5 layers of vendors and transporters involved and adding their profits to the product prices.

The COVID-19 pandemic poses a challenge for the physical market. Rising COVID-19 cases and lockdowns in several states have dissuaded wholesalers from buying mangoes in bulk from mango growers. Wholesalers are not confident that they can sell these commodities in the open market this year. Mango grower societies and cooperatives have therefore decided to go digital using online models. Online models strengthen various processes like payments, deliveries and storage. It has been observed that this trend of digitalization is more pronounced among the prosperous Alphonso mango growers of western India due to the superior quality of their produce as well as the global demand. Mangoes are picked every week and dispatched to all parts of the country through air cargo or local courier networks. Mango producers also use social media channels like Facebook, Instagram and WhatsApp to sell their produce. Mango grower societies and cooperatives have strengthened their online channels this year too.

Mangos are delivered to over 15,000 PIN (Postal Index Number Codes) codes in India. People living in metro cities receive mangoes within two days. One example of direct-from-farm online selling is AlphonsoMango.in. In a period of 50 days, they have sold over 150,000 t of mangoes online at prices ranging from INR500-1,200 (US\$7-16.8) per dozen.

Orchard owners claim that the quality of mangoes is one feature that differentiates them from other e-commerce firms. Fruit is picked just 3-4 days before couriering them to buyers. If the order is from North India, the mangoes are semi-ripened by keeping them in hay and are packed in wooden crates. They also use QR codes to ensure the authenticity of the mangoes.

4.4.5 Post-harvest losses

The post-harvest period exists from the time the food is harvested until it reaches retail markets for consumption. In India, post-harvest losses for fruits and vegetables in general are very high. Detailed overviews on crop losses in different stages of the value chain are provided in Table 4.8 and Table 4.9. Compared to on-farm harvesting losses, post-harvest losses account for the major proportion of losses in the whole value chain. According to Table 4.9, mangoes have the highest post-harvest losses compared to litchis and oranges.

Table 4.8 *Percentage losses in value chain of selected fruits*

Stage of loss	Percentage losses		
	Mango	Litchi	Oranges
Harvesting losses	4-5	4-7	2-3
Sorting, grading and packing	3-5	3-5	2-3
Transportation	4-6	4-6	3-5
Temporary storage or at ripening chambers	8-10	2-3	2-3
Wholesaler level	2-4	2-4	2-4
Retailer level	8-12	10-14	6-8
Total	29-42	25-39	17-26

Source: FGDs and KII.

Table 4.9 shows that tomatoes have the highest post-harvest losses of the four crops. For both fruits and vegetables, the waste at the retail level is the largest compared to other chain levels.

Post-harvest management is a crucial management practice as improper practices result in high wastage which can be potentially avoided. After harvesting, fruit should not be exposed to sun, rain, or wind. Fruit and vegetables should also never be allowed to come in contact with soil after harvest as it can lead to contamination which may have an impact during storage. Collection points should also be shaded. Researchers have reported up to 10°C difference in temperature between shaded and exposed fruit. Rudimentary grading at this point can also improve overall fruit quality. Farmers should discard diseased, damaged or over-ripe fruit.

Table 4.9 *Percentage losses in value chain of selected vegetables*

Stage of loss	Percentage losses			
	Eggplant	Tomato	Peas	Onion
Harvesting losses	3-5	4-7	2-3	3-5
Sorting, grading and packing	2-3	3-5	1-3	1-3
Transportation	3-5	5-7	3-5	2-3
Temporary storage	2-5	2-5	2-3	2-4
Wholesaler level	4-6	4-5	2-4	1-3
Retailer level	6-8	10-12	6-8	5-7
Total	20-32	28-41	16-26	14-25

Source: FGDs and KII.

In today's context, most of fruits and vegetables do not follow the correct way of ripening and best transportation practices in India. In the case of ripening, even though it is banned, carbide is the most prevalent method used which, apart from posing health-related consequences, also results in uneven ripening, thereby resulting in lower prices. In the case of transportation, fruits and vegetables are packed on top of each other and pressed to maximize space and weight resulting in injury and deterioration of quality. Transportation even over long distances happens in normally open trucks leading to high-temperature exposure thereby reducing shelf life. Additionally, the use of tightly packed vehicles without proper packing materials like crates, wooden boxes, etc. result in bruising and

spoilage of produce during transportation. At the retail stage, losses can be particularly significant as most of the fruit and vegetables are sold in unhygienic environments and in open conditions. Poor-quality markets often provide little protection for the product, leading to rapid deterioration. Sorting of produce to separate the saleable from the unsaleable can result in high wastage. Trimming of leafy vegetables also leads to high wastage.

Box 2: Advances in packaging of Litchi fruit

Litchi is a distinctly delicate and delicious summer fruit with a good source of minerals and vitamins. India and China account for about 91% of the world's litchi production but it is mainly marketed locally. It was reported during discussions with various stakeholders that the total loss of litchi from farm to retail was 25-39%, with the highest losses seen at the retail level. Browning and fruit decay by *Alternaria* caused major post-harvest losses. Despite its wide popularity and demand in the domestic and international market, transporting the fruit to distant markets has remained a challenge due to its highly perishable nature. Post-harvest interventions therefore become indispensable to preserve litchi fruit quality for longer. One intervention is packaging which directly influences transpiration losses and respiratory metabolism in litchi fruit. Packaging plays the all-important roles of containment, protection, convenience and communication. Previously, gunny bags, bamboo baskets and wooden boxes were used for packaging but are now being rapidly replaced by corrugated fibre board (CFB) boxes due to their versatility. Modified atmosphere packaging (MAP) of litchi in combination with post-harvest treatments offer promising solutions to preserve litchi fruit quality. In addition, intelligent packaging using sensors shows the way forward for future packaging solutions.



Source: Purbey et al. (2019).

Box 3: Woman from Asia's largest onion market is using Internet of Things (IoT) to help reduce onion wastage

India is the second largest producer of onions in the world. In 2019-2020 the country exported 11.5 million t of fresh onions to the rest of the world and about 28% of it was cultivated in Maharashtra. Though India produces large quantities of the crop, the price is always fluctuating, sometimes by 800%. Therefore, for farmers growing this crop, it is either a jackpot or a complete loss. There are three main onion crops — kharif (June-July sowing, post-October harvest), late kharif (September sowing, post-December harvest), and rabi (December-January sowing, post-March harvest). The rabi crop has the lowest moisture content, making it amenable to storage. Farmers store it in on-field structures called kanda chawls to protect it from moisture and light. This crop is supplied to the markets until the next one arrives.

Traditionally, farmers identified rotting in onions by its distinct smell. However, at this stage, the crop is already 30% damaged. The onion industry also lacks accountability as the government is unaware of the quality or quantity of the products available on the ground. This wastage results in higher prices for consumers while the demand is ever increasing.

Kalyani Shinde, a 23-year-old engineering graduate, born and raised in Lasalgaon (Maharashtra) — home to Asia's largest onion market — is trying to change that with her start-up. Known as the Onion Queen, Shinde entered the market with the notion that there would be resistance from the farmers towards adopting any technology. However, this turned out not to be the case. Farmers do understand the value of technology; however, it is important to design the technology according to their needs and to precisely address the challenges they face. Thus, Shinde initiated Godaam, a Nashik-based start-up converting traditional onion warehouses into smart warehouses to help farmers prevent onion wastage at the warehouse by installing IoT (Internet of Things)-based sensors that can track micro climatic changes and help farmers identify any stock spoilage at an early stage. With the help of Godaam's technology, a farmer can now identify rotting as low as 4%, enabling them to reduce wastage and sell the crop quickly in the market. A farmer who has around 20-25% crop wastage, will now lose only 5% of the stored crop.

Source: <https://www.onewomanproject.org/blog/2020/3/17/godaam-innovations-reducing-onion-wastage-from-40-to-5-using-iot>

4.4.6 Secured markets

There are different ways to make markets more secure and beneficial to smallholder farmers. Direct marketing has facilitated farmers groups, farmer producer organizations (FPO), cooperatives and all the stakeholders to market their farm produce effectively and in a timely manner. In Andhra Pradesh, there are initiatives to decentralize trader-centric market activities to the farm or village level. These initiatives are initiated by the Directorate of Marketing Inspection (DMI) — a Government body of India involving women's self-help groups to enable farmers to market their products within an 8 km radius.

Box 4. The Horticulture Producers Co-operative Marketing and Processing Society Limited (HOPCOMS), Lalbagh, Bangalore: Providing a vehicle for smallholders

Across the developing world, a retail sector transformation is spearheading fundamental change in local food systems, with the relative position of the smallholder farmer coming into serious question. The new retailers have focused on disintermediation in the supply chain to benefit both farmers and consumers. However, what becomes of those who fail to be part of the supply channel? This is a particularly critical question for India, which is a nation of small-scale farmers, many of whom are becoming smaller.

The Horticultural Producers' Cooperative Marketing and Processing Society, popularly known by its acronym, HOPCOMS, is a farmers' society for the direct marketing of farm produce. HOPCOMS reserves 5% of its farmer-memberships exclusively for women. The main activity of the society is the maintenance of a marketing system by which the farmers are ensured a good price for their produce and consumers are provided with quality goods at affordable prices. The community has eliminated the middlemen and acts as the only link between the farmers and the consumers. It is a successful alternative, acting as a counterbalance for small-scale farmers in the modern retail environment. HOPCOMS' main strength is its vertical coordination through low-cost means. It is able to procure farmers' produce and get it to consumers through a network of decentralized procurement centers and scattered retail outlets. Many smallholder farmers who use HOPCOMS are benefited including reduced transaction costs, increased revenue, a secure outlet for their produce, fair prices, availability of inputs and an indent system which favors smallholders over large producers.

The share of vegetables is 55% and that of fruits is about 45%. About 21,000 t of both fruits and vegetables are handled annually in this market. Sustainability of smallholder inclusion will not be under threat in the coming future because of HOPCOMS' frugal and government-supported supply chain infrastructure, and decentralized procurement functions. Its goals are more to maximize social welfare than to maximize its profits. The backward and forward linkages within HOPCOMS enable it to share profits among its users, mainly by increasing farmers' shares in the retail price.

According to officials connected with HOPCOMS, any increased procurement needs to be sold, so they procure only what can be sold through their retail outlets and through institutional sales.

Given the current situation faced by Indian farmers, the HOPCOMS model provides exciting opportunities for replication. In particular, it offers an example of an institution that attempts to provide marketing support to the small farmer through a combination of horizontal and vertical coordination.

Source: An "Other" Revolution? Marketing cooperatives in a new retail context: A case study of HOPCOMS in India, 2007

Raythu Bazaar is a market in which small-scale farmers can sell directly to consumers, thereby eliminating middlemen. It was initiated in Andhra Pradesh by the state government to empower farmers to participate effectively in the open market to get a remunerative price for their produce. The market was also set up to avoid exploitation of both the farmers and the consumers by the middlemen by creating a positive atmosphere of a direct interface between them. As of now, there are 96 Raythu Bazaars operating and spread over different regions and districts of Andhra Pradesh.⁵

Moreover, the National Agriculture Market (E-NAM) platform has proved to be a preliminary success across the nation. The platform helps farmers fetch a better price for their produce and there are no middlemen involved. At present, the platform deals with 90 commodities including staple food grains, fruits and vegetables. Through the aforementioned information, e-NAM helps farmers bargain a better return for their produce.

⁵ Source: https://market.ap.nic.in/rythu_bazars.html

Finally secured markets can be achieved by contract farming. Through contract farming, agricultural production is carried out according to an agreement between a buyer and farmers, which establishes conditions for the production and marketing of farm products. Typically, the farmer agrees to provide agreed quantities of a specific agricultural product. These should meet the quality standards of the purchaser and be supplied at the time determined by the purchaser. In turn, the buyer commits to purchase the product and, in some cases, to support production through, for example, the supply of farm inputs, land preparation and the provision of technical advice. The following are a few examples of contract farming in different states:

Table 4.10 Details of state-wise contract farming in India

Company	Crop	States
Pepsi Foods Pvt Ltd,	Tomatoes and chillies	Punjab, Tamil Nadu
KLA Foods	Tomatoes, peas, onions and eggplants	Uttar Pradesh, Uttarakhand and Bihar
Rallis India	Vegetables	Punjab, Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka and Tamil Nadu
Panchganga	Red onions	Maharashtra
Varun Foods	Tomatoes	Maharashtra
Jain Irrigation	White onions	Maharashtra
Nijjer Agro Foods	Tomatoes and chillies	Punjab
Ion Exchange Enviro Farms Ltd (IEEFL)	Vegetables	Madhya Pradesh

Source: Compiled by author from electronic and print media sources

Box 5: Impacts of PepsiCo contract farming for tomato

PepsiCo entered India in 1989 to sell beverages and snack foods which started with investment in horticulture-based food processing in Punjab. Pepsi decided to venture into tomato processing for selling pastes and purees. However, a key concern was the lack of tomato production in the state, which had a total output of 28,000 t that was largely unsuitable for processing. Moreover, the yield levels were low, with a supply period of 25 days. Thanks to Pepsi's efforts, production grew manifold, improving yield and quality. The supply period increased to 55 days.

The reasons for the company's success are enumerated below: Pepsi leveraged key local agencies such as Punjab Agri-University and Punjab Agro Industries Corporation, which helped the United States-based multinational corporation acquire local knowledge and provide the much-needed extension services to the farmers. Pepsi became closely involved in the farmer extension process, providing training to farmers. Investments were made in research and development (R&D) and field trials were conducted to evaluate if the crop varieties were suitable for use. Farming demonstrations were made to the farmers. The economics of the entire operation was explained to them in order to have greater transparency in working with farmers.

Pepsi's efforts in winning over the trust of the farmers, as well as the introduction of proper crop varieties and agricultural practices, led to its success as shown in the Figure below. These initiatives also ensured a constant supply of quality inputs for its tomato processing plant, creating a successful model for Pepsi.

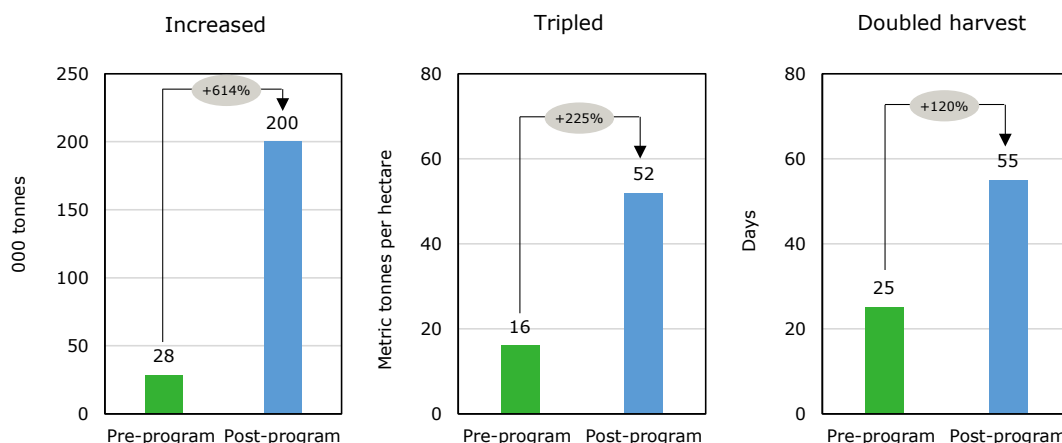


Figure 4.10 Various impacts of PepsiCo contract farming program for tomato

Sources: Company information, press research, industry reports, analyst reports, BCG analysis.

In conclusion, improved supply chain efficiency can substantially reduce the post-harvest losses of fruits and vegetables, potentially benefit farmers and possibly decrease consumer prices.

4.5 Linkages and communication between actors

4.5.1 Linkages of different actors

Marketing systems particularly for perishable products are undergoing rapid transformation as traditional marketing channels with ad hoc sales are being replaced by coordinated links between farmers, processors, traders and retailers. In India, consumers are also becoming more demanding in terms of quality and safety, and demographic and income trends are leading to increased demand for convenience foods, together with assurances of product safety. Supply chains are changing rapidly, with transactions increasingly based on chains that involve coordinated links between farmers, traders, processors and retailers. In India, agriculture is a state-responsible subject and the state is free to introduce national policies partially or fully. During the discussion with marketing experts, it was gathered that the following types of linkages exist for the selected fruits and vegetables and in the selected states:

- Farmer to the domestic trader,
- Farmer to retailer,
- Linkages through a leading farmer,
- Linkages through cooperatives/farmer groups/farmer producer organizations (FPOs)/farmer producer companies (FPCs),
- Farmer to agro-processor,
- Farmer to exporter and
- Contract farming.

The largest portion of a marketable surplus of agricultural produce in India is sold outside the regulated market yard spaces and NSSO data reflects that around 40% or less than that goes to mandis (An agricultural market). During the focus group discussions, the farmers reported that they were selling their produce to known traders based on trust as it is essential for the establishment and continuation of linkages. Therefore, trust has been an essential factor of business dealings. A significant proportion of agricultural marketing transactions between farmers and traders is based on trust. Traders trust farmers to repay loans while farmers trust traders to pay for the products they sell to them, deferred payment being a common practice.

- The number of regulated markets in India is less than 6,700 for its 140 million agricultural households —2,284 APMCs which operate 2,339 principal markets and 4,276 sub-market yards. There are 23,000 rural “haats” which are weekly markets on designated days.
- The marketable surplus with small and marginal holders is quite low to begin with, and given the lack of institutional credit coverage, these farmers resort to selling to local traders who also serve as input dealers for seeds and agro-chemicals.
- There is a variety of marketing channels that exist and are accessible for farmers. Those channels include APMC markets and licensed traders and commission agents there and state procurement agencies which also operate through women’s self-help groups and their federations in some states. Other channels include farmgate traders, processors, input dealers and moneylenders, rural haats, direct marketing to consumers through rythu bazaars/uzhavar santhai/apni mandi, etc., cooperative societies and new age FPOs, direct marketing to retailers and contract farming entities.
- The e-NAM portal had 15.5 million farmers/sellers, over 68,000 commission agents and 220,000 traders/buyers registered by March 2019, including over 650 FPCs/FPOs. However, the inter-state trade through this portal has been dismally low, and minimum support prices (MSPs) are not always secured in this channel.

The number of new age farmer producer organizations (FPOs) that actually function for their members is a contested figure and the number appears to be significantly lower than what is usually cited — which is 6,000. These organizations were formed under various initiatives by the Government of India, state governments, National Bank for Agriculture and Rural Development (NABARD) and other

organizations over the last 8-10 years. At present there are around 5,000 FPOs (including food producer companies under these initiatives. Of these, around 3,200 are registered as producer companies and the remaining as cooperatives or societies, etc. The majority of these FPOs are in the emerging stage of their operations with shareholder memberships ranging from 100 to over 1,000 farmers while many only exist on paper. These organizations require not only technical handholding support but also adequate capital and infrastructure facilities including market linkages to sustain their business operations. FPOs operating in targeted states are presented in Table 4.11.

Table 4.11 *Farmer Producer Organizations (FPOs) in the selected states*

State	SFAC-promoted FPOs	Non SFAC-promoted FPOs	Total no. of FPOs
Andhra Pradesh	15	6	21
Bihar	38	178	216
Odisha	41	-	41
Uttar Pradesh	56	-	56

Source: Compiled from Small Farmers' Agri-Business Consortium (SFAC), New Delhi.

In addition to the traditional channels, new channels are being introduced to engage urban consumers in particular and these are:

- Direct2Homes (B2C): Subscription-based models with add-on produce based on seasonal availability of fruits and vegetables. There is high potential for segmentation across health categories.
- Institutions (B2B): Offices, food service industry There is high potential for long-term contract-based supply.
- Retail distribution (B2R2C): Placements with retail stores and supermarket chains.
- Ecommerce (B2E): Placements with various online platforms such as AmazonFresh and BigBasket.

Even though the new channels currently only account for a tiny percentage of the market (<1%), they are expected to have great growth potential and therefore can be scalable in the future. To summarize, based on discussions with sector stakeholders, we estimate the share of the different market channels as followed:

- Informal markets: 78%
- Formal markets: 20%
- Contract farming <1%
- Platforms and direct supplies to consumers <1%.

4.5.2 Information sharing

Agriculture is a state-responsible subject. The development of the Agricultural Marketing System in the respective states is primarily being taken care of by the State Agricultural Marketing Boards and Directorates. In India, APMCs and Agriculture Marketing Boards play important roles in market information dissemination. These government bodies share information through display boards, print media, radio and television, SMS and online. The aim is to circumvent intermediaries. By circumventing intermediaries, produce reaches consumers in good shape with minimum handling. This results in a better price for farmers and good quality products for consumers at reasonable prices. Different traders also attend as customers in this market and meet with producers to share their information. Traders in fruit and vegetable markets across India have been organized through traders/merchants' associations which safeguard the interests of their members, facilitate transparent trade, dispute settlement and market information sharing (mainly through electronic media such as mobiles, emails, Facebook, mobile apps, etc.). They also organize producer-trader meetings to share information and future activities.

1) National Agriculture Market (eNAM)

The National Agriculture Market (eNAM) is a pan-India electronic trading portal that aims to create a unified national market for agricultural commodities. Launched in 2016, the portal is managed by the Small Farmers' Agribusiness Consortium (SFAC). Presently the e-NAM portal is used by 15.5 million farmers/sellers (including over 650 farmer producer companies), over 68,000 commission agents and 122,000 traders/buyers registered since March 2019. However, the inter-state trade through this portal has been very low due to long distances resulting in late deliveries. Trade through this portal is nevertheless increasing, with 31 fruits and 50 vegetables currently being traded. While so far, an estimated 5% of farmers have completed a transaction on the eNAM platform, there is confidence that it will pick up in usage (source: Interview with the Senior Official of Ministry of Agriculture & Farmers Welfare).

2) AGMARKNET Portal

The AGMARKNET portal also provides market information by connecting more than 3,000 regulated markets in the country to farmers. This portal provides the following information to farmers, traders, processors and other stakeholders:

- a. Dissemination of market information for arrivals and prices of crops grown across the states without the limitations of geographical boundaries.
- b. Provides information on weather forecasts, crop advice, use of fertilizers and pesticides etc., and uploads the latest research reports related to marketing and analysis of information and trends in prices and demand on a continuous basis.

The AGMARKNET website (www.agmarknet.nic.in) is a Government to Citizen (G2C) e-governance portal that caters to the needs of various stakeholders such as farmers, industry, policymakers and academic institutions by providing agricultural marketing-related information from a single window. It facilitates the dissemination, via the web, of the daily arrivals and prices of commodities in the agricultural produce markets spread across the country. The data transmitted from all the markets are made available on the AGMARKNET portal in a variety of languages. It displays commodity-wise, variety-wise daily prices and arrivals information from all wholesale markets. Various types of reports can be viewed including trend reports for prices and arrivals for important commodities. A commodity base, comprising over 300 commodities and over 2,000 varieties being transacted throughout the country, has been compiled and is readily accessible through the portal. The commodities are categorized into various groups including cereals, pulses, oil seeds, fruits, vegetables, spices, fiber crops, beverages, forest products, drugs and narcotics, dry fruits, flowers, forest products and livestock/poultry to facilitate easy retrieval of market information.

Although the portals provide useful information, they are still not widely used by value chain actors, especially smallholder farmers, due to the lack of awareness, IT equipment and knowledge.

Box 7. APMC, Azadpur: Asia's biggest fruit and vegetable market

APMC, Azadpur was established in 1977. It has one principal yard, Chaudary Hira Singh Wholesale Fruit & Vegetable Market Azadpur, and two sub-yards, Okhla fruit and vegetable Market and KelaSiding Azadpur. The principal yard is spread over an area of 160 acres and has separate entry and exit gates. The allotment of shops to the commission agents was made by the Delhi Development Authority (DDA) and initially, and the market was also maintained by them. The DDA withdrew its maintenance staff on December 1, 1979, and the market was handed over to APMC, Azadpur. The basic purpose of setting up this market was to regulate the market of agricultural produce in order to safeguard the interests of producers, sellers and consumers, and also, to provide a transparent system of sales of all types of agricultural produce at the highest possible price.

In this market, the following practices are observed:

- Vehicles freely enter through the exit. The vehicles that leave the market are generally not checked for their gate-passes or trade receipts.
- Most of the vegetables and fruits are not sold openly. Their prices are mostly fixed by the commission agents.
- The farmer is usually never there when his products are being sold.
- Commission agents take their commission from the farmers rather than the purchasers and it varies from 7% to 10%.
- Every year licenses need to be renewed between December 1 and December 31. To do this, one is required to give an "ease amount" of INR500-1,000 (US\$7-14).

There are three sets of figures regarding the number of commission agents functioning inside the market. One is from the officials of the marketing committee office, one is from the officials concerned with issuing of gate-passes, and one is from the commission agents themselves.

All available evidence points towards the failure of the Delhi Agricultural Marketing Board to fulfil its objectives of ensuring farmers receive a fair price for their products and ensuring a transparent agricultural market. Also, in all the markets it was observed when sales took place, if at all, they were conducted covertly. The reluctance of the commission agents and wholesalers to talk about the commission they charge also shows the hidden and closed manner in which business is conducted in these markets. It is obvious that transparency exists only in the law book. It was also noticed that the price of a commodity is informally decided by traders who have strong relationships among themselves and abide by the decision taken collectively. Therefore, while participating in sales they follow the practice of forming a cartel which is against the market regulations.

Thus, based on the results of our investigation, we conclude that although there are many channels including traditional and emerging ones to connect different actors in the fruits and vegetables value chains facilitated by governmental efforts to promote transparent and efficient information sharing, the situation is still far from satisfactory due to lack of awareness, knowledge and equipment, and also due to the resistance of existing interest groups.

4.6 Diversification in fruit and vegetable crops and consumption trends

4.6.1 Introduction of new varieties

There were some examples of the successful introduction of new fruit and vegetable varieties which led to the enriched food environment and therefore to more consumption of fruit and vegetables. For example, the hybrid eggplant is resistant to pests and diseases and therefore contributed to increased consumption as safe and healthy produce.

A new whole, pod-edible, dual-purpose pea variety Arka Apoorva Garden pea (*Pisum sativum* L. var. hortense), also called sweet pea is a choice vegetable grown for its shelled green seeds rich in protein (7.2% of the total mass). PG 3 is a dwarf and early maturing pea variety, ready to harvest in 135 days and with good cooking quality. Punjab 88 is an early-season variety developed by the Punjab Agricultural University (PAU), is ready to harvest in 100 days and also has good cooking quality.

Hybrid tomato varieties have been developed and are in high demand. Cherry tomatoes are in high demand by hotels and restaurants.

An onion variety named NHRDF-RED-2 has been developed which is ideal for growing in different parts of North India. The variety is accepted by farmers because of its higher yield, better adaptability and storage performance.

Respondents in the focus group discussions and key informant interviews stated that the traditional varieties of mangos are alternate bearers and give low yield due to the high vigor nature of the plant. At present, a number of hybrid varieties have been developed by crossing some of the major commercial varieties. The major hybrid varieties are Malika (Neelum X Dashehari), Amrapali (Dashehari X Neelum), Ratna (Neelum X Alphonso) and Sindhu (Ratna backcrossed with Alphonso). These varieties have characteristics including good keeping quality, color and fibreless flesh, and some varieties, like Amrapali, are suitable for high-density plantation. Off-season production of litchi in South India matures in December and January. Thus, availability will be for a longer period in India.

The major sweet orange cultivars (*Citrus sinensis*) are Mosambi (Maharashtra), Sathgudi, Batavian (Bathayi) (Andhra Pradesh), Malta and Jaffa (Punjab). These oranges are in great demand throughout the year because they are consumed not only as fresh products but also in the form of juice, jam, squash, gelatin and syrup. They therefore have a high processing potential. They are also used as a flavoring agent/spice and are the source of peel oil, citric acid and cosmetics which have international market value.

4.6.2 Consumption trends

In India, dietary and nutritional changes are in some ways typical of low-income countries starting from traditional and cereal staple-dominated diets that experienced sustained growth in household incomes. Since the 1980s, Indian diets have experienced diversification away from cheaper sources of calories, e.g., cereals, towards higher-value foods and more expensive sources of calories, e.g., milk, meat, vegetables, fruit, edible oils and sugar. We used the most recent data (2017) from the Lancet's Global Burden of Disease (GBD) study to describe the fruit and vegetable intake for each country. Table 4.12 shows that the intake of fruits and vegetables is below the recommendations of the World Health Organization (WHO) (400 g/day for fruits and vegetables combined), the GBD (250 g/day of fruits; 360 g/day of vegetables) and the EAT-Lancet reference diet (200 g/day of fruits and 300 g/day of vegetables). Gaps in fruit intake are generally larger than those in vegetable intake.

Table 4.12 *Per capita consumption of fruits and vegetables in India*

	Value
Average daily per capita consumption of fruits and vegetables (g/day/person)	262
Average daily per capita consumption of fruits (g/day/person)	76
Average daily per capita consumption of vegetables (g/day/person)	186

Source: Food System Dashboard.

During the focus group discussion and key informant interviews with gender experts, it was noted that the younger female household members, usually the daughter or daughter-in-law of the joint family, normally undertook the cooking, while decisions regarding items to be cooked were decided and/or influenced by other members of the household. Most of the women interviewed noted that husbands and other older members usually decided the food items to be consumed by each member of the household as well the sequence in which meals would be taken. The prevalent sequence of eating (i.e., children followed by adult male members and adult females) was found to be often based on the nature of the work the members were involved in, not just their age and sex. Most household members ate three times a day with the exception of children, who do not follow any fixed number of times for food consumption. Although vegetables were consumed almost daily in these households,

fruit consumption was highly occasional. Roti (chappati), rice, milk and milk products, vegetables, and dal (pulses) were the most common food items consumed daily.

4.7 High fruit and vegetable prices and reasons

4.7.1 High consumer prices

In general, it is valid to say that fruits and vegetables are relatively expensive in India compared to cereals, and fruits are more expensive than vegetables. This is in line with the trends in farmgate prices.

The table below shows an overview of the average costs in US\$, per person per day for a healthy diet defined based on food-based dietary guidelines. The cost of a healthy diet in India is calculated to be US\$3.27, of which US\$1.26 goes towards the least costly available fruits and vegetables (Table 4.13). Thus 39% of the cost of a healthy diet is accounted for by fruits and vegetables. In addition, 78% of the Indian population cannot afford a healthy diet.

Table 4.13 Cost of fruits and vegetables and proportion of cost of a healthy diet in several countries in 2017

	Cost of a healthy diet in US\$ (mean across 10 guidelines)	Cost of least costly fruit and vegetables in US\$ (mean across 10 guidelines)	Share of the cost of a healthy diet in US\$ accounted for by fruits and vegetables	Share of the population that cannot afford a healthy diet
Bangladesh	3.41	1.17	34%	75%
Burkina Faso	3.66	1.08	30%	90%
Ethiopia	3.73	1.46	39%	84%
India	3.27	1.26	39%	78%
Nepal	4.13	1.72	42%	76%
Nigeria	3.57	1.21	34%	91%
Tanzania	2.62	0.86	33%	85%

Note: These results are based on analysis of the 2017 ICP dataset to find the lowest cost foods in each country. National datasets may have additional foods that may be lower or higher cost at different times and places in the country. The proportion of the cost of a healthy diet is based on the mean cost of 10 different national food-based dietary guidelines. The mean cost may differ from the median cost, which was reported in the SOFI, 2020.

Source: Anna Herforth and Aishwarya Venkat, personal communication. Based on the analysis in (Herforth et al., 2020).

The consumer prices for fruits and vegetables are in general higher than those for cereals in India. The prices of the fruits and vegetables are shown in Table 4.14 while the prices of cereals such as wheat range from US\$0.56-0.7 per kg. Except for onion and eggplant, which are the most commonly available fruit and vegetable items consumed in the country throughout the year, all selected fruits and vegetables are more expensive than cereals.

Table 4.14 The consumer prices for fruits and vegetables in India.

Commodity	Consumer Price (US\$/kg)	Season	Remarks
Mango	1.26-1.96	2021	Arrival has just started, therefore, prices are higher.
Orange/kinnow	0.84-0.98	2021	Oranges are not available due to the off season; however, another variety of citrus is available and in high demand.
Onion	0.49-0.56	2021	-
Eggplant	0.56-0.7	2021	-
Tomato	0.84-0.98	2021	-
Green peas	1.12-1.4	2021	Off-season.
Litchi	0.63-0.84	2020	Season starts in May.

Source: Compiled from AGMARK portal.

Table 4.15 also shows that fruits are in general more expensive than vegetables. Of course, the prices are also determined by whether the products are in-season or off-season, however, the general trend that fruits are more expensive than vegetables is valid.

Based on the National Sample Survey Office's (NSSO) Consumer Expenditure Survey (CES) 68th Round in 2011-12, the annual per capita expenditure on vegetables in rural areas was US\$16.12 and US\$20.73 in urban areas (Table 20).

Table 4.15 Expenditure and quantity of vegetable consumption in India in 2011-12

Sector	% of households that consumed vegetables	Per capita per year (US\$)
Rural	98.7	16.12
Urban	92.6	20.73

Note: 1. Monthly quantity and expenditure reported by the NSS-CES are re-calculated per year; 2. Estimates include potato as well but the WHO-recommended intake quantity of vegetables excludes potato and other starchy tubers.

Source: Authors' calculations based on the NSSO-CES (2011-12) Report.

The National Accounts Statistics (NAS) also provides their estimations on the expenditure on vegetables. According to the NAS, the annual per capita expenditure on vegetables has increased from US\$20.13 in 2011-12 to US\$40.19 in 2017-18 (Table 4.16).

Table 4.16 Per capita private final consumption expenditure in US\$ during in India

Item	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Total	548.82	620.54	706.69	780.15	865.14	962.33	1053.89
Food: All	163.53	189.09	219.97	236.85	248.18	285.94	289.37
Vegetables	20.13	22.96	28.11	32.02	32.68	33.66	40.19

Source: National Account Statistics (NAS), Government of India.

Moreover, McKinsey and ICICI (2013) envisaged that the total food expenditure in India will increase at a CAGR of 3.8% over the period 2010-30, from INR11 trillion (US\$154 billion) in 2010 to INR23 trillion (US\$322 billion) in 2030. The noteworthy point is that traditional food items like cereals and pulses as well as oils will grow at a lower rate of 2% CAGR over the period 2010-30. On the other hand, fruits and vegetables are expected to grow faster with an expected CAGR of 4.7% over the period 2010-30 (Figure 4.11).

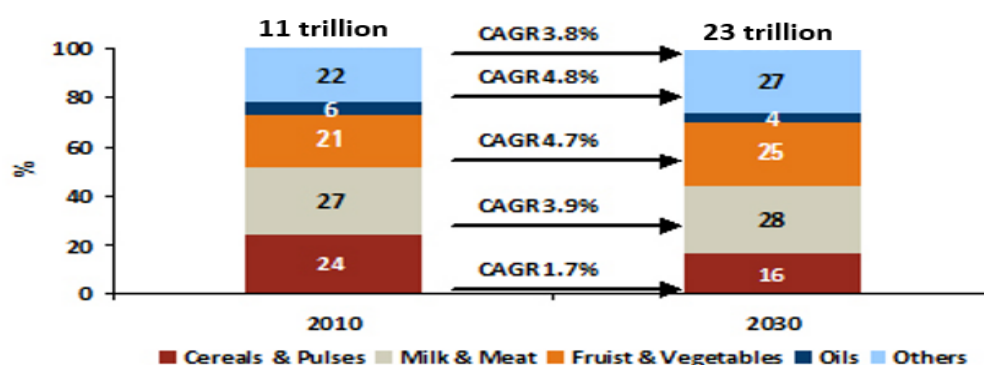


Figure 4.11 Change in food expenditure consumption patterns over the period 2010-30

Source: Adapted from McKinsey Research, ICICI Securities

<https://www.livemint.com/Politics/ZVtmOSHGHcmqGHhsi1IxII/Indias-food-consumption-to-more-than-double-by-2030-CIIMc.html>

4.7.2 Reasons for high prices

The cost of fruit establishment is very high and perennial in nature as fruit comes into commercial production after 6-7 years depending on the rootstock. The annual maintenance cost per unit is also high, therefore the cost of production is higher than cereals. Moreover, the prices of fruit and vegetables are higher because of their nature of perishability.

Seasonality also makes the prices of fruits higher than other food categories. Fruits are perishable and fragile as well as consumed in distant markets in which marketing costs on grading, packing and transportation are very high compared to cereals which are generally packed in jute bags and are mostly locally sold. In addition, in the fruit and vegetable value chains, a large number of intermediaries are involved and make it more expensive than other food crops.

We conclude from this section that the fruit and vegetable prices are indeed high in India due to the specific features of fruit and vegetable products and value chains.

4.8 Women's participation in fruit and vegetable production and value chain operations leads to women's empowerment

4.8.1 Examples of women in fruit and vegetables production and value chains

The overarching trend in India is that women remain limited in their opportunities to break out of their normative roles and become leaders of agribusinesses, or at least breadwinners in their own right within the smallholding context of rural India. There are however exceptions to this, as illustrated in these case studies and the key points summarized as follows:

- For women with little education and access to land in rural contexts, apart from their own motivation, a husband's support is key to success.
- Especially in rural contexts, women have to take the initiative to be norm-breakers. Promoting women leaders and supporting women's start-ups at the micro-scale can help lower this social stigmatization when starting out. The barriers for educated (urban-based) women to found and run start-ups are far lower.
- Pioneering women are able to lower the barriers for other women through direct support and by changing the social stigma around women as business leaders in their own right.
- Organizing structures such as self-help groups are simple and effective means to provide the supportive environment necessary for women to gain skills and confidence. Producer groups are the next step up. Neither of these automatically translate into a profit-making enterprise but lay the basis for this potential next step.

'Kisan Chachi' ('Farmer Aunt')

Mrs Rajkumari Devi started farming in the early 1980s in Muzaffarpur when her husband and other villagers were not able to earn enough from growing tobacco. A mother of three, her husband was not able to generate enough income himself, and so she managed to enrol in Dr Rajendra Prasad Central Agricultural University. Using one of the 2.5 acres owned by her husband, she divided it into small plots to grow organic vegetables and fruits, including bananas, mangoes and papaya (as well as paddy and wheat). Instead of handing over the produce to her husband to sell at market, she took the produce herself by bicycle from village to village to sell there, as well as spread the word about generating an income to other women. Over time her reputation was built and she gained the nickname 'Cycle Chachi'. She started teaching more women about agricultural practices and set up the non-profit Anandpur Jyoti Centre, along with her oldest son, Amrendra. The foundation supports women to establish and run self-help groups (SHGs) to grow and either sell fresh fruits and vegetables, or process them into jams, jellies and pickles. These are sold in large cities like Mumbai and Delhi. To date, nearly 300 women have formed SHGs with the support of the foundation.

Her own community and others were skeptical of this norm-breaking lady and many shunned her. This attitude changed however as her reputation grew, and she was conferred India's fourth highest civilian award, the Padma Shri, as an extraordinary farmer.⁶

Organic farming

Kamala Pujhari is a 69-year-old tribal agricultural activist from Koraput, a rural township in Odisha. Having helped pioneer organic farming for years, in 2002 she was sent to South Africa for an organic farming workshop and received awards that same year and in 2004 from the Odisha government for best farming practices. Over the years she has worked with several tribal villagers to help them abandon chemicals and switch to organic farming practices and was appointed in 2018 as a member of the Odisha Planning Board by Odisha CM Naveen Patnaik.⁷

Self-help groups

Gurdev Kaur Deol had a secure government job but decided to quit to start a foundation called the Global Self Help Group. Following a short training she founded the Global Self Help Group in 2008 (officially registered in 2015) and used 2.5 acres of land she owned in her village, Gurdev Kaur Deol, to support and train other women in organic farming. The NGO acts as both a support structure and aggregator for over 400 farmers and their produce, and makes sauces and juices as well as honey.⁸

Educated women as business leaders

Like in the previous case, there are multiple examples of higher educated women choosing to go into agribusiness because they see a start-up opportunity. Gitanjali Rajamani and Kheyti Saumya are both illustrative of this, having successfully begun start-ups. Ms Rajamani started Famizen in 2017, which allows people that live in cities to rent community farmland close to where they live to produce organic crops. When they don't have time to manage this, on-site farmers are paid to take care of the land. Ms Saumya supports small-scale farmers with her start-up 'Greenhouse-in-a-Box' (GIB), providing a mini-greenhouse, technical support and credit provision. Neither of the women focus specifically on supporting female smallholders but illustrate that gender prejudice towards women in agribusiness drastically declines once a higher level of education is achieved.⁹

Mango in self-help groups

Pickled fruits and vegetables have a high demand both domestically and abroad, especially homemade varieties that are made in earthen jars (which contributes to the flavor). Pickled mango is particularly popular. A self-help group in Uttar Pradesh has been formed and trained in part by the Central Institute for Subtropical Horticulture. Individually, these women used to only go as far as making 'khatai', a sourcing agent derived from mango, which was then sold for little to no profit to middlemen. The institute helped them to process mango into a variety of products, including pickled mango, 'amchur' (dry mango powder) and 'panna' (a refreshing drink made from mango pulp) which they are able to sell directly to consumers. This direct link to consumers has both helped raise income and better understand consumer preferences.¹⁰

⁶ <https://m.dailyhunt.in/news/india/english/kalam+times-epaper-kalamtm/kisan+chachi+of+bihar+name+earned+from+farming+now+showing+the+way+to+other+women-newsid-n196953686>

⁷ https://en.wikipedia.org/wiki/Kamala_Pujari#:~:text=Kamala%20Pujari%20is%20a%20tribal,the%20field%20of%20organic%20farming

⁸ <https://yourstory.com/herstory/2019/04/women-farming-initiatives-agriculture-india>

⁹ <https://yourstory.com/herstory/2019/04/women-farming-initiatives-agriculture-india/amp>

¹⁰ <https://en.gaonconnection.com/amid-the-lockdown-rural-women-led-self-help-group-in-lucknow-up-processes-mango-pulp-into-various-products/>



Mango in producer groups

Mango is a widely sought-after product for both small- and large-scale industry. At the larger scale, mango is one of the most sought-after products for the fruits drink market and so is purchased by multinationals like Marico, Godrej, Parle, PepsiCo and Coca-Cola. To facilitate this broader market demand, producer groups can provide a useful structure for women helping them to generate a good income while maintaining time flexibility.



This is evidenced by Ms. Puse who cultivates two of Odisha's high-quality varieties of mangoes, Amrapalli and Mallika. Until 2015, reaching the market meant walking kilometers with mangoes on her head. On a good day, she would earn 8 rupees/kg (11 cents USD). More often than not, she had no choice but to sell her produce for even less to a wholesale trader. This changed in April 2016, when she became a member of one of the producer groups set up in three districts — Koraput, Raigada and Gajapati — by the Odisha Livelihoods Mission. Producer groups aim to help farmers benefit from scale, organizing them into community entrepreneurship units and providing training. For many women like Puse, who has no formal education, this has meant training in pre- and post-harvest techniques, book-keeping, grading, sorting and packaging of produce to increase the value of their products. One year on, Puse's income has more than doubled. "Earlier, the land earned barely enough to live on," she says. "Now, I earn more than 40 rupees/kg (54 cents USD) of mango. I can now feed my children better and even send them to school." In Koraput, almost 800 women mango cultivators like Puse are organized into 14 producer groups and are benefiting from this intervention. "In a producer group, all goods, whether from big farms or small, are grouped and sold together. The income is then distributed among the farmers based on their produce. This way, every mango counts!"¹¹

Litchi in producer groups

Litchi is another high-value crop that, with the proper support, can benefit women. The Women's Advancement in Rural Development and Agriculture Program (WARDA) is funded by the Bill and Melinda Gates Foundation (BMGF) and is in partnership with the Bihar Transformative Development Project and JEEViKA (implemented at Bihar state level).

¹¹ <https://undp-india.exposure.co/mango-republic>



Covering litchi bunches using bags to protect fruit from birds

It helps set up and provide technical assistance to producer groups to support rural women to improve their lives and communities. To help the women get the most out of litchi, they were supported to establish Samarpan JEEViKA Mahila Kisan Producer Company Limited (SJM KPCL) in 2012. The creation of this women-led farmer producer company was part of a wider initiative to support a total of 496 litchi producing women to get their crop to market. WARDA also connected farmers with the National Research Centre on Litchi, Bihar. Leveraging this local, expert knowledge, WARDA trained women on better orchard management practices, introducing them to simple techniques that they could easily implement on their orchards, such as covering litchi bunches in bags to protect them from sunburn and pests (see picture above). WARDA has pioneered several innovative measures to support smallholder women farmers and has demonstrated the use of new technology to successfully pilot and scale up interventions for economically empowering women who are usually heavily dependent on their male counterparts. The program has the potential to create large scale, sustainable impact on the overall economic development of Bihar and demonstrate a market-oriented model for women's economic empowerment that can be replicated across other parts of the country (Tripathi et al., 2020).

4.8.2 Business models

The case studies above and policy interventions in the following section highlight three consecutive levels of business model types that have been shown to support women in the four focus states (note that the case studies are specific to fruits and vegetables but the policies focused on women in rural livelihoods are not differentiated by crop). Self-help groups provide the lowest threshold of entry for women to gain support without having to commit major resources and time, and so can reach the largest number of women. Producer groups provide greater support through more opportunity to aggregate and grade produce, and provide more services to the female members – though the group must be connected to a large enough market to remain viable. Finally, the more traditional business models of an enterprise start-up can benefit women directly as leaders, indirectly through support from that business, and illustrate to others that women have just as much business acumen as men.

Self-help groups

Self-help groups help women as small informal associations created for the purpose of enabling members to reap economic benefit out of mutual help, solidarity, and joint responsibility. The benefits include mobilization of savings and credit facilities and pursuit of group enterprise activities. The group-based approach not only enables the poor to accumulate capital by way of small savings, but also helps them gain access to formal credit facilities, and in turn provide collateral security. A self-help group generally consists of 10–20 members drawn from a relatively homogeneous economic class, self-selected on the basis of existing affinities and mutual trust. The meeting procedures and processes, leadership change norms, intensive training and guidance are designed to enable these groups to function in a participatory and democratic manner. The objectives of the groups include the overall development of members in the social, political, cultural and economic arena.

Producer groups

A producer group is a business organization, owned and managed by poor and marginal producers for their mutual benefit, formed with an objective of enhancing production and access to services and

markets. Producer groups consist of between 50-150 members involved in the same activity, and so are usually more formal than self-help groups and have more hierarchy and structure. Section 4.8.1 has two examples of producer groups which illustrate the benefits of women joining a larger, more formal structure. A key aspect of getting external support to scale — as illustrated in these examples — is receiving training on health and safety requirements for these products, something which is often missed at the self-help group level.

Agribusiness entrepreneurs

The case studies in Section 4.8.1 highlight two examples of more affluent and educated women that have founded and lead agribusinesses, and one of a semi-educated rural woman who managed to buck social norms to set up a foundation that supports other women. Though in terms of scale, supporting women-led start-up enterprises may have a lower reach than supporting women through self-help groups or producer groups, women active in the agricultural sector and in leadership positions can act as catalysts for change in norms and attitudes of community members, parents of daughters, and of young women themselves as to who can contribute to household income through sale of higher value fruits and vegetables.

4.8.3 Public policy

India has a wide variety of policies that support women in rural contexts. None have been identified that specifically focus on women working on specific crops, so the following is an overview of gender-based policy within the rural livelihoods context more generally, that have shown evidence of benefiting and empowering women.

ICAR-Central Institute for Women in Agriculture (ICAR-CIWA) is an institution set up in 1996 to undertake research on various issues affecting women's roles, participation and emerging opportunities in agriculture. It is housed within the wider Indian Council of Agricultural Research (ICAR) which itself is part of the Ministry of Agriculture and Farmers Welfare. CIWA is one of the leading centers for gender research, and serves as a catalyst for gender mainstreaming and women's empowerment in agriculture through various programs, as well as supporting other R&D institutions in the country to bring a gender-aware perspective into their work.

Its research has focused on participatory action to test the suitability of technologies for rural women to support in their work and workload. These are introduced through various projects and themes, including integrated farming system, integrated pest management (IPM), drudgery, livestock and fisheries, extension methodologies and gender indices. Two examples of these are as follows; in 2015, ICAR established a network of 645 Krishi Vigyan Kendras (KVKs, translated as 'farm science center' or agricultural extension center) to assess and demonstrate technologies and build skills capacity. Over two years 205 women-specific income generation technologies were assessed, covering 2,917 trials around drudgery reduction, farm-mechanization, health and nutrition, processing and value addition, production and management, energy conservation, small scale income generation and storage techniques. The major enterprises included mushroom, sericulture, vermicompost production and nutritional gardens. Almost 340,000 rural women were trained in these programs.

At a smaller scale, in 2014-2015 under the Sub-Mission on Agricultural Mechanization (SMAM), 31 drudgery reducing technologies for women in agriculture were promoted through trainings and demonstrations. Women beneficiaries were also provided 10% additional financial assistance for purchase of various agricultural machines and equipment. Farm Machinery Training and Testing Institutes conduct training on agricultural mechanization for women farmers and have trained 936 women farmers.

JEEVIKA

Launched in 2006 by the Bihar Rural Livelihoods Promotion Society (an autonomous body under the Department of Rural Development) with the support of the World Bank, JEEViKA targets women in poor rural households, helping them improve their livelihoods and enhance household incomes through a core set of interventions; organizing women into self-help groups (SHGs), training and strengthening the SHGs, federating the SHGs into village organizations (VOs) and cluster-level

federations (CLFs), and establishing bank linkages for the SHGs and their federations. Over time, these groups can become membership-based social service providers, business entities and clients of the formal banking system. Over its 13 years of operation, JEEViKA has reached some 1.8 million women in thousands of villages and has proven to be very successful at empowering women through their increased economic contributions.

Broader rural poverty-reduction policies

Besides programs that focus specifically on women in agriculture, more broad-based rural programs either include a gender component or support women as part of poor households to improve their income and wellbeing; the National Horticulture Mission supports women to become more self-reliant through SHGs, and state-sponsored extension reform programs have a 30% minimum quota of resources to be utilized by female farmers and extension workers, and promote their role in decision-making positions of Farmers' Advisory Committees.

Launched in 2011 by the Ministry of Rural Development, the National Rural Livelihoods Mission (NRLM) is an umbrella program supporting multiple initiatives at national and state levels; the start-up village entrepreneurship programs (SVEP) focuses on providing self-employment opportunities with financial assistance and training in business management and soft skills while creating local community cadres for promotion of enterprises. SVEP is implemented across multiple states, while the Orissa Livelihoods Mission (OLM) is a state-specific implementing arm of NRLM targeting poor households through self-help groups, and which are in turn federated into higher level institutions at cluster, Gram Panchayat and block level. In turn, state level programs like the Society for Elimination of Rural Poverty (SERP) in Andhra Pradesh were set up independently to support rural poverty reduction through social mobilization and improvement of livelihoods, and which have since been adopted by the NRLM as a replicable model for other parts of the country.

4.9 Public enforcement of standards and food safety

4.9.1 Relevant standards

Food is a major determinant of health, nutritional status and productivity of the population. It is, therefore, essential that the food we consume is wholesome and safe. Unsafe food can lead to a large number of food-borne diseases. Food safety and quality are important at the home level, but are critical in large-scale food production and processing, and also where food is freshly prepared and served. In the past, many foods were processed at home. Advancements in technology and processing, larger per capita incomes and better purchasing power, as well as increased consumer demand have led to a variety of processed foods and food for health or functional foods being manufactured. Trade is inextricably linked to food security, nutrition and food safety. Trade affects a wide number of economic and social variables, including market structures, the productivity and composition of agricultural output, the variety, quality and safety of food products, and the composition of diets. The institutional framework and the system that governs the development and application of international food safety standards is the Prevention of Food Adulteration Act 1954 (PFA, 1954), Food Safety and Standards Authority of India (FSSAI), etc.

The Prevention of Food Adulteration Act 1954 (PFA, 1954) was enacted by the Government of India to prevent adulteration of food. The Act has been amended as needed numerous times (over 200 amendments). All food products manufactured in India or imported and sold in India must meet the requirements prescribed under this Act. In addition to PFA, there are other orders or acts that help to ensure the quality of specific foods such as:

- a. Fruit and Vegetable Product Order: Specifications for fruit and vegetable products are laid down.
- b. Meat Food Products Order: Processing of meat products is licensed under this order.
- c. Vegetable Oil Products Order: Specifications for vanaspati, margarine, and shortenings are laid down.

The Standard of Weights and Measures Act, 1976 was enacted to establish standards of weights and measures, to regulate inter-state trade or commerce in weights, measures, and other goods which are sold or distributed by weight, measure or number, and to provide for matters connected therewith or

incidental thereto. Generally, the law requires the majority of food, drink and other goods sold to the public to have their quantities indicated for the customer. This includes goods that are weighed or measured at the customer's request or packaged ready for sale.

Organic food standards are regulated by Food Safety and Standards (Organic Foods) Regulations, 2017 notified under the provisions of Section 22 of the Food Safety Standards Act, 2006. Organic certification is a certification process for producers of organic food and other organic agricultural products. In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants. The Food Safety and Standards (Organic Foods) Regulations, 2017 are based on the standards of the National Programme for Organic Production (NPOP) and Participatory Guarantee System (PGS-India). However, direct sales of Organic Food by the small original producer or producer organization to the end consumer exempt from verification of compliance. In December 2017, the Food Safety and Standards Authority of India (FSSAI), introduced the Jaivik Bharat logo to help customers identify authentic organic food. Food Safety and Standards Authority of India (FSSAI) is an autonomous body established under the Ministry of Health & Family Welfare, Government of India. The FSSAI has been established under the Food Safety and Standards Act, 2006, which is a consolidating statute related to food safety and regulation in India. FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safety.

4.9.2 Adherence to food standards

Adherence to international standards is a problem in the agri-food industry in India as there is a large domestic market for products that stringent regulatory authorities would reject. People often do not demand, for example, process certification or assurance of minimal pesticide residues. This may be because they are often not aware of the public health risks that international standards aim to protect against. They may also assume, sometimes incorrectly, that it is possible to assess the product quality at the point of purchase when the market has few middlemen. It was also gathered during market visits that pouches of calcium carbide are placed with mangoes and when this chemical comes in contact with moisture, acetylene gas is produced, the effects of which are similar to ethylene. It was also informed by experts that the use of calcium carbide for artificial ripening is prohibited by FSSAI, considering the health problems they pose. From disorders like dizziness, sleepiness, mental confusion and memory distortion, calcium carbide is known to affect the neurological system. The traces of arsenic and phosphorous hydride cause additional damage to hormonal functioning.

It was gathered during the discussion with officials that governance and enforcement is a big challenge in India. For this reason, standard establishment and enforcement may better be delegated to the local governments. Moreover, lack of testing facilities and skilled manpower, lack of transparency in governance, the influence of big players, etc. are also areas of concern.

4.9.3 Consumer trust in local standards

During the various FGDs, urban consumers revealed that at the point-of-purchase, consumers' decisions are based on color, price, freshness, and information communicated by packaging. Labeling is one of the instruments that helps consumers make a well-informed choice. Consumers trust standards printed on the labels of processed food products and are generally unable to assess the quality of food without the reflection of different traits. As long as labels display ingredients, expiration date, health information, and environmental attributes, consumers often rely on them to assess the food quality attributes.

For other stakeholders in the food system:

- Mandis ensure price transparency and middlemen offer credit to farmers' which is the key to maintain trust among themselves.
- The fruits and vegetables brought to the markets are not uniformly graded as per prescribed standards and therefore, traders regrade them in the market.
- It was also revealed that some farmers do the top grading in the case of fruits while packaging the boxes. In this case, the farmer puts top quality produce in the upper layer in the box or carton followed by poor quality produce in subsequent layers. This leads to a lack of trust and traders open the box from the bottom while selling the produce. Understanding consumers' perceptions of food quality is highly relevant because their buying decisions depend on the produce supplied by farmers and sources. In the absence of proper post-harvest facilities, fruits and vegetables being perishable travel through varied temperature which affects the quality. In many cases, the appearance of produce does not reflect the true condition as there is quality deterioration within the fruit or vegetable. The situation is further complicated when consumers' interpretation of quality contradicts the official definition of it; that is when perceptions create barriers in recognizing food quality.
- The trading of fruit and vegetables is allowed only by open auction under the supervision of the market inspector as per the regulations, but it was observed during the market survey that traders adopt other methods such as negotiation and an undercover system. In this system, representatives of traders and farmers decided the price by putting a piece of cloth on their hands and finalize by touching the fingers — secret codes which neither purchasers nor sellers are aware of. This non-transparent system leads to mistrust among stakeholders on the local standards.

4.10 Nudging and public extension

4.10.1 Policies and strategies

The government of India and some state governments are promoting the holistic development of horticulture through various schemes. The focus of the schemes ranges from production to storage and marketing of mango. The agencies running these schemes are the National Horticulture Board, Ministry of Food Processing, Agricultural and Processed Food Products Export Development Authority (APEDA), Directorate of Marketing and Inspection (DMI) and the horticulture departments of different state governments. In 2014-15, the Government of India integrated different horticulture schemes under an omnibus Mission on Integrated Development of Horticulture (MIDH). An assistance of INR0.15 million /ha (US\$2100/ha) has been provided by MIDH for a drip irrigation system with integration and INR0.10 million/ha (US\$1,400/ha) has been given for a system without integration. An assistance of INR5 million/unit (US\$70,000/unit) has been provided for an integrated packhouse including facilities such as conveyor belt, sorting grading units, washing, drying and weighing. The assistance provided for a ripening chamber was INR0.10 million/t (US\$1,400/t). These are credit-linked back-ended subsidies covering 35% of the project cost in general areas and 50% of the project cost in hilly and scheduled areas, per beneficiary.

APEDA is also providing assistance of 40% of the cost of equipment subject to a maximum of INR1 million/t (US\$14,000/t) per beneficiary for setting up sheds for intermediate storage and grading, storage and cleaning operations for produce, as well as mechanized handling facilities and a pre-cooling facility. Besides the above-mentioned schemes, many states like Odisha, Uttar Pradesh and

Maharashtra are investing heavily in the establishment of fruit processing infrastructure where mango is one of the focus crops.

Other policies include:

- Under the Centrally Sponsored Scheme Support to States Extension Programme for Extension Reforms, mainstreaming gender concerns in agriculture are being addressed by ensuring utilization of a minimum 30% of resources on programs and activities for women farmers and women extension functionaries. To encourage women farmers' participation in the planning and decision-making process, their representation in the Farmers' Advisory Committee at Block, District and State level has been provided under the scheme's guidelines.
- Under the Sub Mission on Seed and Planting Material (SMSP), training is provided under the components of the Scheme Seed Village Programme and Quality Control Arrangement of Seeds in which women farmers are equally benefited. State governments are also advised to allocate adequate funds to women farmers.
- Under the National Food Security Mission (NFSM) implemented in 28 states, 30% of the allocation of funds is being earmarked for women farmers. There is also an intervention under NFSM providing cropping system-based training to farmers, and women farmers to create awareness on improved technology for increasing production and productivity of crops. State governments are implementing the NFSM as per the provisions of the guideline.
- The Mission for Integrated Development of Horticulture (MIDH): The aim of MIDH is to: a) Promote holistic growth of the horticulture sector, through area based regionally differentiated strategies, which includes research, technology promotion, extension, post-harvest management, processing, and marketing, in consonance with comparative advantage of each State/region and its diverse agro-climatic features; b) Encourage aggregation of farmers into farmer groups like Farmer Interest Groups (FIGs)/FPOs and FPCs to bring economy of scale and scope; c) Enhance horticulture production, farmers' income and strengthen nutritional security; d) Improve productivity by way of quality germplasm, planting material, and water use efficiency through micro irrigation; and e) Support skill development and create employment generation opportunities for rural youth in horticulture and post-harvest management, especially in the cold chain sector. The overall impact of the scheme (Global AgriSystem, 2020) reveals that:
 - The scheme has helped the beneficiaries to grow remunerative crops under horticulture. There has been a 5.42% increase in the area of fruits and a 2.51% increase in the area of vegetables during 2014 to 2019.
 - Per capita availability of food including fruits, vegetables, and other horticultural crops for the family has increased. Expenditure on education of the children has also increased. In addition, 86% of respondents reported that their access to drinking water and sanitation facilities had increased, while 86% of beneficiaries responded that their access to better health care facilities had increased.
 - Before availing of the scheme, per household net income was INR0.433 million (US\$6,062 /ha). This increased to INR0.606 million (US\$8,484/ha) after availing of the scheme, i.e., the income has increased significantly by about 45%.
 - There has been an increase in employment also through National Health Mission (NHM) or Economic development agency in New Delhi (HMNEH) interventions. The scheme has increased the annual employment in terms of man-days by 35% and the annual wage percentage has also increased by 29%.

4.10.2 Systemic constraints for women

Women face a number of nutritional barriers, despite various policies and programs designed to support improvements in nutritional intake. During the focus group discussions women highlighted the following key constraints:

- Personal factors: Despite some nutritious green leafy vegetables being available to them, the perception is that they are 'dirty' and 'poor people's food', especially amongst younger women who also didn't know how to prepare them.
- Cost and prioritization: Some fruits and vegetables are expensive and so while women know that they are healthy, they will prioritize their kids over themselves with any small amount that their budget will allow for. Cost will also determine which fruits and vegetables are purchased.

- Market access and decision-making: Similar to the above point, in many cases it is socially unacceptable for women of lower castes to go to the market, or they simply don't have the time given household responsibilities. Instead their husband selects and purchases what then gets eaten in the household. Oftentimes their husbands, mothers and fathers-in-law have priority in deciding what is purchased and consumed in the household anyway.
- Opportunity to consume: Husbands and then children are typically prioritized in access to food in the house, so women have the least opportunity for dietary preference for themselves. Some women also indicated that they are only able to eat after finishing their chores, which can take many hours.

There are however a number of public programs that aim to address nutrition deficits amongst women and the household more generally. The National Nutrition Mission (NNM) is a national nutritional strategy with the ambition of reducing stunting, under-nutrition, and anemia among young children, women and adolescent girls, as well as reducing low birth weight across India by as early as 2022. Underneath this umbrella program are multiple interventions aiming to reach children and mothers (National Action Plan for Children) including nutrition and health education (Integrated Child Development Services), mid-day school schemes, and improving nutritional status specifically for adolescent girls.

A subsidiary program of JEEViKA (see Section 4.8.3 on public policy) is The JEEViKA Multisectoral Convergence Model (JEEViKA-MC), developed under this livelihoods program to address undernutrition among women and children. This program is targeted to female members of SHGs formed by JEEViKA in 12 village councils (gram panchayats) in Bihar, with a special focus on households with young children, mothers of young children and pregnant women.

Similarly, the Odisha Livelihoods Mission (OLM) implementing the NRLM within the state (see Section 4.8.3) includes a component specifically working on nutri-gardens to improve nutrition, and specifically targets some of the barriers women face. Last year, some 90,000 'nutri-gardens' were prepared in the state and in 2021 the target is 500,000. Women get seeds such as eggplant, chilies, ridge gourds and bottle gourds, and rural families are encouraged to rear poultry and goats for adequate nutrition and dietary diversity. The intention is to promote dietary diversity rather than families looking to only one type of vegetable (such as eggplant, which is popularly grown) as well as introducing varieties that are not as dependent on water, for example, moving from tomatoes to okra which is less water-intensive. These nutri-gardens have multiple benefits for women, offering them more control over the produce that is grown, avoiding the cost of fluctuating market prices and improving market access for mobility-constrained women, and allowing any surplus vegetables to be sold and thus, generate income.

4.11 Factors affecting consumers likelihood to increase fruit and vegetable consumption

4.11.1 Availability, affordability and acceptability

During interviews with farmers and key informant interviews with experts, participants stated that food prices influenced food choices and food affordability due to the household's income. In addition, the price and affordability of food affected food security at all levels.

While food price has been reported by some groups as a more important determinant of food choice than taste, promotions, convenience, or environmental concerns, there is still much to learn about the impact of food prices on dietary. Generally, consumers purchase fewer foods when prices rise and the converse when prices fall. However, estimates of food price elasticity values vary greatly and in general, fruits and vegetables have a very high price elasticity (Sikka, 1986).

Price volatility affected all value chain actors and led to large amounts of wastage. It also meant that several products, particularly fruit, were too expensive for many consumers. During field investigations in study areas, it was found that in rural areas over 80% of rural inhabitants revealed

that they were unable to afford even two servings of vegetables except for onion and one serving of fruit per day. It was also found that consumption of these foods decreased as relative cost per serving increased.

The policy experts stated that there may be several opportunities to intervene within fruit and vegetable value chains to increase availability, affordability and access to good quality products such as subsidy/support to villagers to adopt kitchen or community garden interventions. Furthermore, they suggested that the challenges and constraints women face must be treated as a key component in the fight against hunger and malnutrition. Such an approach is achievable. Although it is inexpensive, it can be highly effective. The cost to society of not acting urgently and more decisively will be considerable. The benefits of better education for girls and women are significant. Programs that will improve girls' access to school are essential for poverty reduction and improved nutritional outcomes.¹²

4.11.2 Consumer motives and barriers

While there is a general lack of access to sufficient nutritious foods in rural areas, the focus group discussions illustrate that there are multiple and significant gender-related barriers for women and girls to raising nutritional consumption.

Personal factors: These included women's own likes and dislikes of certain foods. Some women reported during the focus group discussion that wild green leafy vegetables grew abundantly locally and were freely available, but they said that these vegetables were considered "dirty" or "poor people's food". It was usually the younger women who dismissed these vegetables and claimed that they did not know how to prepare them. They also reported that women eat indigenous plants, but young people believe that these are unhealthy and look "dirty". Women generally knew that fruits and vegetables were beneficial for health and had the cooking skills to prepare vegetables. Many women expressed a preference for their children to consume any fresh fruit or vegetables that were available. One woman explained that as long as her daughters had fruit, this was more than enough:

"I am not bothered about myself. I overcome my craving."

Family composition: Many women reported that decisions about what to eat were made by their husbands or their mothers and fathers-in-law hence there was no option for them to decide:

"Whatever vegetables we get, we prepare."

Due to cultural taboos, women in rural India usually eat after the rest of the family and not get to eat proper meals. Men get a proper meal as revealed during the focus group discussion. Children's likes and dislikes were considered important in terms of which fruits and vegetables were consumed. Some women said that if there was fruit in the house, it was given to the children first and if anything was left over the rest of the family would eat it.

Social and cultural norms: Women talked about the norm that men would shop in the market and therefore choose which foods were consumed within the household. It was reported that for some castes it was not considered acceptable for a woman to go to the market. Also, the time and workload burdens on women were not alleviated by their husbands because it would be improper for a man to do household work. If men were seen doing household work then everybody in the village would gossip or say negative things about him, due to India being a male-dominated society.

Overburdened: Many women stated that their appetite for some foods including fruits and vegetables was affected by the daily activities such as getting children ready for school, cooking, household work and farm work. In addition, women must fetch the water, wash the utensils and get flour from the mill. It is only after these activities that they get to eat.

¹² <https://www.adb.org/sites/default/files/publication/30315/gender-equality-and-food-security.pdf>

Time pressures: Travel to the farm for work and time spent at work itself was a major component of women's daily routines and some of them reported that they did not have a full meal in the morning because they needed to rush to the farm. This indicates that work takes priority over preparing and eating food for women.

Seasonal and practical factors: One of these factors included the season of the year. Summer was reported to be a time when fruits and vegetables were in short supply, expensive and often of poor quality. Many women reported preserving certain vegetables to be consumed during the summer. Water availability was an important factor governing whether households could maintain kitchen gardens and therefore grow their own fruit and vegetables.

Cost: Most women stated during discussions that cost was a major factor in terms of the fruit and vegetables they consumed. The decision about which vegetables to buy in the market was often based on the price, and this was considered more important than quality. Many women talked about being poor and having to manage on very low incomes. They often mentioned compromising by buying small amounts of fruit or vegetables and giving these to the children before eating them themselves.

We conclude that the high costs of fruits and vegetables are the major barriers for Indian households to increase their consumption. This is especially the case for women who are the last to consume fruits and vegetables in the home. Furthermore, availability, personal preference, overburdening and cultural issues also hamper the household and women's consumption of fruits and vegetables.

5 Conclusion

The horticulture sector contributes to 4.7% of India's GDP and is of significant relevance for people's livelihoods, especially in the rural area. The per-capita daily consumption of fruit and vegetables is calculated at 262 gram per day per person. This is well below the WHO recommended daily intake.

The increases in fruits and vegetable production during the last decade was mainly due to land expansion instead of productivity enhancement. The underdeveloped value chains, characterized by poor infrastructure and technology applications lead to high losses and unstable productivity and prices. Those factors undermine the efforts to further increase the supply and consumption of fruits and vegetables in India and at the same time hamper the income increase for Indian farmers. Together with the unsecured market, there are significant barriers for farmers (especially the smallholder ones), to intensify their fruits and vegetable production. Moreover, the existence of large numbers of middlemen in the value chains raises the problem of an unbalanced chain power distribution which leaves (smallholder) farmers in a very vulnerable position. Since farmers have no say on the farmgate prices of their products, they get easily squeezed by other supply chain players. However, on the other hand, the middlemen are a big group in the fruit and vegetable sectors. Totally eliminating them from the value chains would cause significant unemployment issues. Moreover, the middlemen have also added value to the fruit and vegetables value chains in terms of, for example, marketing and organizing logistics. An appropriate strategy for dealing with these actors would be changing their roles in the value chains, e.g., from traders or vendors who own the products to service providers, for example logistics organizers. With respect to food safety and standards, even though there are official standards, the implementation of these standards is still a big issue. This hampers sectorial upgrading to create more values in the fruit and vegetable value chains. Finally, Indian women still face a lot of restrictions and cultural barriers to more actively participate in or even to be empowered by the fruit and vegetable value chains.

Despite the huge challenges faced by the Indian fruits and vegetable sectors, there are also positive progresses being made. Although currently those progresses remain at small scales, they have good potentials to be scaled up in the future. Examples show that by adopting new technologies in both the growing phase of the fruits and vegetables and in their post-harvest chains, seasonality and high losses can be mitigated. As a result, chain players, especially farmers, can benefit from more marketable surplus and more stable prices resulting in higher incomes. Moreover, by using the direct marketing channel which eliminates the need for middlemen, farmers can obtain a more favorable margin for their products. Joining contract farming is another effective way of enabling more secured markets. All these advancements will make the farmers more willing to invest in extending their fruit and vegetable production. Processors and retailers will also benefit from more and stable fruit and vegetables supplies, which may result in reduced product prices. Ultimately, consumers will have more access to and choices on fruit and vegetables products, which may lead to increased fruit and vegetable consumption and form a healthier diet.

Women face significant challenges to improving their income and increasing their access to nutritious diets. However, many examples illustrate the exceptions to these norms, with the possibility to scale these up. For example, the three tiers of business models provide a more flexible approach to benefiting women, depending on the market context as well as their own specific preferences. Self-help groups are most informal and support income generation without the structure itself having to become viable. Producer groups are more formal (typically becoming registered) and provide more services, though have more operating costs and so need to be connected to markets to remain sustainable. At the next level are women who are business leaders in their own right, having started an agribusiness; they provide an example for other women, and society more generally, that women can lead in agriculture.

Becoming recognized as a pioneer in agribusiness, whether at local, regional or national scale, has the effect of removing the social stigma for women. The examples that women as agribusiness leaders provide indirect benefits to the myriad of other women that may not start a full-scale business themselves, but need the social acceptance and support of family and community to take some of their own initiative.

Women face multiple barriers to access to nutrition; it is in part due to poverty and therefore constraints on what households can purchase on a slim budget, second, a broader ignorance of what a balanced diet actually looks like, and third, a hierarchy of who gets to eat first. Multiple public policy programs exist that aim to address these constraints that women face as producers, business leaders and consumers.

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Appendix 1 Description of active NGOs in India

CARE FOUNDATION

CARE (Cooperative for Assistance and Relief Everywhere, formerly Cooperative for American Remittances to Europe) is a major international humanitarian agency delivering emergency relief and long-term international development projects. CARE was founded in the United States in **1945** when it sent food parcels to Europe. CARE has been working in India for 70 years, focusing on alleviating poverty and social exclusion among marginalized women and girls through 53 programs on the ground, spanning 19 states and over 90 districts. In 2019-20, CARE reached out to 50.4 million providing them with quality education, maternal and child healthcare services, sustainable livelihood opportunities, and relief and rehabilitation during natural disasters. (<http://care-international.org>)

Bill and Melinda Gates Foundation (BMGF)

The foundation began working in India in 2003 to improve access to quality, affordable health care in India, with a particular focus on maternal and child health, immunization, family planning, nutrition, and neglected tropical diseases (including tuberculosis, lymphatic filariasis, and visceral leishmaniasis).

BMGF efforts in India focus on key issues that will affect the future of India's most vulnerable communities: reproductive, maternal, newborn, and child health and nutrition; sanitation; agricultural development; gender equality, and digital financial inclusion.

In collaboration with India's central and state governments and with a particular focus on Bihar and Uttar Pradesh, BMGF works to develop innovative solutions that improve the quality and coverage of key services. The foundation's data-driven approach allows them to determine what works and what doesn't and to adjust their strategy and approach accordingly. (<https://www.gatesfoundation.org>)

SHARE AND CARE FOUNDATION

In general, the Share and Care Foundation®, funds programs in education, healthcare, capacity building, integrated development projects and livelihood. "Youth" and "women" sectors are the primary beneficiaries. Share and Care only considers requests that fall within these focused areas. Share and Care Foundation believes it is its social responsibility to work towards creating a more equal world, where everyone has access to Gender Equality, Healthcare, and Education. (<http://shareandcare.org>)

AGA KHAN FOUNDATION

Established in 1967, the **Aga Khan Foundation (AKF)** brings together human, financial and technical resources to address the challenges faced by the poorest. **Aga Khan** Development Network is one of the world's leading poverty solutions networks; it breaks the cycle of poverty by making long-term investments, building permanent institutions, and cultivating an active civil society. The Aga Khan Development Network (AKDN) has a long history in India, dating back to the establishment of the first Aga Khan school in Mundra, Gujarat, in 1905. Today its geographic areas of focus include the states of Bihar, Delhi, Gujarat, Madhya Pradesh, Maharashtra, Uttar Pradesh and Telangana. Eight of AKDN's 11 agencies are operational in the country, implementing a range of programs, in diverse fields from water and sanitation to maternal health and family nutrition, sustainable agriculture to disaster risk reduction and response, cultural restoration to school improvement. These initiatives include schools and educational centers, a 162-bed multi-specialty acute care ISO-certified hospital in Mumbai, a rural support program that has benefited over 1.5 million people in over 2,500 villages across the states of Gujarat, Madhya Pradesh and Bihar, and the restoration of a World Heritage site in the nation's capital. (<https://www.akdn.org/our-agencies/aga-khan-foundation>)

VAAGDHARA

VAAGDHARA is non-government organization, registered under the Societies Registration Act, 1958, and FCRA. Its full form is **Voluntary Association of Agricultural General Development Health**

and Reconstruction Alliance. VAAGDHARA was formed in 1986-87 as a result of efforts of a number of individuals including health professional, academics, farmers and social workers.

The immediate goal was to provide relief of farmers who have become victims of successive droughts in GHATOL Tehsil of BANSWARA region of Rajasthan India. Starting with delivery of agriculture inputs such as seed and fertilizer distribution for 15 farm families, the scope and work area of VAAGDHARA has expanded exponentially.

With the aim of augmenting livelihood sources and options through improving traditional agricultural practices among the tribal population and other marginalized groups, the organization has undertaken a variety of activities. The organization, at a broader level, has always strived for the upliftment of tribal community through Policy advocacy, realization of child rights, empowering women and proofing the food security net of the community through their livelihood enhancement.

(<https://www.vaagdhara.org>)

TATA TRUST FOUNDATION

Tata Trusts was founded in 1892 with **Jamsetji Tata**, the pioneer, visionary, philanthropist and founder of the Tata Group, setting up the JN Tata Endowment for higher education of Indians. It raises hopes for a promising and sustainable future. For people across the country, the Tata Trusts symbolize humanitarianism and personify the prodigious force that advances new frontiers of social and economic development (rural livelihoods, education, health, art & culture and civil society & governance).

Jamsetji Tata is regarded as the 'Father of Indian Industry' and one of the most important builders of the modern Indian economy; **Jamsetji Tata** introduced the apprentice system at work, crèches and primary classes for workers. (<https://www.tatatrusters.org/>)

ADARSH MAHILA GRIHA UDYOG

ADARSHA MAHILA GRIHA UDYOG was established in 1976 with the main objective of making women self-reliant. Most of its work is done at the grassroots level in the rural areas covering 152 villages of the Latur district in Maharashtra. Its work primarily focuses on holistic women's empowerment across their entire lifespan — through social, economic, political, legal, health, and sex education along with literacy. The organization also runs many programs focusing on different aspects of rural life. All these programs have had a great impact towards eradicating poverty in those villages and towards women empowerment. (<http://www.adarshmahila.org/>)

DHARMA BHARATI MISSION (DBM)

With a modest beginning of providing midday meals in one school to 50 children every day, in the last nine years the organization has grown to a commendable force with its own infrastructure facilities in providing education, health care, livelihood skills, empowerment and placement and senior citizens' care.

Although initially the focus of the organization was on dealing with the issue of hunger, experience on the ground level drew to light that along with providing meals to prevent malnutrition and child mortality, the organization also needed to address the deeper background issues which are actually preventing progress and development. To address the issue of hunger and to create a "Hunger-Free India", DBM decided to address the issues that act as obstacles in the path of holistic development.

(<https://www.dbmindia.org/>)

SAMMAAN FOUNDATION

In 2007, **Mr. IRFAN ALAM** founded the **SAMMAAN FOUNDATION** with the objective of poverty alleviation of rickshaw pullers, started mobilizing them and providing value added services such as water, new paper etc., on the rickshaws. Advertising was placed on rickshaws for additional income for the rickshaw-pullers. The model soon became a phenomenon and started getting adopted across number of states in India. This was just a beginning, as the socio-economic empowerment of the rickshaw pullers was carried out through a number of initiatives ranging from financial inclusion to health services. In 2010 it integrated health services in its corpus by launching Mobile Medical Unit with the support of State Health Society, Govt. of Bihar under NRHM. It also diversified health services in 2013 by catering 38 districts and 06 Medical Colleges of Bihar through 44 Advance Life Support Ambulances and 50 Mortuary Vans. (<http://www.sammaan.org/>)

THE AKSHAYA PATRA FOUNDATION (TAPF)

By adhering to all safety and hygiene measures, AKSHAYA PATRA has begun its relief service by providing meal or packed grocery kits to the marginalized and low-income segment of the society comprising of daily wage workers, migrant laborers, construction site workers, and needy people at old age homes and night shelters. Presently, the foundation and its association foundations are providing food relief in, Rajasthan, Karnataka, Telangana, Gujarat, Maharashtra, NCR, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Chhattisgarh, Odisha, Assam, Madhya Pradesh, Uttarakhand, Tripura, West Bengal, Punjab, Jharkhand and Himachal Pradesh. (<https://www.akshayapatra.org>)

LEPRA SOCIETY

LEPRA is a UK-based international charity working to beat leprosy. Since being founded in 1924 they have helped to diagnose, treat and rehabilitate people affected by leprosy. LEPRA currently works in India, Bangladesh and Zimbabwe. **LEPRA** is a member of the International Federation of Anti-Leprosy Associations (ILEP), a federation of international non-governmental organizations committed to creating a world free of leprosy and of The UK Coalition against Neglected Tropical Diseases, a collaborative partnership between UK organizations actively engaged in the implementation and research of neglected tropical disease control. Other partners of LEPRA include LEPRA India, London School of Hygiene and Tropical Medicine, the World Health Organization, and the BIG Lottery Fund, as well as a range of corporate partners. (<https://en.wikipedia.org>)

CREA

Full form of CREA is Creating Resources for Empowerment in Action. It was established in 2000 in Delhi with a mission to advance women's human rights, including reproductive rights, violence against women and sexuality. (<https://www.creaworld.org>)

MAKAAM

MAKAAM or MAHILA KISAN ADHIKAAR MANCH is a nationwide informal forum to secure due recognition and rights of women farmers in India. The Mission of MAKAAAM is to make women farmers visible – especially smallholder marginalized women, with a development vision led by social justice, plurality of knowledge systems and sustainability driven by ecological approaches. It also aims to create and secure rights over productive livelihood resources (land in particular) as well as entitlements over a variety of support systems, with equal participation of these women in decision-making in various institutions starting family upwards, to ensure empowered, self-reliant and sustainable women's livelihoods. (<http://www.makaam.in/>)

SHIKSHAN ANE SAMAJ KALYAN KENDRA (SSKK)

SHIKSHAN ANE SAMAJ KALYAN KENDRA is Gujrat based and aims towards social, economic, educational, and agricultural development of the society. (<https://www.sskkamreli.org/>)

THE SELF-EMPLOYED WOMEN'S ASSOCIATION (SEWA)

THE SELF-EMPLOYED WOMEN'S ASSOCIATION SEWA was formed in 1972, in Ahmedabad and is a membership-based organization created in 1972 from a combination of the labor, women, and cooperative movements, to organize self-employed women in the informal economy and assist their collective struggle for social justice, equality and fair treatment. Today it has 1.5 million strong women and it is the single largest women worker's central trade union in India. (<https://www.sewa.org/>)

AZAD FOUNDATION

Azad Foundation provides **livelihoods with dignity for resource-poor women** living in urban areas in India. Azad Foundation is driven by the vision of a world where all women, in particular women from underprivileged backgrounds enjoy full citizenship, earn with dignity and generate wealth and value for all. It is a professional feminist organization working across religious and social divides to enable resource-poor women empower themselves. (<http://azadfoundation.com>)

SNEHALAYA

SNEHALAYA works towards ensuring a life free from inequality, cruelty and discrimination for every woman and child. Their 23 projects work across Ahmednagar District in Maharashtra to prevent an=d

address the root causes of exploitation & support around 17,000 people annually.
(<https://www.snehalaya.org/>)

SWANITI

SWANITI IS a group of passionate people working to lift the most vulnerable out of poverty by improving the delivery of public services across developing nations. SWANITI partners with governments, policy leaders, companies and communities throughout the world and is equipping them with a mix of problem-solving tools, data & research insights, and advisory services.
(<https://www.swaniti.com/>)

FLIGHT SAFETY FOUNDATION

The FLIGHT SAFETY FOUNDATION (FSF) is an independent, non-profit, international organization concerning research, education, advocacy, and communications in the field of aviation safety. FSF brings together aviation professionals from all sectors to help solve safety problems facing the industry. With a membership that spreads throughout the world, FSF brings an international perspective to aviation issues for its members, the media, and the traveling public.
(https://en.wikipedia.org/wiki/Flight_Safety_Foundation)

VIMACHANA

VIMACHANA, meaning liberation, was initiated in 1979. Its inception was a part of the autonomous women's movement of the late seventies, with "the personal is political" as one of its cornerstones. Today as a women's collective, while VIMACHANA's specific concern was and is with the personal forms of violence perpetrated on women within the home and outside, as in dowry tortures, murders and other forms of marital violence, sexual harassment and rape of women, trafficking and commodification of women, its wider preoccupation is also with the larger political, forms of violence in society today. VIMACHANA believes that the growing violence in the personal sphere of the home and community is directly linked to the increasing brutalization of the larger public policy. A brutalization stemming from the new globalized world order in which we see an intense escalation in the impoverishment, displacement, devaluation and destruction of already vulnerable communities and cultures. (<https://www.vimochana.co.in>)

GURIA

Pioneered in the year 1993 by Ajeet Singh, Guria, a 36-member NGO in India, works towards fighting the sexual exploitation of women and children, especially. It is a non-profit organization that is both dedicated to fighting child prostitution, second generation prostitution, and sex trafficking in Northern India. (<http://www.guriaindia.org/>)

ACTION AID INDIA

ActionAid India is part of a global federation and a full affiliate of ActionAid International that has presence in over 40 countries worldwide. Since 1972, the poor and the excluded have been at the center of their programs in India. In 2006, they were registered as an Indian organization called ActionAid Association. ActionAid India is primarily a human rights organization. They work for the rights of disadvantaged women and children ensuring that they have good means of livelihood. ActionAid has empowered its women to take up roles in the society which until now were dominated by males, such as truck drivers, cab drivers etc. (<https://www.giveindia.org>)

MITTI KE RANG

MITTI KE RANG is an NGO collaborating with women and equipping them with all the required technology. Great product making skills of women entrepreneurs and technology along with marketing support of MITTI KE RANG opens new opportunities for the women. Women can start selling across the nation without having to operate stores digitally. MITTI KE RANG will do it for them.
(<https://www.mittikerang.org/>)

MANAV VIKAS SEVA SANGH (MVSS)

MANAV VIKAS SEVA SANGH (Manav Vikas) was founded in 1969 and registered in 1989 under M.P. Firms and Societies Act 1973, and is the official development organization of Catholic Diocese of

Sagar, Madhya Pradesh, India. As an agency Manav Vikas works for the establishment of a society that is based on truth, cooperation, justice, equality, love and brotherhood. (<https://www.mvss.in/>)

SEVEN SISTERS DEVELOPMENT ASSISTANCE (SeSTA),

SEVEN SISTERS DEVELOPMENT ASSISTANCE (SeSTA) collectivizes women to form self-help groups (SHGs), builds their capabilities and strengthen livelihood systems. SeSTA is a culmination of efforts to initiate development work to empower communities in remote rural areas of NE India. It was registered in the year 2011, under the Societies Registration Act (SRA), 1860. SeSTA was conceived to put systematic effort for socio-economic development of NE by building capabilities of poor communities, promoting and strengthening their institutions to facilitate them out of poverty and meaningfully participate in the global economy. (<https://sesta.org/>)

ASHADEEP MISSION

ASHA DEEP Foundation is a Non-Profit Organisation working for the betterment of the community for the past 35 years. All people in the community including women, children and senior citizens, physically challenged, orphaned and destitute are being benefited by the projects. (<http://adf.org.in>)

MAITRI

MAITRI is a New Delhi-based developmental humanitarian NGO that is committed to facilitating every individual's human rights, especially the rights to identity, dignity and respect. Since 2005, MAITRI has worked with over 45,000 individuals on the issues of social and health inequities and public health concerns through education, community outreach, networking and legal advocacy. (<https://www.maitriindia.org>)

APANALAYA

APANALAYA works with urban poor, enabling them the access to basic services, healthcare, education and livelihoods. APNALAYA empowers urban poor to help themselves and ensuring provision of civic entitlement through advocacy with the Government. (<https://apnalaya.org/>)

PRADAN (Professional Assistance for Development Action)

PRADAN was created in 1983 by two young professionals, Mr. Deep Joshi and Mr. Vijay Mahajan, who were convinced that even the stubborn, endemic poverty of rural India can be solved. They work to strengthen the ability of the rural poor to earn a decent living. Their VISION is a just and equitable society where everyone lives and work with dignity. Their MISSION is to enable the most marginalized people, especially rural women, to earn a decent living and take charge of their own lives. They BELIEVE that all people, no matter how poor, are capable of driving the change they need (<https://www.pradan.net/>)

BAIF (Bharatiya Agro Industries Foundation)

BAIF's Mission is to create opportunities of gainful self-employment for rural families, especially disadvantaged sections, ensuring sustainable livelihoods. For the past decade, BAIF has promoted the founding of women's self-help groups (SHGs). SHGs consist of 10-20 women and function as a savings and credit facility. BAIF uses these SHGs as a platform for training, capacity building and the flow of information on health and hygiene. Special attention is paid to issues of reproductive health. (<https://baif.org.in/>)

SYNGENTA FOUNDATION, INDIA

This is the context in which the Syngenta Foundation for Sustainable Agriculture and Syngenta India Limited established Syngenta Foundation India (SFI) as an independent not-for-profit organization in 2005. From the outset, SFI's mission was to have small and marginal farmers participate in agricultural development by improving their access to better seeds and other inputs, increasing their knowledge of agronomic practices, establishing ease of access to credit and providing systematic market linkages. The main objective has remained to educate small and marginal farmers on the latest developments suited to their local needs, and thus ultimately improve their income. (<https://www.syngentafoundation.org>)

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