Report No: ACS22434

### India

## Unlocking Agribusiness for Inclusive Growth, Jobs, and More

**Policy and Investment Priorities** 



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Policy and Investment Priorities

July 2017 GFA12 South Asia Food and Agriculture Global Practice



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### Acknowledgments

This report was prepared by a team led by Elliot W. Mghenyi, Task Team Leader and Senior Economist in the World Bank's Food and Agriculture Global Practice (GFADR), which included Ashi Kathuria (Senior Nutrition Specialist, Health, Nutrition, and Population Global Practice), Badri Narayan (Consultant, GFADR), Madhur Gautam (Lead Economist, GFADR), Aman Khanna (Consultant, GFADR), Meeta Mehta (Consultant, GFADR), and Ramziath Adjao (Young Professional, GFADR). At the early stages, the team included Srinivasan Nallappa (Senior Investment Officer, Manufacturing, Agribusiness & Services). The team is grateful to Bela Verma, Venkatakrishnan Ramachandran, Vivek Prasad, and John Prakash for coordinating various aspects of the work. The report is based on a concept note prepared by Elliot Mghenyi in consultation with officials in India's Ministry of Agriculture, Cooperation and Farmers Welfare; and Pawanexh Kohli, Chief Advisor, National Centre for Cold Chain Development.

The team would like to thank officials within the government of India for a very productive collaboration over the course of preparing the report. Special thanks go to officials at the Department of Economic Affairs (DEA) for their hospitality and productive discussions throughout all stages of the work, including Rishikesh Singh, Director; S. C. Srivastav, Under Secretary (MI); and Guarav Kumar Jha, Assistant Director. The DEA provided highly constructive comments on an earlier draft, which have been considered in producing the final report. Additional comments were also received from the Ministry of Agriculture, Cooperation and Farmers Welfare. The team would also like to thank officials at the Ministry of Food Processing Industries, the National Centre for Cold Chain Development, the Agri-cultural and Processed Food Products Export Development Authority, and the Warehousing Development and Regulatory Authority. The team is grateful for interactions with state gov-ernment officials in West Bengal, Karnataka, Maharashtra, Madhya Pradesh, and Jharkand. Special thanks go to the agribusinesses and farmers who provided crucial data to enable anal-ysis of the study topics. Overall guidance was provided by Onno Ruhl (Country Director for India), Martien Van Nieuwkoop (Practice Manager, GFADR), and Genevieve Connors (Program Leader). The following peer reviewers provided excellent feedback at various stages of the study: Steven Jaffee (Global Lead for Food Quality and Lead Agriculture Economist, GFADR), Loraine Ronchi (Global Lead for Agribusiness and Lead Economist in Trade and Competitiveness Global Practice), Graham Dixie (Agribusiness Advisor, GFADR), Andres Garcia (Senior Economist, Trade and Competitiveness Global Practice), and Farbod Youssefi-Vash, Program Coordinator, GFADR).

The report has greatly benefited from discussions with several individuals, including Parmesh Shah, Animesh Shrivastava, Shobha Shetty, Julia Navarro, Sebnem Sahin, and the South Asia GFADR team, as well as participants of meetings in Delhi and Washington, D.C., which the team used to present and discuss preliminary findings of the report and receive feedback. The team takes full responsibility for any errors or omissions.

### Executive summary

Agribusiness grows faster than primary agriculture during structural transformation,; thus, by the time many countries reach middle-income status, the agribusiness sector not only has grown larger than the primary agriculture sector but is also an important source of jobs. The structural transformation process is a pathway to successful development that has been followed by all countries that started off with a substantial agriculture sector. The process begins with productivity growth in both non-agriculture and agriculture sectors. Two of its most defining patterns are that (1) labor moves out of agriculture to non-agriculture sectors (manufacturing and services), and (2) the contribution of primary agriculture to gross domestic product (GDP) declines. As the share of employment in agriculture declines, labor productivity in agriculture increases, and agricultural wages typically increase faster than non-agriculture wages. Higher wages increase the general level of demand in the economy. In developing economies, where the majority of the population spends a significant share of its budget on food, there is a significant increase in demand for food. Furthermore, the increased wages and growth across sectors boost per capita income and lead to significant shifts in consumption patterns. Consumers move away from traditional staples and toward diversified diets and high-value foods such as fresh fruits and vegetables and animal proteins; this in turn creates demand and growth in postharvest management services such as sorting, grading, cold storage, packaging, and so on. As more people are employed in manufacturing and service sectors, most of which would be in urban areas or secondary cities, the workers and their families would demand foods that are easy to prepare or ready to eat because the value of their time is greater at work than in cooking for their families. This leads to demand for food services such as cafés and restaurants, as well as demand for easyto-prepare or processed foods. The increased value of time leads to demand for convenient shopping for food and other items, which translates to demand for modern food retailing and agroprocessing—especially organized agroprocessing. Operators of modern food retailing require a supply chain that delivers consistent quality. Therefore, they form dedicated supply

chains with backward linkages all the way to farmers and encourage the supply chain to invest in postharvest management services such as sorting, grading, packing, and cold storage. In addition, there is increased demand for food logistics services, dedicated transportation ser-vices (for example, refrigerated vans) and storage services—and more generally in the business of keeping food fresh, safe, and nutritious and delivering it to customers. The cumulative effect is that agribusiness grows faster than primary agriculture.

However, these patterns have not occurred in India, and the domestic agribusiness sector has remained small relative to middle-income comparators. While agribusiness is larger than primary agriculture in many middle-income countries, this is not the case for India. The ratio of agribusiness to agriculture in terms of contribution to GDP is estimated at 0.64 using Global Trade Analysis Project data, which means primary agriculture in India is larger than agribusiness by more than 50 percent. The national accounts in India are not geared to measure the size of agribusiness, and this has generated a lot of debate not only about the size of agribusiness, but also the size of the various segments of agribusiness. A proper understanding of the scale and nature of the agribusiness sector is important to assessing whether the policies, institutions, and enabling investments in place are appropriate to the challenge—and if not, what changes may be needed to make this process more rewarding to farmers and other players in agriculture produce value chains.

This report estimates the size of specific segments of agribusiness. The estimates rely on surveys conducted by India's Central Statistics Office. In particular, the National Sample Survey was used to estimate size of the unorganized segment, and the Annual Survey of Industries was used for the organized segment. The share of agroindustry in GDP is estimated at 4.12 percent, of which the organized segment contributes 2.88 percent and the unorganized 1.24 percent. The share of food processing is estimated at 1.91 percent of GDP, of which the organized sector contributes 1.62 percent and the unorganized 0.29 percent. The share of food services (hotels, restaurants, food trade) in GDP is estimated at 1.62 percent; this only reflects the contribution of the unorganized segment, because data on the organized segment are not available. These estimates indicate that agribusiness contributes about 7.65 percent of GDP—but again this does not account for the organized segment of food services (hotels, restaurants, food trade), which is estimated to exceed the 1.62 percent contribution of the unorganized segment.

The objective of this report is to identify policy and investment priorities in agribusiness to stimulate inclusive growth and jobs. The study ultimately seeks to inform strategic dialogue between the government of India and the World Bank Group toward investments in postharvest management and other segments of agribusiness. The report provides building blocks to identify priorities for policy and investment. After a brief introduction (chapter 1), chapter 2 presents a framework to understand the role of agribusiness in development. The discussion focuses on clarifying what happens to agribusiness during structural transformation using examples from countries that are currently considered middle income as well as from developed countries. The discussion shows that India's agribusiness sector is remarkably small compared to middle-income comparators. The chapter concludes by describing factors that have contributed to the slow growth in agribusiness. <u>Chapter 3</u> provides estimates of productivity and capital investment gaps in various subsectors of agribusiness and simulates the effects of bridging those gaps on macroeconomic indicators, sectoral growth, and jobs. <u>Chapter 4</u> provides lessons on using agribusiness to improve nutrition. Next, the report focuses on specific segments of the agribusiness sector. <u>Chapter 5</u> provides lessons on promoting cold chain development. <u>Chapter 6</u> provides lessons on promoting agroprocessing. <u>Chapter 7</u> provides lessons on promoting inclusive value chains for modern food retailing. Finally, <u>chapter 8</u> provides policy and investment priorities in agribusiness based on the main findings of the report.

### Key messages on policy priorities

The historical regulatory environment of the Agriculture Produce Market Committees Act caused long value chains, created information barriers, encouraged spot markets, and discouraged vertical coordination. The cumulative effect has been low investments in postharvest management and agribusiness. The requirement that wholesale trade could only occur at the *mandi* not only created a long and fragmented chain but also barriers to information. The commission agents and brokers along the chain do not take ownership of the produce and instead are paid a percentage of the sales value of the produce. It means they have no real incentives to invest in postharvest management. Furthermore, the commission agents and brokers mainly sell in auction markets where produce is hardly differentiated on any quality parameters. It means these agents could maximize commissions through volume rather than incurring costly postharvest management. The long value chain means that demand signals from consumers would have to be passed through many actors, including commission agents and brokers, before it reached farmers. Long value chains tend to drop information along the way, which makes it harder for farmers to respond to market demands. Another feature of the regulations is that they discouraged contracting between farmers and agribusiness as well as other forms of vertical coordination. All transactions were spot, in the sense that price and other terms of the transaction are discovered at the time of the transaction and delivery is made on the spot. Therefore, farmers were not able to form coordination arrangements that would have reduced transaction costs, improved efficiency, stabilized expectations on price and other parameters, and ultimately increased investments in postharvest management.

Ongoing reforms should be geared toward eliminating the monopoly of agriculture produce market committees and promoting a unified national market for agriculture commodities that is supported by a regulatory framework that genuinely allows for unfettered vertical coordination in agricultural produce marketing across the country. This is because vertically coordinated value chains are (1) more efficient and more remunerative to farmers compared to the spot markets encouraged by the historical regulatory framework; and (2) provide farmers with better access to input markets, production technology, finance, risk sharing, postharvest management technology, and remunerative output markets. Furthermore, reforms can be more effective if complemented with investments in agriculture marketing. Coordination systems have far-reaching effects on supply chain performance. In vertical coordination, parties agree on terms of a transaction—for example price, quality parameters, and volume—before engaging in a transaction. Risk sharing is an integral part of these arrangements, both in terms of production and price risks.

In a comparative analysis of processed and table potato value chains, the processor invested in advanced forms of vertical coordination with strong backward linkages that have enormously benefited farmers in many ways—including access to input markets, better production technology, credit, and sharing of both production and price risks. On the other hand, the table potato chain operates through spot markets where buyers and sellers have little or no coordination arrangements and the terms of a transaction are negotiated on the spot; physical delivery also takes place on the spot. In the processed potato value chain, prices are announced ahead of the planting season, which not only insures farmers against price risk but also enables them to make more informed decisions about land allocation to the potato crop. Access to finance is critical in meeting working capital requirements, because potato cultivation requires the purchase of large quantities of bulky seed and the application of high-cost inputs. Weak access to credit leads to low working capital, little production technology, and low yields. Farmers in the processed potato chain were provided with credit linked with inputs such as agrochemicals and disease-free planting materials. Overall, farmers in the processed potato chain received better margins.

Opening food retailing to multinational companies that have the knowledge to organize agriculture value chains and have access to cheaper capital could stimulate backward linkages that encourage and reward farmers for quality produce. However, the emerging channels should be vertically coordinated with the unorganized retail sector instead of replacing this segment. Food retailing is a growth sector in India, and there is scope for policies to guide its modernization while making the process and outcomes more rewarding for farmers and inclusive of the unorganized sector. There are concerns that allowing multinationals in food retailing could displace the domestic players in the unorganized sector. Lessons on establishing modern fronts with backward linkages could be drawn from reforms that allowed 100 percent foreign direct investment in agroprocessing in 1991. Those reforms increased the supply of capital and investments in organized agroprocessing without displacing unorganized agroprocessing. The unorganized agroprocessing segment has remained a large part of food processing. Its gross value added was almost at par with the organized segment (2011 figures), while its share of employment is much higher—25 million people were employed in the unorganized segment compared to about 5.5 million in the organized segment. There is need to develop models of modern food retailing that include the unorganized segment, perhaps using a productive alliance approach between farmers, the

unorganized retailing segment, and multinationals that have both knowledge and a cheaper cost of capital. Many countries have struggled with protecting an indigenous sector from being displaced by foreign investors. There is evidence that many countries in Europe (including Belgium, France, Germany, Norway, Scotland, and Spain) gave small retailers various forms of assistance—including grants, training and retraining programs, and even retirement pensions—in order to integrate them with modern retailing or to protect their livelihoods.

The agribusiness sector can help reduce malnutrition through food fortification. Lessons from other countries indicate that regulations that make fortification of certain foods mandatory are the most effective in achieving lasting nutritional outcomes. Mandatory fortification works because it offers the industry a level playing field in terms of cost structure, encourages competitive pricing of fortified products, eliminates the need for costly marketing, provides more equitable access, and has greater potential to reach the majority of the population. Food fortification can have the desired public health impact if there is broad coverage of the population, especially of groups where deficiencies are high. Therefore, the choice of an appropriate delivery option should be carefully considered—whether mandatory fortification, voluntary fortification, or a mixed approach. Voluntary fortification gives the food industry the option to fortify, and the fortified products are marketed as value-added products—rather than just products. Voluntary fortification has significantly lower potential for public health impact, as the approach is dependent on industry interest and uptake, consumer awareness, demand and price sensitivity, and so on. Its ability to reach the most vulnerable is limited. Most stakeholders recommend that India ultimately move to mandatory fortification of foods such as oil, milk, and wheat products, just as it has done for salt iodization. But mandatory fortification requires legislation, which may take several years to enact. In the interim, a strategy to boost voluntary fortification—along with complementary strategies to distribute fortified foods through social safety nets such as the Public Distribution System, the School Mid-Day Meal program, and the Integrated Child Development Services program—will play a critical role. Using existing social safety net programs has great potential to target those at the highest risk of micronutrient deficiencies, but this should be considered an interim measure. There is a need to develop a strategy toward mandatory fortification of foods such as oil, milk, and wheat products—perhaps by mandating that each processor have at least one fortified product in each product category.

### Key messages on investment priorities

The agribusiness sector will become a major source of jobs and employ 17–40 percent more people if India could bridge the productivity and investment gaps relative to middle-income comparators. The simulated impact on jobs is that the agribusiness sector would employ 17 percent more people if India could bridge the productivity and investment gaps relative to middle-income countries. And when India catches up with China in terms of productivity and investment, the agribusiness sector would employ 40 percent more people. In addition to creating jobs, bridging these gaps increases the share of agribusiness in GDP, expands the overall economy, and leads to gains in welfare. The trade balance would be in India's favor, as exports would increase and imports decline. India's productivity is significantly less than middle-income country comparators in the following segments: bovine meat products, vegetable oils and fats, processed rice, sugar, food products not elsewhere classified, and beverages and tobacco products. The sectors where India's productivity is higher than middle-income country comparators are the dairy processing segment (where India's productivity surpasses both the middle-income country average and China) and bovine meat products. India faces significant capital investment gaps in all segments of agribusiness other than vegetable oils and fats. For example, in the bovine meat products segment, India needs to increase capital investment by 114 percent and 93 percent to catch up with, respectively, the middle-income country average and China.

Prioritize policies that raise the supply of capital to the agribusiness sector without causing disinvestment in other sectors or attract foreign capital. Although capital increase to agribusiness would expand the sector and create many jobs, there is a risk that this could cause disinvestment in other sectors if the supply of capital is not increased. The tradeoff could be mitigated if the economy is managed in a way that raises the supply of capital, for example through (1) policies that outcompete other countries in attracting foreign direct investment, and (2) expanding banking services while providing incentives for savings to increase the level of capital from domestic sources. There are lessons to draw from the policy measures taken in 1991 to allow 100 percent of foreign direct investment in agroprocessing. Those measures increased the supply of capital to the agroprocessing sector and led to increased investments without necessarily creating disinvestment in other sectors.

The unorganized processing segment can generate inclusive growth and better jobs if there is support to observe quality and food safety standards, scale up, and attract organized investments. The organized sector applies technology that is not available to the unorganized sector, and observes food safety standards that the unorganized sector is probably not aware of and not required to apply because it is unregistered. However, the unorganized sector is a very large part of agroprocessing. For example, there are over 14 million factories or enterprises in the unorganized sector, compared to only 91,000 in the organized sector; this translates to about 100 times more units in the unorganized sector (2011 figures). But the organized sector is larger by more than 26 times in terms of fixed assets, more than 89 times larger in terms of output, and more than 8 times larger in terms of value of inputs used. The two segments are almost equal in terms of gross value added. The unorganized sector employs more people—about 25 million compare to about 5.5 million in the organized sector—although the jobs in the organized sector are likely to be better. The unorganized sector caters to small towns and centers where incomes are relatively low, food safety standards are low, and the burden of malnutrition is likely higher. There are important public goods to be derived by supporting the unorganized food processing sector, including food safety and

nutrition enhancement through not only observing food quality standards but also microfortification of processed products. Therefore, a program of support could be developed for this segment so that it could observe food safety and quality standards, scale up, become attractive for organized investment, and spur inclusive growth and better jobs than are currently provider. This agenda could draw on lessons from other countries, which suggest that formalizing the unorganized sector alone would not guarantee food safety. Efforts to support the unorganized sector should include transfer of appropriate technology and assets, as well as capacity building of the entire supply chain—processors, farmers, aggregators, consumers, and so on.

Consider a program to put assets for postharvest management of horticultural commodities in the hands of farmers, following successful models in dairy where farmers have been organized in cooperatives and producer companies through which they have acquired assets in milk processing. The successful dairy models could be applied to the apple subsector, where there is a need to further expand the capacity of controlled atmosphere (CA) storage in production areas. Dairy farmers are able to join a village cooperative that has been facilitated by the National Dairy Development Board to invest in postproduction milk chilling. The village cooperative would be a member of a milk union that provides many services to farmers, including milk processing, better genetics through artificial insemination, and animal feed resources. Through their cooperatives, dairy farmers have not only moved up the chain into value preservation and processing, but also integrated backwards into animal breeding and feeding services. This model could be adopted to the apple subsector. Farmers could be organized into producer companies that would receive long-term financing to establish capacity for CA storage owned by the farmers. The producer company would also provide farmers with other services such as upgrading production technology (varieties and management practices) to not only raise productivity and production but also improve the quality of production.

Consider models of private-public partnership (PPP) or productive alliances in postharvest management of horticultural commodities. Lessons from the potato industry in West Bengal suggest that a warehousing receipt system for perishables could be developed to support the envisaged PPPs or productive alliances. Most support for postharvest management of apples has gone to private investors, which have received large amounts of subsidies to install CA storage capacity close to production areas. Farmers are able to rent the capacity when CA store owners consider the market conditions too risky and do not use the capacity. Thus, a farmer obtains access to engage in a business that has been deemed too risky by an agent with better market information. It is no surprise that farmers rarely rent CA stores. This could change with PPPs. For example, where part of the PPP agreement involves a guarantee to the private investor that a portion of the capacity would always be available to an organization of farmers—for example, cooperatives or producer companies. The guaran-tee fee would be based on a rigorous analysis of financial models of CA stores. And farmers

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would be provided with incentives to actually use the dedicated capacity so that the guarantee fee does not materialize. The warehouse receipt system is an instrument that has worked to provide incentives to farmers to use storage warehouses in the cereal sectors. The receipt allows farmers to trade the produce while it is stored and address their short-term needs for liquidity. Although challenging to implement on perishables, there are some successful examples in the potato industry in West Bengal where cold stores are issuing tradable receipts to farmers and traders against the value of potato stored. This model could be replicated with apples.

Any program to increase productivity and investments in agribusiness should include interventions that lead to a much larger pull effect on primary agriculture than the underlying intersectoral linkages offer. Bridging the investment and productivity gaps with middle-income countries will increase the overall size of agribusiness sector by 74.6 percent, which in turn increases the size of primary agriculture by 2.8 percent. When India bridges the investment and productivity gaps with China, the size of agribusiness will double, while primary agriculture will increase by only 10.5 percent. This reflects a small pull effect on primary agriculture, mainly due to weak underlying intersectoral linkages. The job linkages are also modest. Simulations suggest that bridging the gaps with middle-income countries increases agribusiness jobs by 17 percent, while jobs in primary agriculture are increased by 5.2 percent. And when India bridges the gaps with China, agribusiness jobs increase by about 40 percent, and jobs in primary agriculture increase by 10 percent. The weak linkages impose a challenge for programs that seek to increase productivity or expand investment in agribusiness. Such programs would need to stimulate stronger linkages that are implied by the underlying structure of the economy to ensure that farmers benefit from the growth of agribusiness.

## Abbreviations

APMC	agriculture produce market committee
ASI	Annual Survey of Industries
CA	Controlled Atmosphere
CIPHET	Central Institute of Post-Harvest Engineering and Technology
CPRI	Central Potato Research Institute
CSO	Central Statistics Office
FAO	Food and Agriculture Organization
GDP	gross domestic product
GTAP	Global Trade Analysis Project
HDI	Human Development Index
ICAR	Indian Council of Agriculture Research
ICDS	Integrated Child Development Services
MDM	Mid-day Meal
MIDH	Mission for Integrated Development of Horticulture
MT	Metric Ton
NFA	National Fortification Alliances
NTD	neural tube defects
NSS	National Sample Survey
PDS	Public Distribution System
PPP	private-public partnerships
RDA	Recommended Daily Allowance
TFP	total factor productivity
TPDS	Targeted Public Distribution System

## Chapter I

Major changes are occurring in the Indian economy that should inform public policy and investments in the food sector. The main drivers of changes occurring in the Indian economy include rising per capita incomes and urbanization. These patterns have led to increased demand for food and food services, including postharvest management activities, food retailing, and restaurants. The increased demand for postharvest management should influence the nature of investments in the entire food industry—from input supply, primary production, postharvest management, processing, logistics, distribution services, wholesaling, and retailing, and so on. Investments in the food industry are critical to the transition toward a modern food system able to serve the needs of an advancing economy. A comprehensive assessment of what may be constraining investments in the food system and the missed opportunities this has created is lacking. Even basic knowledge on the size of the agribusiness sector remains sketchy. A proper understanding of the scale and nature of the agribusiness sector is important in assessing the extent to which current policies, institutions, and investments are affecting the food system and the required policy and investment priorities to transition toward a food system able to serve the needs of a modern economy.

Aggregate demand for food has increased, and consumption patterns are shifting toward fresh fruits and vegetables, processed foods, and ready-to-eat foods and meals. Expenditures on food have increased in absolute terms and grew by about 4 percent between 2004/05 and 2011/12, although the share of food in average household consumption expenditures in India has declined from about 47 percent in 2004/05 to 41 percent in 2011/12. Increased household incomes and urbanization are associated with consumption patterns shifting toward more diversified and processed foods. These patterns are evident from figure 1.1 and table 1.1. The demand for processed foods is rising the fastest, with a significant shift toward highly processed foods (see box 1.1 for a methodology for categorization of foods according to levels of processing). Looking at growth rates over the period from



Figure 1.1 Annual growth rates for monthly per capita consumption in real expenditures, 1993/94–2011/12

#### Table I.I Changes in food consumption patterns in India

	Share	of total MPCE	Ξ (%)	Annual rate	Annual rate of growth (2004/05 prices		
Level of food processing	1993/94	2004/05	2011/12	1993–2004	2004-11	1993-2011	
Unprocessed	13.7	15.6	14.8	0.48	3.28	1.6	
Primary processed	43.9	38.8	32.9	-1.77	1.58	-0.5	
Low secondary processed	34.2	35.8	37.8	-0.26	4.84	1.7	
Medium secondary processed	4.44	6.04	5.59	2.14	2.89	2.4	
High secondary processed	3.72	3.71	8.87	-0.72	17.83	6.1	
Total MPCE (2004/05 Rs.)	369.3	342.8	451.9	-0.68	4.03	1.1	

Note: MPCE = monthly per capita expenditure

1993 to 2011, the demand patterns show a shift away from primary processed food grains and cereals toward (1) fresh fruits and vegetables—which is creating demand for investments to maintain freshness and for value chains to deliver fresh produce; and (2) more processed foods—which is creating a demand for agroprocessing. These patterns are consistent with growth in demand for income-elastic livestock products and a growing preference for readyto-eat or easy-to-prepare meals. It is projected that in 2017 the demand for fruits will exceed 97 million tons and demand for vegetables will exceed 161 million tons. The increased demand will outstrip 2010/11 production figures by 23 percent for fruits and 9 percent for vegetables (table 1.2).

To meet the emerging demand, farmers need to respond by not only diversifying production toward foods with increasing demand but also with postharvest management

### Box 1.1 Methodology for assessing extent of processing

Different foods require varying levels of processing for their consumption; this recognition is important in assessing levels of processing and drawing implications for the sector. The report classifies food into five levels of processing, where level 1 includes a group of foods that do not require any processing and level 5 includes foods requiring the highest degree of processing. The first group includes agricultural commodities that are consumed in their natural unprocessed form; this mainly includes foods such as fresh fruits and vegetables. While some cleaning, grading, and packing are required, these foods are essentially purchased by the final consumer in their primary form. The second group is defined to include commodities that require what may be classified as minimal processing-for example, grinding, milling, hulling, shelling, and drying but with essentially minimal value added. The third group includes products with additional but still low-value addition, such as products that undergo pasteurizing, heating, fermenting, slaughtering, and crushing (for example, butter, curd, meat, fish, and sugar). The fourth group shows high-value addition, as the primary processed foods are mixed with other processed products to make final products (for example, biscuits, bread, ghee, ice cream, and jams). The fifth group includes products with the highest value-added activities and covers ready-to-eat food, prepared meals, and frozen and packaged meals; these typically involve significant supportive investments in plant and machinery (such as cold chains) or services (such as restaurants). A detailed classification of various foods in these categories is provided in the annex to this chapter.

	Actual production (million tons)	Projected deman	d (million tons)
Food	2010/11	2016/17	2020/21
Cereals	240	235	253
Pulses	17	22	25
Food grains	257	257	277
Vegetables	147	161	189
Fruits	75	97	124
Milk	122	141	173
Fish	8.3	11	14
Meats (nonpoultry)	2.7	3.7	5.0
Poultry meat	2.2 (commercial)	3.3	4.3

#### Table 1.2 Demand projections for selected foods

Source: Twelfth Five-Year Plan, Government of India, 2013.

to preserve the attributes desired by consumers. But there are important constraints to diversification. For example, although the yields of fruits and vegetables have increased tremendously—much faster than cereals—land allocation remains hugely skewed in favor of food grains. Between 2005 and 2011, fruit and vegetable yields increased by about 45 percent and 48 percent, respectively, compared to a 22 percent increase in cereals (figure 1.2). Fruits and vegetables occupy about 7 percent of total cropped area, which is quite low and

Figure 1.2 Trends in crop yields, 2004–11



Source: Food and Agriculture Organization of the United Nations, FAOSTAT (<u>www://faostat.fao.org</u>).

disproportionate to their 27 percent contribution to value of the crop sector. Furthermore, the price of agricultural produce is rising and increasingly volatile, suggesting supply chains are not efficient in meeting consumer demand. A recent case of volatile prices occurred when onion prices rose by about 300 percent in various Indian cities between May and October 2013 (figure 1.3). The price spike kept onions out of the reach of many consumers, especially low-income households and urban consumers. Other commodities were also affected by price spikes. The price of potatoes, a major food item, increased by more than 150 percent in several cities (figure 1.3). Overall, retail prices for all vegetables are estimated to have increased by about 46 percent in the

course of 2013 (*Economist* 2013). A closer look at price data suggests that onions and potato prices have been gradually becoming more volatile in the last ten years. This indicates that supply chains are increasingly facing challenges to consistently meet increasing demand, leading to rising and volatile prices. Additionally, the changing weather patterns, including late monsoons, have raised production risks and reduced supplies. For example, unseasonal rains have been cited as a major cause of production shocks and price volatility in onion markets.



Figure 1.3 Retail prices of onions and potatoes in India

Source: Food and Agriculture Organization of the United Nations, <u>www.fao.org/giews/pricetool/</u>.

The twin strategy of diversification from traditional cereals to high-value fresh produce coupled with better postharvest management would not only raise farmer incomes but also save water and reduce food loss and wastage. The disparities in land allocation relative to value of production between fruits and vegetables and cereals indicates enormous scope to raise farmer incomes. Furthermore, the amount of water used to produce cereals is much higher than that required for producing fruits and vegetables. This is important in a water-stressed country, because it presents an opportunity for climate-smart agriculture. A significant volume of food is wasted due to poor postharvest management and storage—especially at the farm level. For example, recent estimates of postharvest loss in India (CIPHET 2015) indicate that about 7.32 percent of potato production is lost and that about 90 percent of that loss occurs in farm operations (harvesting, collection, sorting and grading, packaging, and transport). The percentage of postharvest loss occurring at the farm level is about 73 percent for cabbage production, 76 percent for tomato, 74 per-cent for onion, 87 percent for apple, 78 percent for banana, and 76 percent for grape. The proportion of food wasted in India is comparable to the level for many developing countries. But the wastage is more economically important in India because of the enormous size of its agriculture sector. Postharvest loss is a waste of the resources used in food production and distribution. It not only hurts the economy, but also leads to negative impacts to the environ-ment and therefore aggravates the climate change problem.

Export shares of high-value commodities are declining, while their import shares are increasing. The share of agricultural exports declined from about 12 percent during 2000 -05 to about 9.10 percent during 2006-11. On the other hand, the share of agricul-tural imports declined from about 4.7 percent to 3.2 during 2006–11 (table 1.3). There are also some important changes in the export and import of agriculture commodities. The larg-est share of exports in agricultural produce is for fresh produce and nuts: about 22 percent during 2006–11. However, this is a decline of about 3 percentage points from the 2000–05 share. The second highest share is for cereal and cereal products, at about 19 percent during 2006–11—a marginal decline of less than 1 percentage point from 2000 to 2005. The third largest share is for meats (including live animals) at 18 percent during 2006–11, which is a decline of about 5 percentage points from 2000–05. These trends indicate that, among the most important sources of agricultural exports, the high-value segments (fresh produce and animal proteins) are declining faster, at least compared to relatively lower-value cereals and cereal products. Furthermore, imports of these high-value commodities are increasing. During the same period, the share of fresh produce in agricultural imports had increased by 2 percentage points; the share of animal proteins had also increased, albeit marginally. The share of cereal and cereal products in imports also increased by 4 percentage points. There were gains in export share for the following commodities: processed foods by about 3 percentage points, edible oils by about 1 percentage point, milk and dairy products by about 1 percentage point, beverages by about 3 percentage points, tobacco by about 1 percentage point, and prepared or frozen foods by about 1 percentage point.

	Share of exports (%)		Share of imports (%)		Growth in exports (%)		Growth in imports (%)	
Product	2000-05	2006-11	2000-05	2006-11	2000-05	2006-11	2000-05	2006-11
Live/fresh/frozen meat, fish, poultry	23.45	18.05	0.30	0.54	3.44	20.16	24.43	29.27
Milk & dairy products	1.36	1.55	0.46	0.72	39.68	-1.21	2.41	70.73
Fresh produce, nuts	25.32	22.08	31.41	33.56	6.43	14.34	18.12	17.95
Cereals & cer. prods.	19.53	18.91	0.41	5.26	23.67	18.85	-12.65	-40.38
Edible oils	11.49	12.70	58.83	50.38	8.92	28.17	14.78	32.41
Animal products- processed	0.74	1.37	0.02	0.03	123.71	-0.29	49.21	23.35
Processed foods	4.04	7.03	3.36	4.43	-1.82	11.18	43.58	60.68
Prepared/frozen foods	3.00	3.09	I.54	1.03	9.03	14.37	-12.14	26.10
Beverages	7.93	11.22	3.39	3.77	11.88	13.49	56.07	22.87
Tobacco	3.13	4.01	0.28	0.28	11.90	19.45	44.59	11.90
All agriculture	12.06	9.10	4.69	3.17	9.92	17.64	17.48	24.58
Total exports					19.13	17.91	22.61	18.73

 Table 1.3 Shares of and growth in exports and imports of primary and processed agricultural products

Source: COMTRADE.

Fresh produce accounts for the largest share of exports as well as the second highest share of imports. The share of fresh produce in exports is 22 percent, which is highest; and its share in imports is 34 percent, which is second highest. These patterns could be attributed to (1) exports constituting more traditional fresh produce, while imports are meeting changing consumer preferences toward the types of fresh produce not produced in the country; or (2) weak technology for off-season production and value preservation prompting exports in the producing (surplus) season and importing in the lean season. Both factors may be at play. <u>Chapter 2</u> details how the historical regulatory framework for agriculture marketing in many states of India has created information barriers between farmers and consumers. In brief, the agriculture produce market committees have created long value chains that impose information barriers between farmers and consumers, making it difficult for information to be passed through; these include demand signals and changing preferences for different types of commodities or different attributes in commodities produced locally (for example, shape, size, color, taste, crispness). These barriers prevent farmers from reacting to emerging consumer preferences. The seasonality of production also contributes to fresh produce having the largest share of exports as well as the second highest share of imports if there are no adequate investments in value preservation.

### Imports are growing faster than exports in most food categories; these patterns appear to be driven by increasing demand for foods that the domestic food industry

is not adequately supplying. During 2006–11, imports have grown faster than exports for the following high-value food categories: live or fresh or frozen meat, fish, and poultry; milk and dairy products; fresh produce and nuts; edible oils; processed animal products; processed foods; prepared or frozen foods; and beverages (table 1.3). It is important to note that all of these food groups involve some degree of processing—except for fresh produce and nuts—and the higher growth of their import relative to export is evidence that the domestic sector is being outcompeted by imports and losing the opportunity to create jobs and raise incomes at home. Overall, imports have grown faster than exports in 8 of the 10 food categories in table 1.3. The gap between growth in imports and exports is widest in milk and dairy products (import growth of 70.7 percent versus export growth of -1.2) and processed foods (import growth of 60.7 percent versus export growth of 11.2 percent). Since these two categories are large segments of the agribusiness sector, the remarkably high growth in imports means lost opportunities for jobs and incomes. The only two categories for which export growth has outstripped import growth are cereal and cereal products and tobacco.

The changing composition of food demand and trade patterns indicates enormous scope for investment in various segments of agribusiness, including postharvest value preservation, agroprocessing, and modernized food retailing. It is an opportunity to create jobs and raise incomes in the domestic economy. As household incomes have increased, consumers are spending more on high-value foods (fruits, vegetables, animal proteins, and processed foods), demanding better quality food, and moving toward value-added differentiated food products rather than commodities. Furthermore, India's population is getting younger, and the youth will outnumber the very young and elderly in the coming years. There will be a demographic dividend that will put even more pressure on the food system, through various pathways—including the fact that a younger population will have more demand for meals prepared outside the home and meals that are ready to eat (Park and Capps 1997). Without growth in the food industry, especially in the production of fruits and vegetables, postharvest management, agroprocessing, and modernized retailing of processed products, the rising demand for highly processed products and fresh products will increasingly be met through imports, and India will lose the opportunity to create jobs and incomes at home.

## Annex Classification of foods according to degree of processing

Degree of processing	Food
Primary agriculture commodities	Eggs (no.), potato, onion, radish, carrot, turnip, beet, sweet potato, arum, pumpkin, gourd, bitter gourd, cucumber, parwal, jhinga/torai, snake gourd, papaya (green), cauliflower, cabbbage, brinjal, lady's finger, palak/other leafy vegetables, french beans, tomato, peas, chillies (green), capsicum, plantain (green), jackfruit (green), lemon (no), other vegetables, banana, jackfruit, watermelon, pineapple (no.), coconut (no.), guava, singara, orange, mausami (no), papaya (green), mango, melon (kharbooza), pears, berries, leechi, apple, grapes, other fresh fruits, garlic (gm), ginger (gm), coconut: green (no)
Processed food 1 (low value added)	Rice pds, rice others, chira, khoi, lawa, muri, other rice products, wheat/atta-pds, wheat atta-other sources, maida, suji, rawa, sewai noodles, other wheat products, jowar and products, bajra and products, maize and products, barley and products, small millets and products, ragi and products, other cereals, cereal substitutes (tapioca, jackfruit, and so on), arhar (tur), gram (split), gram (whole), moong, masur, urd, peas, soybean, khesari, other peas, gram products, besan, other pulse products, coconut copra, groundnut, dates, cashew nut, walnut, other nuts, raisin (kishmish, monacca, and so on), other dry fruits, salt, turmeric (gm), black pepper (gm), dry chillies (gm), tamarind (gm), oilseeds (gm), other spices (gm), ice
Processed food 2 (high value added)	Milk: liquid (litre), curd, butter, mustard oil, ground nut oil, coconut oil, edible oil: other, fish, prawn, goat meat/mutton, beef/buffalo meat, pork, chicken, other: birds, crabs, oyster, sugar (pds), sugar: other sources, gur, honey, tea: leaf (gm), coffee: powder (gm)
Processed food 3 (high value added)	Bread (bakery); baby food; milk: condensed/powder; ghee; ice cream; other milk products; vanaspati; margarine; candy; misri; curry powder (gm); cold beverages: bottled/canned (litre); fruit juice and shake (litre), other beverages: cocoa, chocolate, and so on; biscuits; salted refreshments; prepared sweets; cake; pastry; pickles (gm); sauce (gm); jam; jelly (gm); other processed food
Processed food 4 (high value added)	Tea:cups (no), coffee:cups (no), cooked meals (no)

# Why agribusiness matters for development

## What happens to agribusiness during structural transformation?

The structural transformation process is a pathway to successful development that has been followed by all countries that started off with a substantial agriculture sector.<sup>1</sup> The process begins with productivity growth in both non-agriculture and agriculture sectors. Two of its most defining patterns are that (1) labor moves out of agriculture to non-agriculture sectors (manufacturing and services), and (2) the contribution of primary agriculture to gross domestic product (GDP) declines. As the share of employment in agriculture declines, labor productivity in agriculture increases, partly because fewer people are working in the sector and also because growth in the manufacturing sector is creating demand for raw materials from agriculture. The increased labor productivity and declining employment in agriculture boost agricultural and rural wages, such that agricultural wages would typically increase faster than non-agricultural wages. Higher wages increase the general level of demand in the economy. In developing economies where the population spends a significant share of its budget on food, there is a significant increase in demand for food, which in turn spurs further growth in primary agriculture. For example, although the share of food in the average household consumption expenditures in India has declined from about 47 percent in 2004/05 to about 41 percent in 2011/12, expenditures on food have increased in absolute terms by about 4 percent between 2004/05 and 2011/12. The increased demand could actually increase agricultural GDP in absolute terms, even though its relative share in total GDP would be declining due to relatively faster growth in other sectors (manufacturing and services). The wage dynamics during structural transformation where agriculture and

<sup>&</sup>lt;sup>1</sup> The exceptions are Singapore and Hong Kong, neither of which had a significant agriculture sector to begin with.

rural wages grow faster than those in other sectors narrow wage differences across sectors. Wage dynamics are amplified by urbanization, which further reduces the supply of labor to the agricultural and rural sectors. If the structural transformation process is successful, the narrowing of the wage differential between agriculture and non-agriculture sectors would eventually make agriculture an attractive occupation for skilled individuals, including educated youth.

Since the agribusiness subsector is usually included in all sectors (agriculture, manufacturing, and services), its dynamics during structural transformation are obscured and therefore not very well understood. The agribusiness segment in primary agriculture includes all activities related to agricultural inputs-for example, generating seeds, producing chemical and organic fertilizers, and producing agrochemicals, as well as the storage and distribution of these inputs. The main agribusiness activities in manufacturing include producing agricultural implements and machinery (tractors, threshers, combine harvesters, tillers, and so on) and processing primary agricultural commodities (both formal and informal). Agribusiness activities in services include postharvest management services such as cold storage, controlled atmosphere storage services, warehousing, food logistics, food transportation and distribution, financial services (for example, banking and insurance to the inputs sector, farming sector, and agroprocessing sector), food retailing (both unorganized and modern), and restaurant services. Not all countries identify agribusiness as a sector in their national accounts; therefore, data are not always available for a careful study of the dynamics of agribusiness during the development process. An example of a country where agribusiness is identified in national accounts is Brazil. For this country, there are not only data on the share of agribusiness to GDP, but also on the contribution of various sectors to agribusiness inputs, agriculture, industry, and services (figure 2.1). The data indicate that,



Figure 2.1 Agribusiness and constituent sector share of GDP in Brazil, 1995-2015

Source: http://cepea.esalq.usp.br/pib/.

in 2015, the agribusiness sector contributed about 22 percent to Brazil's GDP of Brazil, of which about 6.4 percent is from agriculture, 5.9 percent is from industry, and 6.6 percent is from services. The data also indicate that, over the past two decades, agribusiness segments in agriculture and industry have gradually been losing their share to agribusiness segments in services.

Agribusiness grows faster than primary agriculture during structural transformation. The increased wages and growth across sectors boost per capita income and lead to significant shifts in consumption patterns. Consumers move away from traditional staples and toward diversified diets and high-value foods such as fresh fruits and vegetables and animal proteins; this in turn creates demand and growth in postharvest management services such as sorting, grading, cold storage, and packaging. As more people are employed in manufacturing and service sectors—mostly in urban areas or secondary cities—workers and their families demand foods that are easy to prepare or ready to eat, because the value of their time is greater at work than in cooking for their families. This leads to demand for food services such as cafés and restaurants, as well as for easy-to-prepare or processed foods. The increased value of time leads to demand for convenient shopping for food and other items, which translates into demand for modern food retailing and agroprocessing—especially organized agroprocessing. Operators of modern food retailing require a supply chain that delivers consistent quality. Therefore, they form dedicated supply chains with backward linkages all the way to farmers and encourage the supply chains to invest in postharvest management services such as sorting, grading, packing, and cold storage. In addition, there is increased demand for food logistics services, dedicated transportation services (for example, refrigerated vans) and storage services—and more generally in the business of keeping food fresh, safe, and nutritious and delivering it to customers. The cumulative effect is that agribusiness grows faster than primary agriculture.

By the time many countries reach middle-income status, the agribusiness sector not only becomes several times larger than primary agriculture but also becomes an important source of jobs. The share of primary agriculture in GDP declines during structural transformation, while the share of agribusiness increases. In many middle-income countries, the share of primary agriculture would decline to about 10 percent of GDP while the share of agribusiness grows to more than 30 percent (World Bank 2007). However, these patterns are hard to quantify, because most countries do not keep national accounts on various segments of agribusiness—instead, the sector is buried in all three "classic" sectors of agriculture, manufacturing, and services. Despite the data challenges, this report makes an effort to compare the relative size of agribusiness to primary agriculture in middle-income countries using input-output data from the Global Trade Analysis Project (GTAP) 2011.<sup>2</sup>

<sup>&</sup>lt;sup>2</sup> Special thanks to World Bank colleagues Julia Navarro, Sebnem Sahin, and Steven Jaffee for sharing the data.

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The data indicate that in current middle-income countries such as in Botswana, the Republic of Korea, Mexico, and South Africa, agribusiness is more than 2.5 times the size of primary agriculture (figure 2.2). And in other middle-income countries such as Brazil, Chile, China, Namibia, the Philippines, and Thailand, the contriution to GDP of agribusiness is estimated to be more than 1.5 times larger than primary agriculture. Furthermore, these trends appear to hold even after some countries transition from middle-income to developed countries; for example, the agribusiness sectors of France and the United States are estimated to be more than 2.5 times larger than primary agriculture. These comparisons are drawn from the GTAP 2011 input-output data set, which provides a consistent classification of agribusiness and primary agriculture sectors across countries and is therefore useful for cross-country comparisons. (See the annex to this chapter for sector classification.) However, it is likely the data underestimate the size of agribusiness relative to primary agriculture; this is illustrated by the example of Brazil, where data on the contribution of both primary agriculture and agribusiness are readily available, including disaggregated data on various segments of agribusiness). As noted above, figure 2.1 indicates that agribusiness contributes about 22 percent to Brazil's GDP, while the World Bank's World Development Indicators data indicate that primary agriculture contributes 5 percent. Thus, agribusiness is about 4 times larger than primary agriculture and not 1.5 times larger, as suggested by the GTAP 2011 data.





Source: GTAP 2011 input-output matrix.

### Agribusiness has remained relatively small in India

The agribusiness sector in India has remained small relative to middle-income comparators. This report estimates that agribusiness contributes about 7.65 percent to India's GDP, without including the organized segment of food services (hotels, restaurants, food trade) for which data were not available. While agribusiness is larger than primary agriculture in many middle-income countries, this is not the case for India. The ratio of agribusiness to agriculture in terms of contribution to GDP is estimated at 0.64 using GTAP data—which shows that primary agriculture in India is larger than agribusiness by more than 50 percent. The national accounts in India are not geared to measure the size of agribusiness; this has generated much debate not only about the size of agribusiness, but also about the various segments of agribusiness. As part of the analysis for this report, an effort was made to estimate the size of specific segments of agribusiness. The analysis relied on surveys conducted by India's Central Statistics Office. In particular, the National Sample Survey was used to estimate the size of the unorganized segment, and the Annual Survey of Industries was used for the organized segment. Table 2.1 provides estimates of the size of agroprocessing and food retail business using the gross value added in these sectors from National Sample Survey unit-level data, which is taken as a ratio of sectoral and aggregate GDP at factor cost. The share of agroindustry in GDP is estimated at 4.12 percent, of which the organized segment contributes 2.88 percent and the unorganized 1.24 percent. The share of food processing is estimated at 1.91 percent of GDP, of which the organized sector contributes 1.62 percent and the unorganized 0.29 percent. The share of food services (hotels, restaurants, food trade) in GDP is estimated at 1.62 percent; this only reflects the contribution of the unorganized segment, because data on the organized segment are not available. Of the 1.62 percent contribution from unorganized food services, about

	Total	Organized	Unorganized
Total manufacturing (2011/12)	16.28	11.58	4.70
Food processing	1.91	1.62	0.29
Agroprocessing	4.12	2.88	1.24
Services (2010/11)			
Food services (hotels, restaurants, food trade)			1.62
Hotels, restaurants			0.43
Food trade (food, beverage, tobacco)			1.19
Retail			0.99
Wholesale			0.21

### Table 2.1 Shares of agroprocessing and agroservices in India's total GDP, at factor cost

Source: National Sample Survey; Annual Survey of Industries.

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0.43 is from hotels and restaurants; the remaining 1.19 percent is from food trade, of which retailing contributes 0.99 percent and wholesaling 0.21 percent. These estimates indicate that agribusiness contributes about 7.65 percent of GDP—but again this does not account for the organized segment of food services (hotels, restaurants, food trade), which is estimated to exceed the 1.62 percent contribution of the unorganized segment.

When the size of agribusiness is measured based on World Development Indicators data combined with GTAP input-output data, agribusiness is seen to contribute about 10.68 percent to GDP. According to the World Development Indicators data, primary agriculture contributes 17.8 percent to GDP in India (part of which is agribusiness). Using this number, together with the ratio of agribusiness to agriculture indicated by the GTAP input-output data (0.64), suggests that the contribution of agribusiness to GDP would be about 10.68 percent. However, even at 10.68 percent of GDP, the agribusiness sector would still be smaller than the contribution of primary agriculture—which is a larger share at 17.8 percent than the sector's contribution to GDP in middle-income comparators. Primary agriculture contributes about 5 percent of GDP in Brazil, 9 percent in China, 3 percent in Chile, 2 percent in South Africa, and 10 percent in Thailand.<sup>3</sup>

This report estimates that about 13.56 percent of agricultural produce is processed in the organized sector. The extent of processing is estimated using three measures. The first is the share of all processed agricultural products in the total value of output of the agriculture and allied sectors (agriculture, livestock, forestry, and fisheries). Using this measure, the extent of processing is calculated as 6.59 percent in the organized sector (2011/12) and 2.11 percent in the unorganized sector (2000/01) (table 2.2). The second measure is based on the share of processed agricultural products in the total value of crop output. Using this measure, the estimates are 10.39 percent in the organized segment (2011/12) and 3.17 percent in the unorganized segment (2000/01). A third estimate considers the large share of

	Organized		Unorganized	
Measure	2000/01	2011/12	2000/01	Total <sup>a</sup>
Share of all processed agricultural products in the total value of output of agriculture and allied sectors (%)	2.53	6.59	2.11	8.7
Share of processed agricultural products in the total value of crop output (%)	3.79	10.39	3.17	13.56
Food grains processed as a share of the value of production of total food grains (%)	0.29	3.67	1.55	5.22

### Table 2.2 Extent of processing of agricultural products by sector

a. Sum of organized in 2011/12 and unorganized in 2000/01.

<sup>&</sup>lt;sup>3</sup> Source: World Bank, http://wdi.worldbank.org/table/4.2.

food grains in India's annual agricultural production and captures the extent of processing of food grains as a share of the value of production of total food grains. Using this measure, the estimates are 3.67 percent in the organized sector (2011/12) and 1.55 percent in the unor-ganized segment (2000/01). A recent estimate by Ghosh (2014) indicates that the level of agroprocessing is 5.4 percent in the organized sector alone. The three estimates described above may not be exactly comparable with Ghosh's estimates due to differences in methodology, number of commodities included, level of aggregation, and so on.

Although there has been significant growth in agroprocessing, this segment is relatively small compared to middle-income countries, which indicates enormous potential to use agroprocessing for growth and jobs. When the extent of processing is defined as the share of processed agricultural products in the total value of crop output, the share of process-ing is estimated at 13.56 percent (10.39 percent in the organized sector and 3.17 percent in the unorganized). This reflects impressive growth from the 3.79 percent estimate of 2000/01 in the organized sector, but falls below other middle-income countries. For example, the comparable shares of processing are estimated at about 23 percent in China and 65 percent in the United States. The low level of agroprocessing indicates enormous untapped potential to add value and reduce wastage. The benefits to the economy could be huge, because agro-processing has very high backward multipliers (Ganesh-Kumar and Panda 2013). [needs to be in references] The employment multiplier effects of agroprocessing are estimated at about 2.5 times higher than other industries (Bhavani, Gulati, and Roy 2006). [needs to be in ref-erences] It means that if India were to increase agroprocessing to China's levels, from about 13.56 percent to 23 percent of production, the gains to the economy could be enormous in terms of providing employment as well as backward linkages to farmers involved in pri-mary production. Agroprocessing could be a new hub of growth for India and a gateway to expanding horticulture exports, as well as providing domestic consumers with value-added differentiated products and meals that are ready to eat or easy to prepare.

### Why India's agribusiness sector is lagging middle-income comparators

The regulatory environment created by the Agriculture Produce Market Committees Act has led to long value chains that have created information barriers, encouraged spot markets, and discouraged vertical coordination—all of which stifled investment in postharvest management and agribusiness. Marketing of agricultural produce is regulated through agriculture produce marketing committees (APMCs) in nearly all states.<sup>4</sup>

<sup>&</sup>lt;sup>4</sup> The exceptions are Kerala, Manipur, Andaman and Nicobar Islands, Dadra and Nagar Haveli, Daman and Diu, and Lakshadweep.

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The APMCs carry out various regulatory functions, using powers delegated to them by state governments through state APMC acts. Each APMC has a catchment area (a sphere of regulatory influence), crowned with physical marketing facilities (mandis). These facilities are owned by the committees and rented by traders licensed to operate within the premises. The APMCs collect fees and levies on traded produce on behalf of state governments. Transactions are carried out under the purview of the committees. For many years, the APMC acts of most states mandated the *mandis* to be the only place where wholesaling of agriculture produce could take place and prohibited large buyers from purchasing directly from farmers. This meant that farmers and aggregators (brokers) needed to take produce to the mandis where they would sell the produce through commission agents. The requirement that wholesale trade could only occur at the *mandi* not only created a long and fragmented chain but also barriers to information, since commission agents and brokers do not take ownership of the produce and are instead paid a percentage of the sales value of the produce. They have no real incentives to invest in costly postharvest management. Furthermore, they mainly sell in auction markets where produce is barely differentiated on any quality parameters. Thus, they could maximize commissions through volume rather than incurring costly postharvest management.

Another implication of the long value chains is that demand signals from consumers had to pass through many actors before reaching farmers. Long value chains tend to drop information along the way. The APMC regulations also discouraged contracting between farmers and agribusiness, as well as other forms of vertical coordination. Instead, all transactions were spot in the sense that price and other terms of the transaction are discovered at the time of the transaction and delivery is made on the spot. Farmers could not enter vertical coordination arrangements which are often associated with lower transaction costs, improved efficiency, stable expectations on price and other parameters, and so on. This environment ultimately stifled investments in postharvest management.

On the retail end, food retailing is stifled by policies that have effectively discouraged foreign direct investment (FDI) in modern food retailing and blocked critical knowledge on organizing value chains. The lack of FDI means that global companies with extensive experience and knowledge in creating dedicated modern retail value chains are not able to use that expertise to bear on India's agribusiness sector. India is losing the opportunity to tap into this knowledge, which would benefit players in the dedicated supply chain. There would be trade-offs from FDI because the modern front-end outlets could substitute for the small and usually family-owned *kirana* shops. The real challenge is to find ways to integrate these *kirana* shops in a modern retail value chain. The lack of FDI also means India is losing out on cheap capital to invest in modern food retailing because interest rates are higher in India compared to more developed countries. This is important because modern food retailing is not only capital intensive but also risky. This combination does not provide the right incentives for domestic investors, especially when there are other, less risky, retail growth segments—for example, nonfood retail.

The good news is that the regulatory environment is drastically improving, beginning with reforms proposed in the Model Act of 2003 and, more recently, the delisting of fruits and vegetables from the APMC acts in some states. As part of an effort to address regulatory impediments in marketing agricultural produce, the Government of India passed a Model APMC Act in 2003 to encourage states to adopt various reforms. The model act contained several propositions to stimulate vertical coordination arrangements between agribusinesses and farmers and encourage private sector investment in marketing agricultural produce. The main elements of the reforms proposed in the model act are (1)direct marketing of agricultural produce from farmers to licensed buyers (for example, processors, exporters, graders, packers) that would purchase agricultural produce directly from farmers without passing through APMC mandis; (2) establishment of private markets; (3) contract farming, which is a strong form for vertical coordination between farmers and buyers; (4) single-point payment of marketing levies, regardless of the number of times an item is traded in various markets; and (5) a single license for traders to operate in more than one APMC jurisdiction. However, the adoption of the model act has followed different paths among states. While some states have embraced the reforms and incrementally revised their state APMC acts, others have barely considered the reforms. Moreover, some states have carried out reforms in ways not envisaged in the model act. On the other hand, there are states that have not reformed their APMC act but have instead issued certain directives that mimic reforms. For example, Uttar Pradesh has not reformed its APMC act since the model act was proposed in 2003, but has instead passed an administrative order that allows bulk purchases by agribusiness. The outcome has been the entry of private sector players such as Haldiram, ITC, Pepsico, Big Bazaar, and Spencers into direct marketing arrangements with farmers and registered vendors (World Bank 2013). Similarly, Punjab has not amended its APMC act, but ordinances have been issued giving some agribusinesses special status to buy from farmers.

More recently, several states have delisted fruits and vegetables from the jurisdiction of the APMC act. Madhya Pradesh is perhaps a pioneer along this path of reform, with the state delisting fruits and vegetables from its APMC act in 2012, followed by Assam and Chattisgarh later that year. The reform provides for a simple but clear regulatory environment which could open up horticulture marketing to vertical coordination arrangements between farmers, traders, and agribusinesses. It eliminates the earlier confusion in other states where APMCs expected traders that bought produce directly from farmers to pay fees even though the trade occurred outside the *mandis*. The central government has backed this new wave of reform and has advised all states to delist fruits and vegetables. Following this advisory, several states have delisted fruits and vegetables from their respective APMC act, including Nagaland and Rajasthan in 2013; Delhi, Haryana, Himachal Pradesh, Karnataka, Meghalaya, and West Bengal in 2014; and Gujarat and Odisha in 2015. However, not all fruits and vegetables have been delisted in all states. Assam specifically delisted only 23 fruits and 6 vegetables, Delhi delisted all fruits and vegetables but only in 3 selected markets, Meghalaya exempted potato from the delisting, West Bengal exempted onion and potato from delisting, and so on. States that have reformed their APMC act but not delisted fruits and vegetables include Andhra Pradesh, Arunachal Pradesh, Goa, Gujarat, Jammu and Kashmir, Jharkhand, Maharasthra, Mizoram, Punjab, Sikkim, Tamil Nadu, and Tripura.<sup>5</sup> Bihar, Kerala, and Manipur have no APMC act.

Ultimately, the reforms should aim at ending the monopoly of the APMCs. Apart from India, there are no middle-income countries with a regulatory environment that creates a monopoly for marketing agriculture produce. Furthermore, there is nothing unique in India to suggest that APMCs should have a monopoly over agricultural marketing. Therefore, the ultimate aim of reform should be to end the monopoly of the APMCs and allow unfettered competition through other marketing arrangements, including contracts between agribusiness and farmers or farmer groups, and electronic and digital market platforms.

In addition to the historic legacy of a disabling policy and regulatory environment which is the principal reason behind the slow growth of agribusiness in India—the sector has been hampered by other factors including (1) low productivity of primary agriculture; (2) fragmented farm holdings and land tenure policies; (3) poor technology for harvesting and postharvest management, especially at the farm level; and (4) a lack of relevant grades and standards that capture produce value, reward quality, and provide incentives for investments in appropriate technology for production and postharvest management.

<sup>&</sup>lt;sup>5</sup> Recent news reports have indicated that the Maharashtra government is considering delisting.
# Annex Classification of sectors in comparing the size of agribusiness to primary agriculture

Classification	Sector
Agriculture	Paddy rice, wheat, cereal grains not elsewhere classified, vegetables, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, crops not elsewhere classified, cattle, sheep, goat, horses, raw milk, wool, silkworm cocoons, forestry, fishing
Processed agriculture (agribusiness)	Animal products not elsewhere classified; meat: cattle, sheep, goat, horse; meat products not elsewhere classified; vegetable oils and fats; dairy products; processed rice; sugar; food products not elsewhere classified; beverages and tobacco products; textiles; wearing apparel; leather products; wood products
Non-agriculture (all other sectors)	Coal, oil, gas, minerals not elsewhere classified, paper products, publishing, petroleum, coal products, chemical, rubber, plastic products, mineral products not elsewhere classified, ferrous metals, metals not elsewhere classified, metal products, motor vehicles and parts, transport equipment, electronic equipment, machinery and equipment not elsewhere classified, manufactures not elsewhere classified, electricity, gas manufacture, distribution, water, construction, trade, transport not elsewhere classified, sea transport, air transport, communication, financial services not elsewhere classified, insurance, business services not elsewhere classified, recreation and other services, public administration/defense/health/education, dwellings

Source: GTAP, <u>https://www.gtap.agecon.purdue.edu/databases/contribute/detailedsector.asp.</u>

# Chapter 3 What can agribusiness do for jobs?

Without growth in the agribusiness sector, the rising demand for high-value foods and processed products will be met through imports, and India will lose the opportunity to create jobs and income at home. Emerging trends suggest that import growth is being fueled by increasing demand for food products that the domestic food industry is not adequately supplying. For example, during 2006–11, the imports of high-value food categories have grown faster than exports for the following food categories: live or fresh or frozen meat, fish, and poultry; milk and dairy products; fresh produce and nuts; edible oils; processed animal products; processed foods; prepared or frozen foods; and beverages (table 3.1). It is important to note that all these food groups involve some degree of processing, except fresh produce and nuts, and the higher growth of their import relative to export is evidence the domestic sector is being outcompeted by imports and losing the opportunity to create jobs and raise incomes at home. Overall, imports have grown faster than exports in 8 of the 10 food categories in table 3.1. The gap between growth in imports and growth in exports is widest in milk and dairy products (import growth of 70.7 percent versus export growth of -1.2) and processed foods (import growth of 60.7 percent versus export growth of 11.2 percent). Since these two are large segments of agribusiness, the remarkably high growth in imports means lost opportunities for jobs and incomes. The only two segments where export growth has outstripped import growth are cereal and cereal products and tobacco.

# Estimating productivity and capital investment gaps

Any efforts to grow the agribusiness sector would need to address productivity and capital investment gaps that may have been created by the historical policy environment. This report estimates the size of productivity and investment gaps in the agribusiness sector. A good source of data to estimate these gaps is the Global Trade Analysis Project

	Average exports (\$)		Average in	mports (\$)	Growth i	n exports	Growth i	n imports
Commodity	2000-05	2006-11	2000-05	2006-11	2000-05	2006-11	2000-05	2006-11
Live/fresh/frozen meat, fish, poultry	164,7209	3,175,119	10,821	52,690	3.44	20.16	24.43	29.27
Milk & dairy products	104,295	252,502	15,447	82,433	39.68	-1.21	2.41	70.73
Fresh produce, nuts	1,796,273	3,769,073	1,105,034	3,082,177	6.43	14.34	18.12	17.95
Cereals & cereal products	1,426,753	3,326,237	11,777	361,407	23.67	18.85	-12.65	-40.38
Edible oils	820,95 I	2,358,763	2,054,020	5,005,163	8.92	28.17	14.78	32.41
Animal products-proc.	60,203	217,548	578	2,926	123.71	-0.29	49.21	23.35
Processed foods	274,508	1,265,960	131,370	475,625	-1.82	11.18	43.58	60.68
Prepared/frozen foods	214,166	525,523	47,116	98,284	9.03	14.37	-12.14	26.10
Beverages	571,870	1,93,0879	1,35,513	353,344	11.88	13.49	56.07	22.87
Tobacco	224,732	677,034	10,967	24,682	11.90	19.45	44.59	11.90
All agriculture	7,140,960	17,498,638	3,522,644	9,538,733	9.92	17.64	17.48	24.58
Total exports	61,992,007	191,269,390	78,889,691	298,567,262	19.13	17.91	22.61	18.73

#### Table 3.1 Exports and imports of primary and processed agricultural products

Source: COMTRADE.

(GTAP) data set, because it provides a consistent classification of economic activities and sectors across many countries. As a first step in estimating the gaps, the GTAP data are used to identify segments of economic activities that could be classified as agribusiness; the remaining segments are then classified into useful economic sectors for the purpose of this analysis. Table 3.2 provides the classification of different segments of economic activities into the following sectors: agribusiness, primary agriculture, other primary sectors, allied agrobased industries, other manufacturing sectors, services partly for agribusiness, and other service sectors. Most of the analysis here focuses on sectors classified as agribusiness, but other sectors are also included to understand how the underlying intersectoral linkages influence

#### Table 3.2 Classification of economic activities into agribusiness and other sectors

Classification	Segment of economic activity
Agribusiness	Bovine meat products, meat products not elsewhere classified, vegetable oils and fats, dairy products, processed rice, sugar, food products not elsewhere classified, beverages and tobacco products
Primary agriculture	Paddy rice; wheat; cereal grains not elsewhere classified; vegetables, fruits, nuts; oil seeds; sugar cane, sugar beet; plant-based fibers; crops not elsewhere classified; bovine cattle, sheep, and goats, horses; animal products not elsewhere classified; raw milk; wool, silkworm cocoons
Other primary sectors	Forestry, fishing, minerals and energy commodities
Allied agro-based industries	Textiles, wearing apparel, leather products, wood products, paper products, publishing
Other manufacturing sectors	Other sectors
Services partly for agribusiness	Business services, trading services, transportation, financial services, insurance services
Other service sectors	Other services

the effects of bridging productivity and investment gaps in agribusiness. For example, it is important to understand the degree to which any growth in agribusiness—as a result of bridging productivity and investment gaps—would pull up primary agriculture through backward linkages inherent in the structure of the economy. While the agribusiness sector includes the category "services partly for agribusiness," this segment is ignored for the rest of the analysis because the way data are constructed in the GTAP data set does not provide much guidance on apportioning various segments of the services sector into agribusiness and non-agribusiness. The main drawback of ignoring agribusiness services is that the simulations will not include injecting productivity and investments into this segment. Therefore, the simulations discussed in the next section could be considered lower bound in the sense that they ignore second-round effects on food distribution services (both modern and traditional wholesaling and retailing), food storage (warehousing, cold, and controlled atmosphere), financial services (lending and insurance to agribusinesses), and so on.

The report estimates productivity and investment gaps in India relative to middleincome comparators. In measuring the productivity and investment gap, India is compared to the following middle-income comparators: Brazil, Chile, the Republic of Korea, South Africa, and Thailand; as well as to a developed country, the United States. A detailed methodology for estimating productivity and investment gaps is discussed in annex 3.1. In summary, the productivity gap is measured by comparing total factor productivity (TFP) in each segment of agribusiness between India and middle-income comparators. The TFP captures the change in output not due to change in inputs. It means the estimated productivity gap captures differences in productivity that are not due to differences in the use of inputs, but rather are attributable to factors such as technological progress or efficiency in conversion of inputs to outputs, including the efficient use of installed capacity. The TFP calculations are based on the Solow growth accounting model (Solow 1957). The investment gap is calculated using GTAP data as the change in capital required to shift the ratio of cap-ital to total value added (sum of all primary factors) in India so that it matches the ratio in middle-income comparators. Since there are many middle-income countries (MICs) being compared to India, the analysis is simplified by comparing India to the average of the five MICs considered in the analysis. In addition, China is taken as a stand-alone benchmark to estimate the differences in productivity and investment gaps between the two countries, and also to simulate outcomes in the scenario where India catches up with China on productivity and investments in various segments of agribusiness.

There are significant productivity gaps in most segments of agribusiness, except in the dairy processing segment where India's productivity surpasses both the MIC average and China. Table 3.3 presents comparative estimates of productivity in various segments of agribusiness between India, Brazil, Chile, South Africa, the Republic of Korea, Thailand, and the United States. Based on these estimates, two productivity gaps are calculated: (1) between India and the average for MICs, and (2) between India and China. The results in table 3.3

Segment	Brazil	Chile	India	Korea, Rep. of	South Africa	Thailand	United States	MIC average	Gap w/ MICs	China	Gap w/ China
Bovine meat products	0.101	0.047	0.066	0.134	0.093	0.013	0.067	0.104	56.95	0.274	312.73
Meat products n.e.c.	0.079	0.015	0.098	0.018	0.053	-0.019	-0.02 I	0.078	-20.37	0.304	208.78
Vegetable oils and fats	0.145	0.162	0.108	0.134	0.098	0.106	0.076	0.146	34.47	0.266	145.56
Dairy products	-0.016	-0.077	0.156	0.076	0.121	-0.063	0.055	0.050	-68.10	0.151	-3.10
Processed rice	0.110	0.308	0.214	0.129	0.244	0.430	0.127	0.253	18.27	0.339	58.07
Sugar	0.217	0.148	0.055	0.016	0.003	0.093	0.083	0.101	84.40	0.175	219.64
Food products n.e.c.	0.189	0.229	0.132	0.099	0.137	-0.016	0.086	0.149	13.55	0.275	109.48
Beverages and tobacco products	0.173	0.218	0.184	0.200	0.233	0.149	-0.015	0.219	18.98	0.378	105.00

Table 3.3 Productivity and productivity gaps in various segments of India's agribusiness sector (percentages).

Note: n.e.c. = not elsewhere classified.

show that in the bovine meat products category, productivity in India needs to increase by about 57 percent to catch up with the MIC average. For India were to catch up with China, its productivity would need to increase even more—by about 313 percent. This is because China's productivity in bovine meat products is way above the average for MICs. The results show that India's productivity is less than both the MIC average and China in the following segments: bovine meat products, vegetable oils and fats, processed rice, sugar, food products not elsewhere classified, and beverages and tobacco products. On the other hand, India's productivity in the meat products not elsewhere classified segment is higher than the MIC average and hence has a negative productivity gap. It still falls below China in this segment, however; India would have to increase its productivity by about 208 percent to catch up. Another segment where India's productivity is higher than the MIC average is dairy products. In this case, India's productivity is also above China's. One of the most unique features of the dairy sector in India is that it has never been regulated through the Agriculture Produce Market Committees (APMC) Act or a policy of that nature. Farmers have always been free to sell milk to any buyer whether large or small, and many farmers—whether small or large—have moved up the chain and are involved in dairy processing through a robust network of cooperatives that not only own dairy processing plants but are also linked to breeding programs and feed processing. These efforts have been led over several decades by the National Dairy Development Board. The World Bank was a significant partner in this process through financial support and supervision of five Operation Flood projects between 1974 and 1995<sup>1</sup>—and

<sup>&</sup>lt;sup>1</sup> These were the Karnataka Dairy Development Project (Cr. 482-IN), the Rajasthan Dairy Development Project (Cr. 521-IN), the Madhya Pradesh Dairy Project (Cr. 522-IN), the National Dairy Project (Cr. 824-IN), and the National Dairy II Project (Cr. 1859-IN/Ln. 2893-IN).

more recently with the ongoing National Dairy Support Project. Overall, India faces a significant productivity gap in most segments of agribusiness.

There are significant investment gaps in most segments of agribusiness. The investment gap is estimated as the change in capital required to shift the ratio of capital to total value added in India to catch up with the average ratio for middle-income comparators and for China. The results are presented in table 3.4 (see annex 3.2 for a detailed presentation of the methodology). The third column shows the capital ratio in India, and the fourth column shows the average capital ratio in the MICs. The fifth column calculates the extent to which capital needs to increase in India in order to catch up with the MIC average. This is converted to percentage terms in column six. The rest of the table repeats the same calculations using China as a comparator. The results indicate that India has investment gaps in all agribusiness segments, except vegetable oils and fats. For example, in the bovine meat products segment, India needs to increase capital investment by 114 percent and 93 percent, respectively, to catch up with the MIC average and with China. It is interesting to note that while the dairy products segment in India was more productive relative to both the MIC average and China, the capital investment gaps are very large. These large gaps are perhaps because the bulk of investment in dairy processing occurred several decades ago, between 1974 and 1995 through the Operation Flood projects, and there has been relatively less investment in recent years. This also means that the part of output from these processing plants that is not attributable to inputs is higher in India, because less capital inputs are being injected relative to other MICs—which partly explains the relatively higher TFP in India. Furthermore, capacity utilization in dairy processing is also likely higher because the volume of milk production has increased tremendously in India over the last two decades. Higher capacity utilization translates to higher TFP. The expansion in dairy production has propelled India to become the world leader in volume of milk production. Milk has become the single largest

		Total for all	India capital	MIC avg capital	Capital i India to	ncrease MIC avg	China capital	Capital India to	increase China
Sector	Capital (\$, mil.)	factors (\$, mil.)	ratio (%)	ratio (%)	(\$, mil.)	(%)	ratio (%)	(\$, mil.)	(%)
Bovine meat products	314	1,035	0.30	0.48	360	114.46	0.46	292	92.86
Meat products n.e.c.	46	143	0.32	0.46	38	84.11	0.34	5	11.15
Vegetable oils and fats	3,226	4,348	0.74	0.59	-1,632	-50.60	0.51	-2,047	-63.45
Dairy products	1,491	6,053	0.25	0.50	3,142	210.70	0.60	5,379	360.68
Processed rice	5,659	18,610	0.30	0.54	9,276	163.90	0.49	6,951	122.82
Sugar	1,520	3,422	0.44	0.58	1,092	71.86	0.53	599	39.40
Food products n.e.c.	3,151	13,058	0.24	0.48	5,960	189.14	0.52	7,466	236.95
Beverages & tobacco products	3,035	8,326	0.36	0.59	4,450	146.63	0.54	3,268	107.68

#### Table 3.4 Capital investment gaps in various segments of India's agribusiness sector

Source: Calculated from GTAP v9 data 2011.

Note: n.e.c. = not elsewhere classified.

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agricultural commodity in the country, accounting for about 18 percent of agricultural gross domestic product (GDP).

# Simulating the effects of bridging the productivity and capital investment gaps

A simulation model is used to examine the effects of bridging the productivity and investment gaps on various economic outcomes. The simulations are simple comparative statics that seek to measure changes in various economic indicators if India bridges productivity and investment gaps in various segments of agribusiness. The simulations rely on the GTAP model, and are discussed in more detail in <u>annex 3.3</u>. In conducting the simulations, several basic assumptions were made in the model. First is that capital could move across sectors but not across countries. This is motivated by rigidities in international capital flows, especially in a country such as India where there are regulations to check inflows of foreign direct investment (FDI). In particular, the simulation model does not allow additional FDI other than what is already in the country. This means that increased capital investment in agribusiness would be drawn from other sectors of the domestic economy—which is effectively disinvestment in non-agribusiness sectors. The sectoral capital shares would then rebalance based on returns to capital. With increased capital investments and productivity, the supply of agribusiness goods will increase in the economy. The model includes a demand shifter to meet the increased supply. In other words, most of the incremental agribusiness goods would be consumed domestically, and there will not be significant price effects that would have occurred if there was a supply-demand imbalance. However, the increased demand for agribusiness goods comes at a cost to goods from other sectors, in the sense that it reduces their demand. Another basic assumption is with regard to labor supply. There are two types of labor—skilled and unskilled—and there are two competing approaches to addressing effects on labor markets. The first approach is to fix the supply of skilled labor and let wages for skilled labor adjust. This would correspond to a scenario where there are rigidities in acquiring new skills. In this scenario, the supply of unskilled labor will not be fixed, but wages for unskilled labor will be fixed. However, not fixing the supply of unskilled labor indicates there are abundant supplies in the economy, which appears inconsistent with the reality of rising wages for unskilled labor. Therefore, a competing second approach is to fix the supply of unskilled labor and leave its wages to adjust. In this scenario, the wages for skilled labor will be fixed but not the supply of skilled labor. The simulation results are not sensitive to these competing approaches, meaning that either approach could be used in the simulations without changing the main findings. More technical assumptions of the simulation model are described in annex 3.3.

# Effects on growth and economic indicators

Bridging the capital investment and productivity gaps will significantly expand the size of agribusiness. The results on economic indicators consider both macroeconomic and sectoral effects. All simulations consider two scenarios. The first is India bridging productivity and capital investment gaps with the average of MICs, and the second is India bridging these gaps with China. The simulation results on sectoral effects to GDP are presented in table 3.5. If India catches up with the MIC average in terms of productivity and investments, the GDP of agribusiness increases by about 74.6 percent, the GDP of primary agriculture increases by about 2.8 percent, and there is contraction in all other sectors of the economy. The contraction is explained by disinvestment in sectors that are not agribusiness. However, primary agriculture expands because expansion of agribusiness pulls up this sector in the sense that it creates more demand for raw agriculture produce. And if India catches up with China, the agribusiness GDP doubles, which further pulls primary agriculture to grow by about 5.5 percent. Overall, the pull effect appears to be small and this is because of the underlying structure of the economy where linkages between primary agriculture and agribusiness have been historically constrained by the policy and regulatory environment (see the discussion in chapter 2). The main implication is that any strategy to grow agribusiness must include interventions that lead a much larger pull effect on primary agriculture than what the underlying intersectoral linkages offer. When India catches up to China, the contraction in other sectors is even higher with the category allied agro-based industries contracting by about 9 percent. In reality, such contractions could be avoided by managing the economy such that increased capital investments do not cause disinvestments in other sectors of the economy. Approaches to increase capital supply in the economy may include (1) policies that out-compete other

Crown	Due –il	China	Chile	ما به ما	Korea,	South	Thai-	United			
Group	Brazii	China	Chile	India	кер. от	Africa	land	States	ROVV		
Scenario I: catch up with MIC average											
Primary agriculture	0.05	0.05	0.12	2.80	0.06	0.08	-0.14	0.11	0.16		
Other primary sectors	-0.14	-0.11	-0.08	-3.12	-0.10	-0.17	-0.05	-0.12	-0.05		
Agribusiness	0.01	0.02	0.03	74.60	-0.04	0.06	-0.05	-0.03	0.03		
Allied agro-based industries	-0.08	-0.08	0.03	-5.12	-0.0I	0.04	0.03	-0.01	0.03		
Other sectors	0.05	0.03	0.03	-2.42	0.04	0.02	0.05	0.02	0.03		
		Scenari	o II: catch	up with (	China						
Primary agriculture	0.11	0.12	0.27	5.50	0.16	0.17	-0.04	0.23	0.38		
Other primary sectors	-0.3 I	-0.24	-0.17	-5.30	-0.22	-0.33	-0.11	-0.26	-0.10		
Agribusiness	0.08	0.04	0.07	201.80	-0.08	0.15	0.06	-0.03	0.08		
Allied agro-based industries	-0.19	-0.19	0.06	-9.17	-0.01	0.08	-0.02	-0.02	0.04		
Other sectors	0.12	0.06	0.06	-3.90	0.09	0.04	0.10	0.05	0.05		

#### Table 3.5 Effects on sectoral GDP

Note: ROW = rest of world.

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countries in attracting foreign direct investments (FDI), and (2) expanding banking services while providing incentives for savings to increase the level of capital from domestic sources. In terms of macroeconomic effects, both scenarios enhance welfare in India. If India catches up with MICs the Equivalent Variation—a measure of welfare—increases by about 1.1 percent, GDP increases by 1.4 percent, exports grow, imports decline, and there is a positive trade balance (see annex table A3.3.1). And when India catches up with China, the results are even better for India. Welfare increases by about 4.4 percent, GDP increases by about 4.9 percent, and so on (see annex table A3.3.2).

## Effects on jobs

Bridging the capital investment and productivity gaps will significantly increase jobs in the agribusiness sector. The simulated effects on jobs are presented in table 3.6. If India catches up with other MICs agribusiness will employ about 17.1 percent more people while primary agriculture will employ 5.2 percent more people. There will be contractions in employment in other sectors of the economy because of disinvestments in those sectors in favor of agribusiness. Again this is a construct of the comparative statics in the model. In reality, such disinvestments could be mitigated by managing the economy in a way that increases supply of capital supply and such measures may include (1) policies that out-compete other countries in attracting foreign direct investments (FDI), and (2) expanding banking services while providing incentives for savings to increase the level of capital from domestic sources. The second scenario reflects India catching up with China. In this case the agribusiness sector

Sector	Brazil	Chile	China	India	Korea, Rep. of	South Africa	Thai- Iand	United States	ROW		
Scenario I: catch up with MIC average											
Primary agriculture	0.2	0.2	0.1	5.2	0.1	0.2	-0.3	0.3	0.3		
Other primary sectors	-0.5	-0.4	-0.3	-4.3	-0.3	-0.4	-0.2	-0.3	-0.2		
Agribusiness	0.0	0.1	0.0	17.1	-0.I	0.1	-0.2	0.0	0.1		
Allied agro-based industries	-0.I	0.1	-0.I	-4.9	0.0	0.1	0.1	0.0	0.0		
Other sectors	0.1	0.1	0.0	-2.2	0.1	0.0	0.1	0.0	0.0		
		Sc	enario II: c	atch up wi	th China						
Primary agriculture	0.5	0.6	0.2	10.5	0.4	0.5	-0. I	0.6	0.7		
Other primary sectors	-1.0	-0.9	-0.6	-7.9	-0.8	-0.9	-0.5	-0.7	-0.5		
Agribusiness	0.1	0.2	0.1	39.9	-0.2	0.3	0.2	0.0	0.2		
Allied agro-based industries	-0.3	0.2	-0.3	-9.6	0.0	0.1	-0.I	0.0	0.1		
Other sectors	0.2	0.1	0.1	-4.6	0.2	0.1	0.2	0.1	0.1		

#### Table 3.6 Effects on jobs

Note: ROW = rest of world.

employs about 40 percent more people and primary agriculture employs about 10.5 percent more people. And the contractions on other sectors are larger. Just as with effects on sectoral shares, in both scenarios, the effects on jobs in agribusiness sectors of other countries are modest. This is mainly because of several elements of the simulation model, including that both capital and FDI are fixed within countries—although they come move across different sectors of the same country, and also because productivity and capital investments are not exogenously changed in the simulations.

## Conclusions

The historical regulatory environment of Agriculture Produce Market Committees (APMC) Act has led to long value chains that created information barriers, encouraged spot markets, and discouraged vertical coordination—all of which stifled investment in postharvest management and agribusiness. The requirement that wholesale trade could only occur at the mandi not only created a long and fragmented chain but also barriers to information. The commission agents and brokers along the long chain do not take ownership of the produce and instead are paid a percentage of the sales value of the produce. It means they have no real incentives to invest in postharvest management. Furthermore, they mainly sell in auction markets where produce is hardly differentiated on any quality parameters. These agents could maximize commissions through volumes rather than incurring costly postharvest management. Another implication of the long value chains is that demand signals from consumers would have to be passed through many actors before it reached the farmer. Since a long value chain tends to drop information along the way, farmers are only able to obtain fuzzy information about the types of produce and attributes desired by the market. Another feature of the APMC regulations is that they not only discourage contracting between farmers and agribusiness but also discourage other forms of vertical coordination. All transactions are spot in the sense that price and other terms of the transaction are discovered at the time of the transaction and delivery is made on the spot. Farmers could not form d vertical coordination arrangements that are often associated with lower transaction costs, improved efficiency, stable expectations on price and other parameters, and so on. It is not surprising that this environment has stifled investments in postharvest management.

Agribusiness would make enormous contribution to jobs—by employing 17 percent more people if India could bridge the productivity and investment gaps relative to middle-income comparators—and by employing about 40 percent more people if India catches up with China in terms of productivity and capital investments. India's productivity is less than MIC comparators in the following segments: bovine meat products, vegetables oils and fats, processed rice, sugar, food products not elsewhere classified, and beverages and tobacco products. And the productivity gaps are significant. The sectors where India's productivity is higher than MIC comparators are dairy processing segment where India's productivity surpasses both the MIC average and China and in bovine meat products. Similarly, India faces significant capital investment gaps in all segments of agribusiness, except vegetable oils and fats. For example, in the segment "bovine meat products" India needs to increase capital investment by 114 percent and 93 percent to respectively catch up with the MIC average and China. If these gaps are bridged the agribusiness sectors would become an important source of jobs. The share of agribusiness in GDP would significantly increase and the overall economy would expand with gains in welfare. The trade balance will be in favor of India as exports would increase and imports would decline.

Consider policies that raise the supply of capital to the agribusiness sector without causing disinvestment in other sectors or attract foreign capital. The preceding analysis shows that while growth in agribusiness, fueled by bridging the capital investment and productivity gaps with MICs would expand agribusiness and create many jobs, there is a danger that this would cause disinvestment in other sectors. Such trade-offs could be mitigated if the economy is managed in a way that raises the supply of capital—for example by (1) policies that outcompete other countries in attracting foreign direct investments (FDI) and (2) expanding banking services while providing incentives for savings to increase the level of capital from domestic sources. A good lesson on this is the policy of un-licensing and allowing 100 percent FDI in agroprocessing in 1991. This increased the supply of capital to the agroprocessing sector and led to increased investments without creating disinvestment in other sectors. There is no evidence that FDI displaced the unorganized agroprocessing segment because it has remained a large part of the sector with gross value added almost at part with the organized segment in 2011 while employing 25 million people compared to about 5.5 million in the organized sector.

Any strategy, project, or program to increase productivity and investments in agribusiness should include interventions that lead to a much larger pull effect on primary agriculture than the underlying intersectoral linkages offer. The effects on sectoral contribution to GDP indicate that bridging the investment and productivity gaps with MICs will increase the size of agribusiness by 74.6 percent while primary agriculture increases 2.8 percent. And when India catches up with China, tthe size of agribusiness will double, while primary agriculture will increase by only 10.5 percent. This reflects a small pull effect on primary agriculture, mainly due to weak underlying intersectoral linkages. The job linkages are also modest. Simulations suggest that bridging the gaps with MICs increases agribusiness jobs by 17 percent, while jobs in primary agriculture are increased by 5.2 percent; catching up with China will increase agribusiness jobs by about 40 percent and agriculture jobs by 2 percent. The weak linkages, especially in terms of size of GDP, impose a challenge for programs that seek to increase productivity or expand investment in agribusiness. Such programs would need to stimulate stronger linkages that are implied by the underlying structure of the economy. This would enable farmers to benefit from growth of agribusiness in terms of linking farmers to agribusiness and ensuring that farmers are able to earn better incomes.

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# Annex 3.1 Methodology for estimating the size and structure of agribusiness

#### Sources of data

The analysis uses the following data:

- Unit level data on organized manufacturing from the Annual Survey of Industries at two points of time: 2000/01 and 2011/12, CSO.
- Unit level data on unorganized manufacturing from quinquennial NSS surveys for 56th Round (2000/01) and 67th Round (2010/11) Unincorporated Non-Agricultural Enterprises (excluding construction), GOI.
- Unit level data on the tertiary sector based on quinquennial NSS surveys for 57th Round (2001/02) on Unorganized Services excluding Trade & Finance and 67th Round (2010/11) Service Sector enterprises, GOI. It is important to mention that the former round excludes wholesale trade, thus making the two data sets unmatched.
- National income across broad economic sectors and value of output from agriculture and allied activities, value of processed food items from National Accounts Statistics, Central Statistical Organization (CSO), Ministry of Statistics and Programme Planning, Government of India (GOI) from 2000/01 to 2011/12.
- Export and Import of major agricultural commodities from 1996 to 2013 from COM-TRADE and FAO and area under production of major agricultural commodities from FAO and Agricultural Statistics at a Glance, GOI.
- Consumption expenditure across broad items from unit level NSS Surveys carried out during 1993/94 (50th round), 2004/05 (61st round), 2009/10 (62nd round), and 2011/12 (68th round) GOI.

#### Analysis

The analysis is carried out at the national level at NIC 3, 4, and 5 digit levels in both manufacturing and retail activities. The current values of fixed assets, input and outputs, are converted to 2004/05 prices using gross fixed capital formation for manufacturing given in the NAS. For deflating other variables, the wholesale price index of all commodities is used (base 2004/05). A comparable time series data on key performance indicators in food and beverage industry is prepared based on a concordance matrix between three digit classes of NIC-2004 and NIC-2008. The industries falling under NIC (2008) three-digit-level codes 016, 101–108, and 110 are categorized under processing of food and beverage. The industrial code 016 refers to postharvest crop activities; 101 refers to production, processing, and preservation of meat; 102—processing and preserving of fish, crustaceans, and mollusks and products thereof; 103—processing and preserving of fruits-vegetables; 104—manufacture of vegetable and animal oils and fats; 105—manufacture of dairy products; 106—manufacture of grain mill products, starches and starch products and prepared animal feeds; 107—manufacture of other food products and 108 is manufacture of beverages including water and liquor. These along with industrial codes 120, 131, 141, 142, 2021, 2098, 2825 respectively for tobacco, cotton textiles, wool textiles, agricultural inputs and machinery and food processing equipment and their repairs are considered to fall under the agroprocessing industry.

In the case of wholesale and retail trade, the broad activities considered include NIC 561, 562, 563 (hotels, motels, restaurants, beverages), NIC 750 (veterinary activities), NIC 4620, 4630, 4653 (wholesale trade in livestock, food processing and agricultural tools and equipment's), NIC 4711, 4722, 4723, 4781 (retail trade in food and beverages), 46101, 46692, 46695, 52101 and 52102 (wholesale trade in fertilizers, agro chemicals, textiles and warehousing refrigerated and nonrefrigerated).

The data on inputs used in the manufacturing and tertiary sectors were given as per ASICC codes in the NSS, which have now been replaced by NPC-MS. For each of the selected industry/enterprise, the quantity and value of inputs used is extracted at five digit level for 2000/01 and 2011/12. It is important to mention that apart from organized and unorganized sectors, processing is carried out in the micro, small and medium enterprises (MSME) within the organized as well as unorganized segments. The fourth Census on Micro, Small and Medium Enterprises (MSMEs) for 2006/07 shows existence of nearly 60 lakh registered and unregistered agro enterprises employing 125 lakh workers, each having a share of 30 percent in total. However, more that 90 percent of the agro and food enterprises surveyed were categorized under the micro segment<sup>2</sup> which could possibly be covered in the NSS rounds on unorganized manufacturing.

Data on the number of workers, factories/enterprises, and value of fixed assets, output, and inputs used in each of the selected industry/sector are extracted to see the size and structure of agroprocessing and retail business. This is followed by estimation of the extent of processing of major agricultural commodities based on the use of agricultural commodities as inputs in the respective industries in quantity as well as value terms. The agricultural produce used in each of the industries is taken at the five digit level. The share of each input (agri-commodity) in total agricultural output (in quantity and value terms) is estimated to get the extent of processing of agriculture (EPA) after duly accounting for seed usage and wastage. For NIC 106 and 107 relating to grain milling and other food products, the analysis is further taken up at 5 digit level to estimate the magnitude of primary processing (unmilled) and secondary processing (milled) in wheat, paddy and pulses in both organized and the unorganized sectors.

The backward and forward production linkages between agriculture and agro industries and retail sector have been estimated based on the usage of agriculture inputs in the respective processing and retail activities. The inputs used in each industry (extracted at five-digit level)

<sup>&</sup>lt;sup>2</sup> As per Census MSME, micro enterprises are ones that have fixed investment in plant & machinery up to Rs 2.5 million, small enterprises above Rs 2.5 million & up to Rs 50 million; medium enterprises above Rs 50 million & up to Rs 100 million.

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are segregated into six categories: raw agricultural commodities—0; agricultural commodities with low-value addition—1; agricultural commodities with moderate value addition—2; agricultural commodities with high value addition—3; agricultural inputs (fertilizer & pesticides), machinery and equipment's—4; and non-agricultural inputs—5. The categorization is done to estimate both intersectoral (agriculture and industry) and intra-industry (with agroprocessing) linkages. The latter stands important as some of the final products of food industry may be used as inputs within the processing industries such as butter and cheese. For organized sector, inputs are also analyzed separately as per indigenous and imported raw material. As in the case with NIC 2004 and NIC 2008, a concordance matrix is prepared between NIC (2008) and SITC (2008) (export and import) to make the series comparable and uniform over the period. Based on the value of each input used, input coefficients (IC) are estimated by taking the ratio of value of input and output separately for agriculture and agroprocessed products to represent the extent of backward and forward intersectoral and intra-industry production linkages.

#### Limitations

Following are the data limitations encountered for this study. The first concerns the non-availability of data on organized wholesale and retail trade in agricultural and food under the service sector. For unorganized (informal) service sector, we have utilized the quinquennial NSS rounds (57th and 67th), which could again be an underestimation as many wholesale and retail trade activities fall under the medium and small scale sectors for which official data is unavailable. Also, the NSS 57th round does not cover retail trade which may not permit a proper comparison of wholesale and retail trade in food over the period. The estimations of unorganized manufacturing could also be undervalued as a good number of activities are taken up in the medium and small industries. A second limitation is the non-availability of detailed data on inputs used in each manufacturing and retail enterprise in the NSS 67th round on unorganized manufacturing enterprises, wholesale and retail trade activities. The information is collected only for five key inputs used in the production process in each enterprise. This may lead to an underestimation of the EPA and also the extent of linkages in the unorganized industry and tertiary sectors.

# Annex 3.2 Methodology for simulating impacts of agribusiness growth on jobs and other parameters

#### Estimating productivity gap

The productivity gap is measured by comparing total factor productivity (TFP) in different segments of agribusiness between India and middle-income comparators as described in table 3.2. Total factor productivity captures the change in output that is not attributable to change in inputs. The analysis relies on the Solow residuals (Solow 1957) as proxies for measures of TFP. Many studies estimating productivity change have used the Solow residual method, and some have extended it to consider sophisticated assumptions such as imperfect competition (Hall 1988, 1990; Srivastava and others 2000), factor utilization rate variations (Finn 1995; Paquet and others 1997, 2001); nonconstant returns to scales (Srivastava and others 2000). But even without these assumptions, the method is a good measure of TFP. Furthermore, some assumptions in the standard GTAP model, such as full factor utilization and constant returns to scales, are consistent with this method. The Solow model is a growth accounting model built on the neoclassical production function

$$Y_{t} = A_{t}F(K_{t}, L_{t})$$
(A3.2.1)

Where  $Y_t$  is output,  $K_t$  is the capital stock,  $L_t$  is the labor input, and  $A_t$  represents total factor productivity (TFP). For simplicity, consider a Cobb-Douglas production function. Taking natural logarithms and differentiating both sides of (A3.2.1) with respect to time *t*, the growth rate of aggregate output can be expressed as

$$\dot{Y}/Y = \dot{A}/A + \alpha(\dot{K}/K) + (1-\alpha)(\dot{L}/L)$$
 (A3.2.2)

Notice that *Y* stands for the derivative of *Y* with respect to time *t*, and so Y/Y stands for the growth rate. As is well known, these weights can be represented by respective shares of rental payments for capital and labor in total income. Thus, the TFP growth can be computed from (A3.2.2) as the residual.

#### Calculating labor inputs

Data on the total labor in each country is available. However, data on labor inputs on different segments of agribusiness is not available and needs to be calculated. We use different versions of GMig2 data base (Aguiar and others 2009; Walmsley and others 2009) and GTAP data base (Dimaranan 2006; Narayanan and Walmsley 2008) to estimate the labor input of each agribusiness sector. We rely on GTAP 9 Data Base for the years 2004, 2007 and 2011, while we use version 6 for the year 2001. GMig2 data includes information on number of people employed, in addition to that on migration and remittances. We use this data for estimation

because it is fully consistent with the standard GTAP data base—which is the main source of this study.

Two methods to estimate the labor input of each industry are compared. In the first method labor input is estimated in two steps. First, the total payment to the labor force is divided by the number of labor force, from the GMig2 data base, to get the average wage of each country. Second, the total labor input of each segment of each country is calculated by dividing the value of labor purchases by all firms at agent prices (EVFA)—obtained from the GTAP Data Base—with the average wage obtained in first step. This calculation assumes that the wages of all the sectors are the same. And it is done for the years 2001, 2004 and 2007. The GMig2 data base is utilized. The endowments purchased at agents' prices by the firms (EVFA) is used as the weight to split the total labor force (from the World Bank data set) into the sectoral levels of employment.

In the second method, data on the total regional labor force is collected from World Bank, and then the sectoral EVFA is used as weights to split the total labor force into sectoral labor input. The resulting data on labor from the two methods is compared in figures A3.2.1 and A3.2.2. The labor inputs of agribusiness in China, India and Brazil are significantly higher than in other countries. And labor inputs varied across different segments of agribusiness. Most of the labor went into the food products not elsewhere classified segment, which is almost double that of beverages and tobacco products sector. The bovine meat products sector occupied the least labor force. Since the estimates for the year 2011 are calculated from the GTAP database rather than the GMig2 database, we note considerable fluctuations of labor inputs in some sectors, more specifically of China and India. In contrast, the estimates from GTAP database are more explicable than those in the GMig2 database, since the intertemporal changes are not that drastic (figure A4.1b). Therefore, the second method of using GTAP database to calculate labor inputs is adopted.

#### Calculating capital inputs

We use the data of public companies on rates of return (RoR) from the Standard and Poor's Capital IQ data set to estimate the capital stock of each industry. In the data processing, the missing values of the rate of return were replaced by the average value of each industry. For the vegetable oils and fats sector, since no values of net income and total asset exist, we replace them with the average value of all industries. Following are the formulas to calculate the sector-specific capital stock (*VKB*) in the beginning, as well as *RoR*:

$$VKB = VFM/(RoR + Depreciation)$$
 (A3.2.3)

$$RoR = net income/total asset$$
 (A3.2.4)

The output of (A3.2.1) is presented by the endowment purchased at market value by firms (VFM) and deflated by CPI (Consumer Price Index). The capital share ( $\alpha$ ) is calculated



Figure A3.2.1 Sectoral labor inputs of each country, GMig2 estimation (in millions)

Source: GMig2 data base (2001-2007) and GTAP data base (2011). The labor input data was calculated by the author.



Figure A3.2.2 Sectoral labor inputs of each country, GTAP estimation (in million)



as the ratio of capital cost to GDP. Labor share is equal to  $(1-\alpha)$ . Capital cost and GDP are derived from the GTAP data base.

#### Estimating capital investment gap

Investment gaps between India and MICs or that between India and China in each sector is calculated based on the GTAP data base. We first calculate the ratio of capital to total endowment commodities of each sector in each country. Then we estimate the capital gaps of each industry between India and other countries. To estimate the capital shock, we temporarily assume that the other primary factors will not change in the next decade, except the capital stock. If India will bridge the gaps of investment, the increment of capital (dk) can be calculated by using the equation below, so the shock to capital can be obtained.

(K + dk)/(all primary factors + dk) = target ratio of capital to value added (A3.2.5)

In equation (5), we are essentially assuming that the shock required to boost capital investment in India is given by the shock in capital required to move the ratio of capital to total value added (sum of all primary factors) to the target ratio, which is the average for all other countries considered in the study.

#### Data

#### GTAP data

The GTAP v9 database consists of data for the years 2004, 2007 and 2011, while the v6 database has the data for the year 2001. We aggregated the 140 regions and 57 sectors available in GTAP 9 Data Base into 9 regions and 35 sectors. Data from the GTAP 6 database was also aggregated similarly. These are the main data sets used for the analysis of the effects of the expansion of agribusiness activities in India. The classification of different segments of economic activities into sectors is provided table A3.2.1. The list of aggregated regions employed in this study is as follows: (1) India, (2) South Africa, (3) Chile, (4) Thailand, (5) Brazil, (6) China, (7) the Republic of Korea, (8) the United States, and (9) rest of the World.

All groups above are well-defined in GTAP except 5 in the sense that only part of the service sectors pertain to agribusiness. Nevertheless, these are important to be considered in the agribusiness context if apportion is possible. We attempted to chalk out the parts of these service sectors that are related to agricultural and agribusiness sectors using forward and backward linkages identified in the data set. However, this proved complicated and therefore agribusiness services were excluded from the analysis.

#### GMig2 data

The sector specific data, such as the wage bill, labor and the shocks to labor productivity, are required in our data analysis, especially in the GTAP modeling. However, we cannot directly

No.	GTAP Sector Acronymn	Economic segment	Sector
I	PDR	Paddy rice	Primary agriculture
2	WHT	Wheat	Primary agriculture
3	GRO	Cereal grains n.e.c.	Primary agriculture
4	V_F	Vegetables, fruit, nuts	Primary agriculture
5	OSD	Oil seeds	Primary agriculture
6	C_B	Sugar cane, sugar beet	Primary agriculture
7	PFB	Plant-based fibers	Primary agriculture
8	OCR	Crops n.e.c.	Primary agriculture
9	CTL	Bovine cattle, sheep and goats, horses	Primary agriculture
10	OAP	Animal products n.e.c.	Primary agriculture
П	RMK	Raw milk	Primary agriculture
12	WOL	Wool, silk-worm cocoons	Primary agriculture
13	FRS	Forestry	Other primary sectors
14	FSH	Fishing	Other primary sectors
15	CMT	Bovine meat products	Agribusiness
16	OMT	Meat products n.e.c.	Agribusiness
17	VOL	Vegetable oils and fats	Agribusiness
18	MIL	Dairy products	Agribusiness
19	PCR	Processed rice	Agribusiness
20	SGR	Sugar	Agribusiness
21	OFD	Food products n.e.c.	Agribusiness
22	B_T	Beverages and tobacco products	Agribusiness
23	TEX	Textiles	Allied agro-based industries
24	WAP	Wearing apparel	Allied agro-based industries
25	LEA	Leather products	Allied agro-based industries
26	LUM	Wood products	Allied agro-based industries
27	PPP	Paper products, publishing	Allied agro-based industries
28	MINEN	Minerals and energy commodities	Other primary sectors
29	OMANU	Other manufacturing sectors	Other sectors
30	BUSSERV	Business services	Services partly for agribusiness
31	TRD	Trading services	Services partly for agribusiness
32	TRANS	Transportation	Services partly for agribusiness
33	FIN	Financial services	Services partly for agribusiness
34	ISR	Insurance services	Services partly for agribusiness
35	OTHSERV	Other services	Other sectors

Table A3.2.1 List of aggregated GTAP sectors to be employed in the study

Note: n.e.c. = not elsewhere classified.

collect these data from existing sources. So some other data will be used to derive this sector specific data. The GMig2 data base was employed to arrive at the number of laborers employed in each sector. The GMig2 database, extends the GTAP 8 Data base to include global bilateral migration and wages and remittances, particularly, the number of migrants and locals in the labor force. These data sets are largely derived from the World Bank data set.

#### Complementary data

The data used for estimating the capital stock is collected from the Capital IQ data of public companies, which mainly includes the data on total asset and net income. The total labor force data is from the World Bank.

#### **Back-of-the-envelope analysis**

To simplify the interpretation of results of this study, we describe the results with the back-ofthe-envelope (BOTE) analysis. The BOTE analysis helps us to understand the mechanism of how improvement of investment and productivity could affect India's macro and sectoral welfare. In the BOTE analysis, we change (A3.2.1) into the percentage change term, namely:

$$y = a + S_{l} \times k + S_{l} \times l \tag{A3.2.6}$$

Where *y*, *a*, *k*, and *l* are the percentage change gaps between India and the world, while  $S_k$  and  $S_l$  are the shares of capital and labor in GDP. In the demand side, we can decompose the GDP growth into private consumption (*C*), government consumption (*G*), investment (*I*), export (*X*), and import (*M*). The corresponding percentage change form is also provided:

$$Y = C + G + I + X - M$$
 (A3.2.7)

$$y = S_c \times c + S_g \times g + S_i \times i + S_x \times x + S_m \times m$$
(A3.2.8)

#### **GTAP** modeling

The standard GTAP model (Hertel and Tsigas 1997) is used for this study. This is comparative static in nature, implying that there is no real dynamics involved in this study. In other words, we cannot attribute the results in this study to correspond to any specific length of time in the future. The main technical features of the standard GTAP model are as follows:

On the production side, each sector has a representative firm which produces goods using land, labor (skilled and unskilled), capital and intermediate goods and services. The model employs a nested framework to address substitutability of the factors of production. Land, labor and capital substitute for one another in a value-added aggregate in the first nest, and composite intermediate inputs substitute for value-added at the next nest.

Labor and capital are assumed to be fully employed, mobile across all uses within a country but immobile internationally.

- On the demand side, each region has a representative household whose expenditure is governed by an aggregate utility function. This aggregate utility function is of a Cobb-Douglas form, allocating expenditures across private consumption, government spending, and savings. Private household demand is represented by a Constant Difference of Elasticities' (CDE) functional form, which has the virtue of capturing the non-homothetic nature of private household demands (that is, a demand structure that changes with increased income, reflecting the fact that consumption of particular types of goods such as luxury goods increases more with higher income than does consumption of other goods such as staple food products).
- Bilateral international trade flows are modeled based on the Armington hypothesis, which says that goods and services are differentiated by their region of origin and are imperfect substitutes.

#### Modifications of the GTAP model

#### Capital input and mobility

In the standard GTAP model, capital input is mobile across sectors, similar to labor. The regional capital stock is fixed but capital can move across different sectors. In order to model the catch-up effect of sectoral capital input in the agribusiness sectors, we need to modify the capital input mechanism. So in the ENDW\_SUPPLY equation in standard GTAP model, we need to exclude the capital input. In the standard GTAP model, the equation determines qoes("SkLab,"j,r), qoes("UnSkLab,"j,r), and qoes("Capital,"j,r), but in our modification, it only determines the first two sets of variables. The qoes("capital,"j,r) will be determined by Equation ENDW\_SUPPLYb1. We introduce an exogenous variable, kb\_t2(j,r), which is the capital input in sector j and region r. We fix India's capital, but allow for mobility among the sectors, to account for two facts:

- FDI in agri-business sector is limited and hence any increases in investment should come from within the domestic economy. Therefore, the total capital in the economy is fixed.
- Increased investment in agri-business sectors have to be funded by decreased investment in other sectors, since overall capital in India is fixed, based on point 1 above.

We also introduce some new sets for convenience, AGRIBIZ and INDIA, representing agribusiness sectors and India respectively. Their counterparts are NONAGRBIZ and NONINDIA. More importantly, a new equation (kb\_t2\_nab) is introduced to shift the capital supply mechanism.

Additionally, we assume that the overall regional capital is sluggish and allow for the capital in other sectors to move in, to support the catch-up in agribusiness sector. For non-agribusiness sectors, capital will be rebalanced, based on the return on capitals. So we modify the values of CET elasticity of capital (ETRE, from 0 to 10) to increase the capital mobility within non-agribusiness.

Before the adjustment, the regional capital stock of all endowment commodities, qo(i,r), are exogenous. It becomes endogenous and is determined by Equation E\_MKTCLENDWC. The equation just states that the percentage change of the regional capital inputs is the weighted average change in sectoral capital inputs.

In the standard closure, the regional capital input, qo("Capital," REG) is exogenous. This means that the capital stock in the global economy is fixed. However, it should not be fixed for India, given the increases in capital inputs for agribusiness. But it is modified in the new closure. Since we introduce a new variable to represent the sectoral capital stock, kb\_t2(j,r), we need to include it in the exogenous variables list. Specifically, we only exogenize qo("Capital," "India"), that is, we fix India's capital stock, and only exogenous the capital input of the agribusiness sector in India. But the new introduced variable f\_kb\_t2\_nab is used to swap the qo("Capital," "India"), and f\_kb\_t2\_ind(NONAGRIBIZ) is used to swap kb\_t2("Capital," NONINDIA). The household demand shock (hh\_dmdshk) is in the exogenous variables list. In addition, for developing countries like India, the supply of unskilled labor is sufficient, while skilled labor is limited and takes time to train. Thus, we fix the unskilled labor price to make the labor supply adjust, while we fix the skilled labor and endogenize its prices.

Intuitively, we modify the assumption in the GTAP model that capital stock in different sectors is endogenously determined. Instead we introduce a variable that can shock capital in different sectors. We also modify the assumption that fixes capital stock in total, to allow this to be endogenously determined by the model, based on the sector-level changes in capital stock.

#### Household consumption demand

Looking at the historical sales of agribusiness sectors, we find that domestic consumption absorbed a large proportion of output of these sectors (more than 70 percent on an average). Therefore, if the agribusiness sectors expand in the next decade, the domestic absorption should increase accordingly. To this end, we introduce a new household consumption demand mechanism in the new model (Baltzer 2008). Thus, increased supply of agri-business products will be met with increased demand, and this may have effects on prices.

With new sets (EXOG) and new variables (hh\_dmdshk and hh\_endodmd), we can conveniently shock the household consumption of commodities produced by agribusiness sectors. The new equation BUDGBALANCE restrains the household consumption budget, which means that the increase in agribusiness consumption will decrease the demand on other sectors. In the new equation DMDSHKID, we have not identified the preferences of household consumption. So the demand on other sectors will decrease at the same rate across the ENDO commodities.

#### **Modification of the closures**

In GTAP simulation, different closures adopted can lead to results quite significantly different from each other. Three closures are of particular importance in influencing the results: the microeconomic closure, which determines the response of factor supply to factor returns; the macroeconomic closure, which determines the response of the trade account to a policy shock; and the government tax-expenditure closure which determines whether the government balance adjusts passively or whether a tax replacement assumption is imposed. We comment on these below.

#### Microeconomic part of the closure

The GTAP default microeconomic closure fixes the capital and labor supply and requires the model to restore equilibrium by adjusting factor prices. This is sometimes described as reflecting a medium-term time horizon in which labor supply is relatively "sticky." Under alternative microeconomic closures that are sometimes used, the return to capital or to labor can be fixed, causing the supply of capital and/or labor to then adjust to restore equilibrium. In our study, we adopt the former one, that is, aggregate capital supply is exogenous, for all countries other than India. Aggregate skilled labor supply is fixed across the world, while unskilled labor supply is endogenous, allowing for some unemployment to exist in this type of labor.

#### Macroeconomic part of the closure

Two conventional approaches are available. First, the current account can be fixed. This assumes that the external balance is determined entirely by domestic investment-savings dynamics. When trade policy shocks result in unbalanced changes in imports and exports, the original trade balance is then restored by implicit exchange rate adjustments. Alternatively, the current account can be allowed to adjust to the trade shock. The change in the current account then must be offset by equivalent changes in capital flows. In reality, unbalanced trade impacts are likely to have both effects: induce subsequent exchange rate adjustments, and also offsetting capital flows. We adopt the closure where the current account is adjusted in this study to reflect the impact on international trade balance.

#### Tax revenue-government expenditure part of the closure

In the GTAP modeling framework, the aggregate utility function allocates expenditure to private consumption, government expenditure, and savings. The default closure imposes fixed budget shares, which means that impacts on tax revenues from a shock are not linked to government expenditure. However, a tax revenue replacement closure can be specified to preserve the government balance, in which case the private household expenditure adjusts to satisfy the regional household's budget constraint (Hertel and Tsigas 1997; chapter 2: Structure of GTAP). The simulation reported adopts the default closure.

# Annex 3.3 Simulated effects on macroeconomic indicators

					Korea.	South		United	
	Brazil	Chile	China	India	Rep. of	Africa	Thailand	States	ROW
EV Welfare (\$ mn)	1,693	-4	-116	18,786	920	40	53	4,852	3,361
GDP(\$ mn)	873	34	216	23,776	349	33	63	1,500	6,675
% Change in Welfare	0.08	0.00	0.00	1.10	0.09	0.01	0.02	0.04	0.01
% Change in GDP	0.04	0.02	0.00	1.34	0.03	0.01	0.02	0.01	0.02
Private Consumption	0.08	0.01	0.00	1.04	0.09	0.02	0.03	0.04	0.01
Gov Consumption	0.05	0.00	0.03	2.08	0.07	0.01	0.01	0.02	0.01
Investment	0.36	0.02	0.05	-1.67	0.17	0.11	0.20	0.26	0.07
Exports	-0.44	-0.04	-0.05	3.53	-0.09	-0.08	-0.03	-0.3 I	0.02
Imports	0.36	-0.07	0.05	-1.11	0.06	0.00	0.05	0.18	0.04
Trade Balance (\$ mn)	-1,592	-14	-1,048	16,989	-428	-75	-180	-7,637	-6,015
Capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unskilled Labor	0.11	0.07	0.01	-0.95	0.09	0.03	0.07	0.03	0.07
Skilled Labor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Terms of Trade	0.22	-0.02	0.05	-0.58	0.09	0.01	0.00	0.12	-0.02
CPI	0.13	-0.05	-0.01	-0.17	0.02	-0.04	-0.07	0.03	-0.04

## Table A3.3.1 Scenario I: catch up to MIC average

## Table A3.3.2 Scenario II: catch up to China levels

	Duozil	Chile	China	India	Korea,	South	Theiland	United	
	Drazii	Chile	China	India	кер. от	Africa	Inaliand	States	ROVV
EV Welfare (\$ mn)	3,945	-8	-1,626	74,569	1,912	89	417	10,897	4,853
GDP(\$ mn)	2,002	80	394	88,005	768	76	188	3,349	13,474
% Change in welfare	0.19	0.00	-0.03	4.37	0.19	0.02	0.14	0.08	0.01
% Change in GDP	0.09	0.04	0.01	4.94	0.07	0.02	0.06	0.02	0.04
Private consumption	0.19	0.02	-0.01	4.35	0.19	0.04	0.16	0.09	0.03
Gov consumption	0.11	0.01	0.07	7.14	0.15	0.03	0.13	0.05	0.03
Investment	0.86	0.05	0.11	-2.82	0.38	0.27	0.52	0.60	0.18
Exports	-1.03	-0.10	-0.10	10.15	-0.20	-0.15	-0.12	-0.70	0.02
Imports	0.90	-0.14	0.12	-1.50	0.13	0.06	0.14	0.42	0.09
Trade balance (\$ mn)	-3,82 I	-40	-2,465	39,849	-947	-175	-404	-16,926	-15,071
Capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UnskilledlLabor	0.25	0.16	0.02	-1.85	0.20	0.07	0.22	0.07	0.14
Skilled labor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Terms of trade	0.54	-0.03	0.12	-1.57	0.19	0.04	0.11	0.27	-0.03
CPI	0.29	-0.14	-0.07	-0.36	0.00	-0.13	-0.07	0.02	-0.12

# Chapter 4

# What can agribusiness do for nutrition?

## Introduction

Agribusiness can contribute to improving nutrition outcomes through preventing food and nutrient loss, replacing lost nutrients, enrichment or fortification of foods by adding nutrients (particularly micronutrient), and preventing food wastage. The agribusiness activities that could generate such outcomes include proper postharvest handling to avoid bruises that lead to food contamination and food wastage (especially fruits and vegetables); sorting and grading to avoid good produce getting contaminated by bad produce; appropriate storage in warehouses, cold-stores, and control atmosphere stores to reduce food and nutrient loss; proper packing during food distribution and using technologies that better retain nutrients; basic agroprocessing to prevent food and nutrient loss; and food fortification to replace lost nutrients or add nutrients that are not naturally available in main staples. A well-developed food processing sector helps in the reduction of wastage, improves value-addition, insures farmers against price risks, generates off-farm employment, increases export earnings, among others. By preventing food loss, nutrient loss, and food wastage, there would be more food and more nutrients available, as well as more natural resources saved. Postharvest loss occurs when the edible food mass is decreased. There are two types of postharvest loss: food loss and food wastage. Food loss refers to decreases in food mass that occur early in the food chain, including during production, postharvest and processing, while food waste refers to decreases in food mass occurring at the end of the chain, including retail and final consumption (Parfitt and others 2010; FAO 2011). Food loss and food waste have distinct drivers and therefore the possible mitigating solutions can be quite different. Food loss is likely to occur due to inadequate knowledge of farming systems, availability of storage technologies (including packaging), lack of timely access to finance to perform the necessary value chain activities, and so on. On the other hand, food waste occurs due to poor storage conditions, poor inventory management, and poor consumption decisions on quantity

and timing of purchasing and consumption. The distribution of food losses and wastes also vary significantly between developed and developing nations. Food loss is more prevalent in developing countries while food waste is a more common phenomenon in the developed world (figure 4.1). It is estimated that food loss incurred at the production, handling and storage levels are nearly twice as much in developing countries, while food wasted at the consumption level are four times larger in developed countries.

Food fortification is one of the most cost-effective ways to improve micronutrient deficiencies in populations. Food fortification is part of the agroprocessing segment of agribusiness. Fortification involves adding micronutrients to foods, with minimal effects on taste and cooking properties, but with large benefits in nutritive value of foods. Fortification is typically applied to staple foods and condiments consumed by a large majority of the population, including by those most at-risk. Such foods can be fortified using simple technologies to add a micronutrient "premix" during processing, followed by blending if required (GAIN 2015). The fortification process sits squarely within the agroprocessing segment of agribusiness and is one of the most powerful ways in which the agribusiness sector can contribute to improving undernutrition or hidden hunger.

Overall, the level of food fortification is low with only about 1 percent of food fortified. The levels of fortification in India are low by global standards. The levels of fortification globally are estimated at about 28 percent for industrially milled wheat flour, 58 percent for industrially milled maize flour, and 0.8 percent for industrially milled rice (Food fortification





Source: World Resources Institute 2013

initiative 2016). The low levels in India are partly explained by the following factors: lack of demand due to lack of awareness, unwillingness by producers to incur additional costs, and the dispersed nature of production and processing facilities for many common foods. It is estimated that 2.2 million metric tons of wheat flour is fortified every year in India in the States of Delhi, Rajasthan, Madhya Pradesh, Andhra Pradesh, Kerala, and West Bengal together (Bhagwat and others 2014). Milk fortification is mostly carried out by Mother Dairy and some private dairies. Mother Dairy is fortifying its bulk vended milk with Vitamin A and D and the milk is sold through its outlets in Delhi and Calcutta. Rajasthan is fortifying over 500,000 MTs of low-fat milk. Currently, about 0.5 million tons of the 17.5 million tons of edible oil is fortified with vitamins A and D. Rice fortification is being piloted in the MDM program in two districts of Odisha, but the products are not commercially available. Availability of fortified foods through the Public Distribution System PDS (primarily fortified wheat flour) is limited to a few states. Fortified wheat flour is being sold through open market channels and distributed through the PDS in the states of Madhya Pradesh, Rajasthan, West Bengal, Tamil Nadu and Kerala.

## Why should agribusiness focus on nutrition?

Although undernutrition has declined in India during the past two decades, the undernutrition burden remains unacceptably high and India ranks 55 out of 76 countries in the Global Hunger Index 2014. India is home to about 40 percent of the world's stunted children under the age of 5 and nearly 50 percent of the wasted children (UNICEF 2013). While the rate of decline of undernutrition has almost doubled when the period 2007–13 is compared with 1999–2006, the levels remain unacceptably high. About 29.4 percent of children are underweight; 38.7 percent are stunted; and 15.1 percent are wasted (Ministry of Women and Child Development 2014). Furthermore, there is considerable variation among states and these averages mask alarming rates of undernutrition in some states (International Food Policy Research Institute 2015). And the burden of hidden hunger is considerable. For example, more than 30 percent of children are born with low birthweight; almost 75 percent under three years old are anemic (National Family Health Survey-3); 62 percent are deficient in vitamin A (WHO 2009), and over 13 million infants remain unprotected from iodine deficiency disorders (UNICEF 2009). While national data is not available, research studies from various parts of India have reported high folate deficiency among various age groups and folic acid deficiency stands at around 40 percent in adolescents (Kapil and Bhadoria 2014); 50 percent in children from 6 months to 12 years of age (Chandra and others 2002); and over 27 percent in young married women (Pathak and others 2004). Folic acid deficiency, especially during the pre-pregnancy phase increases the risk of neural tube defects (NTDs). Recent systematic reviews show the birth prevalence of NTDs in India to be around 4 cases per 1000 total births (Allagh and others 2015; Bhide and others 2013).

Undernutrition has long-term consequences on accumulation of human capital and economic development and the main pathways are increased mortality and morbidity, reduced cognitive development, and reduced productivity. Much of the undernutrition occurs during pregnancy and in the first two years of a child's life. And if appropriate interventions are not made the damage is irreversible in terms of physical and cognitive development, future economic productivity, and to overall human development (Lancet 2008). The main consequences of undernutrition are:

- Increased mortality and morbidity. Undernutrition is the single largest factor contributing to the death of young children. It increases the mortality risk associated with the major killers of children (respiratory infections, diarrhea, malaria, measles and other infectious diseases). Compared to normal children, the relative risks of mortality are 2.5 for children who are 70–79 percent of their median weight for age, 4.6 percent for children who are 60–69 percent of the median and 8.4 percent for those who are less than 60 percent of the median (Pelletier and others 1994). Using these relative risk, malnutrition is associated with 2.8 million deaths per year in low-income Asia. Iron deficiency is estimated to be associated with 23 percent of maternal deaths (Ross and Thomas 1996), accounting for an estimated 65,000 of the 286,000 maternal deaths per year in the region. In India, more than half of all deaths in children under five are related to malnutrition, with mild to moderate undernutrition contributing to 43 percent of the deaths and severe malnutrition to 11 percent (Arnold and others 2009).
- Cognitive development is compromised. Malnutrition at any stage of childhood affects schooling and hence the lifetime-earnings potential of the child (Alderman 2005). Cognitive losses associated with childhood undernutrition, iron deficiency anemia and with being born to a mother deficient in iodine are more or less irreversible by the time a child reaches school. Malnourished children are more likely to repeat school years or to drop out of school. These cognitive losses are associated with lower productivity in adulthood. The losses due to cognitive impairments are pervasive but difficult to quantify. Estimates suggest that protein-energy malnutrition in childhood is associated with a 15-point decrease in IQ, which is in turn associated with a 10 percent drop in earnings (Selowsky and Taylor 1973). Similarly, childhood anemia is associated with about one-half of one standard deviation on cognitive test scores, which in turn is associated with a 4 percent decrease in hourly earnings (Ross and Horton 1998). The average productivity loss per child born to a mother with goiter is estimated as 10 percent (Ross 1997).
- Reduced productivity. Estimation of overall economic costs of undernutrition is difficult, and economic calculations are based only on market economic activity and exclude nonmarket losses—even though these may be socially valuable. Given these difficulties, researches admit to being conservative and the estimates of productivity losses are understood to be lower bounds. In terms of human development, malnutrition (stunting) in early years is linked to a 4.6 cm loss of height in adolescence, a 0.7 loss in grade attainment, and a 7-month delay in starting school, contributing to reduced lifetime income

by 7–12 percent (World Bank 2006). Iron deficiency in adults has been estimated to decrease productivity by 5–17 percent, depending on the nature of the work performed (Horton 1999) and direct productivity losses are estimated at more than 10 percent of lifetime individual earnings (World Bank 2006). If estimated as a proportion of GDP, the adult productivity losses due to iron deficiency alone are 0.57 percent of GDP. Iodine deficiency disorders are associated with adulthood productivity losses ranging from 0.3 to 3.3 percent of GDP—depending on the severity and prevalence (Horton 1999). Overall, without considering the long-term productivity losses associated with developmental and cognitive impairment, undernutrition contributes to about a 2–3 percent loss to GDP (World Bank 2006; Horton 1999). The combined productivity loss due to physical work and cognitive losses is estimated at 4.05 percent of GDP (Horton and Ross 2003). There are also indirect losses such as those associated with deficits in cognitive development and schooling, and increased costs of health care.

There is evidence that the economic and social benefits of food fortification outweigh the costs. India loses over \$12 billion annually in GDP to vitamin and mineral deficiencies (UNICEF and Micronutrient Initiative 2004; World Bank, 2009). This is staggering considering that scaling up core micronutrient interventions would cost less than \$574 million per year (World Bank). The benefit-cost ratio for salt iodization is estimated at 70:1 in Horton (2006); and for iron fortification at 6:1 in terms of effects on physical productivity, which rises to 36:1 if cognitive benefits are also included Horton and Ross (2003). The Copenhagen Consensus of 2008, a meeting of some of the world's most notable economists declared adding micronutrients to staple foods as one of the most cost-effective ways to help address the global malnutrition crisis. Iodizing salt can cost as little as \$0.05 to \$0.10 cents per person per year, but provides a return on investment of more than \$26 in increased productivity and health care savings (Horton and others 2008). Global estimates indicate that estimated cost of rice fortification (\$/MT) with hot extrusion technology varies from \$10-\$31 (\$10-\$20 in China; ~\$12 in Philippines and \$31 in India) see Maberly 2011. The total cost of adding mandatory nutrients to flour in the United States (that is, 6.4 mg/kg Vitamin B1, 4.0 mg/kg Vitamin B2, 52.9 mg/kg Niacin and 44.1 mg/kg Iron) is less than \$1 per metric ton of flour while milk fortification costs around \$1.59 per 1,000 litres (USAID and DSM). On average, cost of milk fortification comes to around Rs 0.14 per Litre of milk (GAIN and IIHMR 2015). Cost of fortification ranges from Rs 20 to Rs.100 per metric ton, or just about 2 to 7 paisa per kg of food, depending on the type and number of micronutrients and the staple food that is being fortified. Cost of fortifying wheat flour is about Rs 80 per MT, using the best and WHO-recommended NaFeEDTA as the iron compound, Folic acid and Vitamin B12 for fortification of wheat flour (table 4.1).

#### Table 4.1 Cost of fortification for different foods in India

Food	Cost/unit (rs)
Milk*	I4p/L
Oil*	<10p/kg
Wheat*	<10p/kg
Rice**	1.20p/kg

Note: \* represents estimates from GAIN and \*\* are estimates from PATH

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# Lessons on effectiveness of food fortification in promoting nutrition

The prevalence of anemia has decreased significantly in countries that fortify flour with micronutrients, while remaining unchanged in countries that do not. Data is available from 12 countries carrying out flour fortification (either wheat flour or in combination with maize flour) and 20 that do not. It suggests that after controlling for time effects, HDI and endemic malaria<sup>1</sup>—each year of fortification was associated with a 2.4 percent reduction in the odds of anemia prevalence (Barkley and others 2015). In Brazil, prevalence of anemia fell by 5.3 percentage points overall due to fortification. And in regions with higher prevalence, the results were even more remarkable with prevalence of anemia falling by about 8 percentage points in areas where pre-fortification prevalence was high (Fujimori and others 2011). With the extremely high prevalence of anemia in India, the country stands to gain substantially by reducing iron deficiency and improving iron status. The technology for fortification is key to achieving results. The studies show that fortification programs cannot be expected to have a significant health impact if the iron compounds are not easily absorbed by the human body. In particular, programs will not have the expected impact if insufficient iron amounts are used, if the program is not well-monitored, or if a high proportion of the population does not consume fortified foods. On the other hand, well-planned, fully implemented and carefully monitored programs to fortify flour with the recommended level of essential vitamins and minerals will reduce the risk of anemia from nutritional deficiencies over time.

There have been significant increases in blood concentrations of micronutrients provided through fortified foods such as flour, bread, rice, salt and milk. Results from several studies and meta-analysis of multiple micronutrient fortification provide evidence on the effectiveness of food fortification. For example, multiple micronutrient fortification shows 57 percent reduced risk of anemia in children (Eichler and others 2012), increase in hemoglobin concentrations, ferritin, Vitamin A concentrations, and so on. Iron fortification of foods resulted in 41 percent reduction in the risks of anemia and a 52 percent reduction in iron deficiency (Gera and others 2012). Other studies have shown that bread fortified with Vitamin D increased serum 25-hydroxyvitamin D concentration in women (Natri and others 2006), and use of zinc fortified milk supplements in pre-term infants increased their zinc concentrations (Diaz-Gomez and others 2003). Studies using fortified rice showed increased iron stores (Morretti and others 2006), increased serum ferritin (Radhika 2011; Zimmerman and others 2006) and reduced prevalence of iron deficiency in Indian children (Thankachan 2012). A six-month trial of rice-based lunch meals fortified with multiple-micronutrients showed significant increase in the plasma vitamin B-12 levels and physical performance in the 6- to 12-year group and at all levels of fortification. However, it did not show significant differences in hemoglobin concentration, anemia, and deficiencies of other micronutrients

<sup>&</sup>lt;sup>1</sup> Controlling HDI and endemic malaria was to address the non-nutritional causes of anemia.

or cognitive function after 6 months, except a reduction in anemia prevalence in the low-iron group was seen (Thankachan 2012). Efficacy of khichdi locally fortified with encapsulated ferrous fumarate and vitamin A premix showed improved iron status and reduced the prevalence of anemia, iron deficiency, and iron deficiency anemia in West Bengal preschool children (Varma and others 2007).

Consumption of fortified milk showed reductions in morbidities in India. Sazawal and others (2007) reported lower incidence of diarrhea, pneumonia and fewer days of sickness. This mirrors evidence from other parts of the world. For example, in Indonesia, consumption of iron fortified milk and fortified noodles was associated with decreased odds of child anemia (Semba and others 2010). Evidence from Chile shows a 66 percent reduction in the prevalence of anemia among infants after consumption of iron fortified milk (Chunming and others 2003 and Stekel and others 1988). Kim Lien et. al (2009) found lowered occurrence of underweight and stunting, improved micronutrients status, better learning indicators and improved quality of life among primary school children in Vietnam.

Fortification has been effective in reducing the burden of NTDs.<sup>2</sup> Food fortification with folate is especially a very effective strategy to improve folic acid consumption pre-pregnancy as the neural tube closes in the first 28 days after conception, which is even before a woman comes to know that she is pregnant. An interventional study that compared the relative effectiveness of dietary modification, supplementation and fortification with folate over a 12-week trial showed increased blood folate only in women taking supplements or fortified food. The natural food folate group showed only modest (nonsignificant) increase in blood folate, possibly because the synthetic form of vitamin is more bioavailable and stable than natural food folates (Cuskelly and others 1996). Studies suggests that food fortification can reduce the incidence of NTDs by between 37 percent and 54 percent and reduce NTD-specific neonatal mortality by 46 percent. And there is emerging evidence that folic acid fortification reduces both the incidence and the severity of NTDs (Bol and others 2006; Cotter and Daly 2005). Countries such as Canada, South Africa, Costa Rica, Chile, Argentina, and Brazil have reported declines in NTDs ranging from 19 percent to 55 percent since the initiation of folic acid food fortification (Canada Gazette Food and Drugs Regulations. SOR/96-527; Chen and Rivera 2004; Hertrampf and Cortes 2004; Sayed and others 2008; de Wals and others 2003; Ray and others 2002; Persad and others 2002; Liu and others 2004; de Walls and others 2007 and Lopez-Camelo and others 2010).

<sup>&</sup>lt;sup>2</sup> NTDs are an important cause of mortality and morbidity globally with a conservative estimated incidence of 4300000 new cases a year (Jegatheesan and others 2006) resulting in an estimated 41000 deaths and 2.3 million disability-adjusted life years (DALYS) (Global burden of disease 2004). Adequate folic acid status especially during the pre-pregnancy phase has shown to reduce the incidence of NTDs.

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## Policy and regulatory framework needs a strategic break

The policy framework for food fortification is improving. India's National Nutrition Policy (1993) explicitly acknowledges and positions fortification of essential foods as a direct nutrition intervention and further states that essential food items shall be fortified with appropriate nutrients. Furthermore, it recognizes and promotes intensification of research in iron fortification of rice and other cereals, and mandates that iodized salt is distributed to cover all the population in endemic areas of the country. In fact, salt iodization was subsequently made mandatory throughout the country. The policy milestones in food fortification could be traced back to 1980 when the Department of Food introduced a scheme of fortification of milk with vitamin A to prevent nutritional blindness (National Nutrition Policy 1993). The need to promote food fortification has been reiterated in India's 10th, 11th and 12th five-year national plans (see box 4.1). Fortification of hydrogenated fat with Vitamin A has been mandatory since 1953. The government of India's recent move to allow distribution of wheat flour in place of whole wheat through the Targeted Public Distribution System (TPDS) is a big enabler to enrich the diets of the most vulnerable sections of society with critical micronutrients. In addition, several Government of India guidelines and recommendations support provision of fortified foods under the Integrated Child Development Services (ICDS) and the School Mid-Day Meal (MDM) programs. The Ministry of Women and Child Development has recommended fortification of the food supplements provided through its program with nine micronutrients at 50 percent of the recommended daily allowance levels. In addition, the Ministry has directed the mandatory use of double fortified salt in the ICDS and MDM national programs. The use of double fortified salt in the MDM is also reiterated in the guidelines for the MDM scheme by the Ministry of Human Resource Development.

Regulations and standards for fortified food products are still evolving and there is a lot to learn from the successes in salt iodization, including mandatory legislation. The Food Safety and Standards Authority of India, established under the 2006 Safety and Standards Act, is responsible for developing regulations and guidelines for food products and their safety. In October 2016, the authority notified draft regulation for the standards of fortified salt, wheat flour, edible oil, and rice. This is a positive step to provide for a more enabling environment for large-scale food fortification in the country. In India as per the Coverage Evaluation Survey 2009, it is estimated that about 91 per cent of households had access to iodized salt, of whom 71 per cent consumed adequately iodized salt (Ministry of Health and Family Welfare 2011). The most recent National Iodine and Salt Intake Survey (2014–15) shows significant progress in iodised salt coverage over the last decade at national and zonal level. Overall, 92 percent of the households were found to be consuming iodized salt (78 percent adequately iodized and 14 percent inadequately iodized). The survey also reported adequate iodine intake in women in the reproductive age group. India's success in driving universal salt iodization can serve as an example for scaling up fortification of other foods as

#### Box 4.1 Fortification is recognized in successive national development plans

#### Excerpts from XII plan document (2012-2017):

"Double fortification of salt with iron and iodine presents a cost-effective and feasible strategy to prevent two of the key nutritional deficiencies in our country."

"Nutritional issues call for multi-stakeholder strategies, including informing communities on how to maximise nutritional benefits from locally available foods, food fortification and micro-nutrient supplementation."

#### Excerpts from XI plan document (2007-2012)

"The Eleventh Plan will support food fortification based on scientific evidence."

"Examples of food fortification include adding specific micronutrients to commercially processed staple foods, such as vitamin A in sugar and margarine, iron and B vitamins in wheat and corn flour, and iodine in salt."

"Studies will be undertaken for collection of evidence regarding interaction amongst micronutrients, taste, smell, and shelf life of fortified foods, regional variations in deficiency, differing requirements of individuals, etc. before implementation of any multiple micronutrient supplementation and food fortification strategies."

#### Excerpts from X plan document (2002-2007)

"There are three approaches for combating micro-nutrient deficiencies: medicinal supplementation, food fortification and dietary diversification with increased intake of micronutrient-dense foods."

"more cost-effective and efficient targeting of the PDS to address macro and micronutrient deficiencies. This may include providing coarse grains, pulses and iodized/double fortified salt to below-poverty line (BPL) families through the targeted PDS (TPDS)."

"food fortification, including introduction of iron and iodine-fortified salt and other iron-fortified items (for example, Atta in specific areas);"—identified as one of the strategy to combat anemia in children.

"evaluate the safety, efficacy, acceptability and cost effectiveness of double (iodine and iron) fortified salt so that decisions regarding universal double fortification of salt and its supply through TPDS system could be taken"

well, particularly wheat flour, oil and milk fortification. It is noteworthy that salt iodization had faced many challenges such as highly decentralized salt production units, including small scale producers and multiple distribution channels. The key factors that contributed to the success of the salt iodization program include (1) legislation mandating universal iodization of salt, which equalized costs in the industry; (2) effective monitoring with regional hubs and presence of dedicated government commissioner and department (Salt Department) to monitor production, delivery, distribution and quality control; and (3) consumer awareness programs targeted at grassroots awareness, including through schools and local nutrition centers (Mukherjee and others 2013).

# There are enormous opportunities to scale-up food fortification

The projected growth in demand of fortifiable foods, such as wheat flour, rice, edible oil and milk, combined with rising incomes and increasing population, presents enormous opportunities to scale-up fortification. Although there is a projected shift from consumption of grains and pulses, the demand for all food categories is projected to increase in the next decade (see table 4.2). It means that staple grains and pulses will continue to provide enormous opportunities for food fortification. Furthermore, it is projected that demand will shift toward some fortifiable foods such as dairy and edible oils. These demand side changes will be driven primarily by increasing incomes, rapid urbanization, and increasing awareness about the importance of good nutrition and healthy living. On the supply side, India is the world largest producer of milk and pulses, second world largest producer of wheat, and one of the world's largest producers of white rice and brown rice, accounting for 20 percent of all world rice production.

Edible oil is an attractive and easily fortifiable food and its demand is expected to grow rapidly. Compared to other fortifiable food industries such as wheat flour, rice and milk, the oil industry is more concentrated with about 60 percent of the market share of edible oil in the country coming from the organized sector. Hence, from a fortification standpoint, the edible oil sector is easier to work with compared with the wheat sector (Bhagwat and others 2014). India's annual current per capita consumption of about 14.3 kg is well below the world average of 20kg, thus providing growth opportunities for Indian edible oil industry. The edible oil industry is growing at a compounded annual growth rate of 5.44 percent. The demand for edible oils is projected to rise between 22.8 and 29.4 million tons by 2020 if the average per capita income grows between 4 percent and 6 percent (National Council of Applied

	Actual production (million tons)	Projected (million	demand tons)
	2010-11	2016-17	2020-21
Cereals	240	235	253
Pulses	17	22	25
Food grains	257	257	277
Vegetables	147	161	189
Fruits	75	97	124
Milk	122	141	173
Fish	8.3	11	14
Meats (non-poultry)	2.7	3.7	5.0
Poultry meat	2.2 (commercial)	3.3	4.3

#### Table 4.2 Demand projections for selected foods

Source: Twelfth five-year plan, government of India 2013
Economic Research 2014). The total demand for edible oils is expected to increase from its current level of 17.55 million tons to 23.1–26.4 million tons by 2020.

Wheat flour and rice are highly suitable for fortification. Wheat flour that is produced in roller flour mills comprises around 30 percent of the flour produced and is generally sold in consumer packs. The rest is largely milled at local flour grinding mills. The roller mill produced flour is sold through organized retail channels and is likely to be consumed by the middle class as well as higher-income groups that access such shops. However, it may not reach the poor and vulnerable. Several states have demonstrated that by distributing fortified wheat flour through the Public Distribution System (PDS), it is possible to reach the most vulnerable populations. But since micronutrient deficiencies are not limited only to those belonging to the poor households, it is important that fortification is broadly targeted to other groups as well. India processes about 85 million tons of paddy per year and provides staple food grain and other valuable products required by the population. More than 50 percent of the overall rice production is processed by modern mills, 40 percent by conventional mills, and the remaining 10 percent by hand pounding (Shwetha and others 2011).

### Lessons on accelerating food fortification

Government stewardship and multi-stakeholder cooperation is crucial to promoting food fortification. For example, in Uganda, the Government passed mandatory fortification legislation in 2011, a tax waiver on premix importation in 2012, and mobilized resources through annual budget support to implement food fortification. National Fortification Alliances (NFA) that brought together multiple stakeholders in partnership arrangements in Uganda, Nigeria, and Kenya provide important lessons for such alliances. While the model and leadership of the alliances were different in each case, the coming together of the different actors was crucial to move the food fortification agenda forward (see box 4.2 for key elements of the NFAs in the three countries). The main elements of successful partnerships are communication with all stakeholders and complete transparency of goals, efforts, and achievements. These elements go a long way to secure the commitment of all stakeholders, each of whom may have varying interests. Complete transparency of government's goals, efforts and achievements through continual updates via mass media and social activities is critical. It helps set the right expectations in terms of what can be achieved through high quality and coverage of fortification programs.

The experience from several countries shows that mandatory fortification is not only the most effective and sustainable option, but also provides more equitable access, has more potential to reach the majority of the population, offers the industry a level playing field in terms of cost structure, encourages competitive pricing of fortified products, and eliminates need for costly marketing. The choice of delivery options and appropriate targeting is crucial to reach the most vulnerable populations. If food fortification

# Box 4.2 National Fortification Alliance: experience from Uganda, Nigeria, and Kenya

In Uganda, the NFA was formed early on in the program and was led by the Ministry of Health and had various subcommittees, for example, for production and distribution, safety and quality, social marketing and communications. Under the leadership of the Uganda National Bureau of Standards (UNBS) and in consultation with multiple stakeholders, the first fortification standards in the country were developed in 2003 and revised in 2006. Later, the NFA was crucial in development of fortification standards, their revision and finally for legal endorsement and legislation for mandatory fortification of selected food products.

In Nigeria, after initial leadership for fortification by the National Planning Commission, the NFA was formed with stewardship of the National Agency for Food and Drug Administration and Control (NAFDAC), and all stakeholders unanimously agreed that private sector should serve as chair. A private sector-led NFA helped to strengthen the relationship between government and industry by allowing industry to have an equal voice in a supportive setting.

The Kenya National Food Fortification Alliance (KNFFA) operates as part of the National Interagency Coordinating Committee with the Ministry of Public Health and Sanitation, Division of Nutrition serving as Secretariat. Similar to Nigeria, there was unanimous support for the KNFFA being led by industry. The chair rotates between the three main fortifying industries (maize and wheat flour and oil). The KNFFA helps to build consensus between Government and private sector for fortification.

is to have the desired public health impact, there has to be broad coverage, especially coverage of groups where deficiencies are high. Therefore, the choice of an appropriate delivery option should be carefully considered—whether mandatory fortification, voluntary fortification or mixed approaches. Globally there are about 86 countries that have legislation mandating fortification of at least one industrially milled cereal grain. In contrast, voluntary fortification gives the private food industry the option to fortify. Fortified products are marketed as "value-added" products rather than just products. Voluntary fortification has significantly lower potential for public health impact as the approach is dependent on industry interest and uptake, consumer awareness, demand and price sensitivity—thus limiting the ability to reach the most vulnerable, especially from the lower socioeconomic status.

A two-pronged approach for consideration is that as mandatory fortification is being explored there should be an interim strategy to promote voluntary fortification. Most stakeholders contacted for this study overwhelmingly feel that India should ultimately move to mandatory fortification of foods such as oil and milk—just as it was done for salt iodization. But mandatory fortification requires legislation and government commitment and therefore the process may take several years. In the interim, a strategy to boost voluntary fortification, along with complementary strategies to distribute fortified foods through social safety nets such as the PDS, MDM, and ICDS will play a critical role. This approach has great potential to reach those at the highest risk of micronutrient deficiencies as it offers a targeted approach. But this should only be considered an interim strategy. And part of this strategy should include a process toward mandatory fortification of foods such as oil, milk, and wheat products—perhaps by mandating that each processor should have at least one fortified prod-uct in each product category.

Strong industry leadership is critical and the industry should be engaged and work in partnership with government in developing clear standards for oil, milk and rice. For example, in West Africa, through strong industry leadership the professional oil industry association (the Association of Oil Producers of the West African Economic and Monetary Union, AIFO-UEMOA), passed a resolution for vitamin A fortification by all member coun-tries in West Africa-and this was before legislation was in place. Oil producers recognized that they could add value to their product through fortification. This not only provided the domestic industry with a competitive advantage over nonfortified imported oil, but it also positioned the industry to contribute to resolving vitamin A deficiency. Lessons from Brazil indicates there is need to gain industry support even when flour fortification is made man-datory. Since there is no legislation for mandatory fortification, the immediate steps needed to promote voluntary fortification include expediting the notification of clear standards for fortified foods, including the type and amount of fortificant to be added. When fortification is voluntary, it becomes crucial to generate demand through consumer awareness programs on health benefits of foods and long-term economic and social benefits of healthy foods. For example, in West Africa an innovative approach was used to develop a regional forti-fication logo, "Enrichi." The logo was developed in Cote d'Ivoire, but it has been adopted by all UEMOA member countries. In addition to stimulating fortification, the concept also appealed to industry players because of its potential to help facilitate intra-regional trade (GAIN 2012) (table 4.3).

Table 4.3 Potential	public health	benefit of delivery	y options	for fortified for	ods
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Delivery Option	Low Income	High Income	Rural	Urban
Voluntary	Low	High	Low	High
Mandatory	High	High	High	High
Mixed	High	Low	High	High

Source: adapted from Sight and Life and WFP (2014)

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## Chapter 5

# Promoting cold chain development

### Why a case study on apples?

Apple is one of the most important temperate fruit commercially and is fourth among the most widely produced fruits in the world—after banana, orange and grape.<sup>1</sup> The consumer demand for apple as a healthy and popular fruit is year round, across economic strata, and hence consumers have a willingness to pay a premium for off-season availability. Compared with most other horticulture produce, apple has natural characteristics such as low respiration rate<sup>2</sup> and thick skin that allow a longer natural shelf life and greater extendibility of that shelf life under controlled conditions. Life extendibility is important for apples because its production is seasonal in all major production zones. In addition to the natural characteristics, the extent to which the shelf life of any horticultural produce could be extended depends primarily on the technology of preservation and product quality at entry. For apples, the literature suggests that apples could be stored between 7 and 26 weeks<sup>3</sup> under normal temperature controlled "cold storage" technology and up to 12 months<sup>4</sup> under "controlled atmosphere" technology. The main difference between cold storage and controlled atmosphere technologies is that while only temperature is controlled in cold storage, the controlled atmosphere technology would involve controlling for additional parameters, including humidity and oxygen. Figure 5.1 maps the shelf-life of various fruits and vegetables

<sup>&</sup>lt;sup>1</sup> National Horticulture Board (NHB), government of India.

<sup>&</sup>lt;sup>2</sup> Production Guide for Storage of Organic Fruits & Vegetables, New York State Dept. of Agriculture & Markets; <u>http://www.nysipm.cornell.edu</u>.

<sup>&</sup>lt;sup>3</sup> Ministry of Micro, Small and Medium Enterprises, government of India; <u>http://www.dcmsme.gov.in/publications/pmryprof/food/ch7.pdf</u>.

<sup>&</sup>lt;sup>4</sup> Northwest Horticulture Council, USA; <u>http://nwhort.org/about/description-of-council/</u>.



Figure 5.1 Suitability of various horticulture crops for investment in preservation

Source: NHB, Agricultural and Processed Food Products Export Development Authority, Directorate of Marketing and Inspection, Ministry of Agriculture, government of India

under cold storage with wholesale price value. In comparison with other produce, apple has both high price spread between farm-gate and wholesale and longer shelf-life extendibility.

A significant share of the cold storage capacity in India is dedicated to apples because of relatively high spread between farm-gate price and wholesale price after cold storage and longer shelf-life extendibility. In addition to the high upside value, apples have the following characteristics which make the fruit attractive for investments in value preservation. First the window for harvesting apples is very short while demand is throughout the year. For example, in the major producing areas apples are mainly harvested from September to October in Jammu and Kashmir, August to September in Himachal Pradesh, and July to August in Uttarakhand. In addition, apple production requires unique high-altitude agroecological conditions. In India, most production occurs close to the Himalaya and far from major urban consumption areas. The dispersion between production and consumption areas raises demand for value preservation services, especially closer to the farmers, before the product is transported to consumption areas. Thirdly, the production volume in the major production areas is high enough to justify dedicated cold storage and capital-intensive investments in controlled atmosphere facilities (table 5.1 and figure 5.2).

Table 5.1	Harvesting	season in	producing	states

State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jammu and Kashmir							Lean	Lean	Peak	Peak	Lean	
Himachal Pradesh						Lean	Lean	Peak	Peak	Lean	Lean	
Uttarakhand							Peak	Peak	Lean			

Source: National Horticulture Board



Figure 5.2 Share of cold storage of key horticulture commodities

Source: Prepared from data compiled from NHB

### Production is highly concentrated and marked by low productivity and high volatility

Apple production has been volatile despite steady growth in area under cultivation. Production is highly concentrated in the high-altitude agroclimatic zones of Jammu and Kashmir, Himachal Pradesh, and Uttarakhand. These three states together account for over 98 percent of national production. Among the three, the state of Jammu and Kashmir has continued to main its historical position as the leading apple producer followed by Himachal Pradesh and Uttarakhand (see figure 5.3). Apples are also produced in parts of Nagaland and Arunachal Pradesh—but the quantities from these states are not large enough to attract investments in postharvest man-agement and almost the entire produce is largely marketed through the traditional *mandi* system. The volatility of production follows fluctuations in weather patterns such that pro-duction is higher in good temperature and monsoon conditions while adverse weather such



Figure 5.3 Distribution of apple production, 2003–14

Source: Prepared from data compiled from NHB and APEDA

as hailstorms would damage the crop and reduce volumes. For example, production in Himachal Pradesh fell by about 70 percent in 2010/11 from previous year levels due to icy weather in spring which damaged the flowering apple orchards and additional spells of hailstorm that struck many parts of the apple growing belt that year (Business Standard 2011). However, area under apple cultivation has grown steadily by about 50 percent in the past decade—from about 200,000 ha in 2003/04 to about 317,000 ha in 2015 (NHB and APEDA). There are concerns that demand for land to cultivate apple has led to large scale deforestation to expand area under apple cultivation, especially in Himachal Pradesh.<sup>5</sup>

Apple productivity in India is the lowest among major producers in the world, and the main reason behind low productivity is poor production technology, including old orchards<sup>6</sup> with low yields and poor agronomic practices. While leading producers like China and Chile have improved yields dramatically over the last two decades, yields in India have remained stagnant and are the among peers (figures 5.4 and 5.5). For example, in 2003/04 the yield stood at about 7.6 MT/ha and then consistently decreased in the next five years until the bumper harvest of 2010/11 when yields reached the highest recorded levels of 10 MT/ha. But in the next year (2011/12) the yield dramatically fell by about 70 percent to 6.8 MT/ha and then decreased further the year after to reach 7.9MT/ha in 2015. India's average yield of about 8

<sup>&</sup>lt;sup>5</sup> Compiled from interviews with farmers in Himachal Pradesh; Report "Deforestation and Village life," Ramesh Kumar Jha 1999 and "Not so delicious" article in newspaper, Mint 2012.

<sup>&</sup>lt;sup>6</sup> The orchards are mostly old with estimated average age of about 30- to 35-year-old (USDA 2013).



Figure 5.4 Apple yields in India over the years (MT/ha)

Source: Authors compilation using data from NHB and APEDA



Figure 5.5 Apple yields (MT/ha) in key producing countries (1992-2012)

Source: Authors compilation using data from Food and Agriculture Organization (FAO)

MT/ha compares poorly to leading producers both in the developed and emerging world. For example, the yield in Chile is 49 MT/ha which is about six times the yield in India. In Italy the yield is 40 MT/ha and in the United States 34 MT/ha. Furthermore, the yields in neighboring China are about 20 MT/ha which is more than twice the yields in India. The stagnant productivity in India is mainly due to low technology which is linked to a host of factors including:<sup>7</sup>

 $<sup>^7</sup>$  Compiled from Economic survey 2014–15 of government of India, NHB, FAO.

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- Monoculture of a few old cultivars that have degenerated over the years. For example, in Himachal Pradesh, old cultivars such as royal delicious and rich red account for most of the area under apple cultivation
- Lack of adequate extension and promotion of better yielding varieties have not only caused lack of awareness of clonal rootstocks but also limited supplies of the planting material
- Lack of awareness of advanced apple farming techniques like high-density apple plantations on clonal rootstocks
- Highly seasonal and often erratic rainfall in apple producing areas coupled with the fact that the production areas are hilly have reduced efficiency with which available moisture is used by the crop
- Low use of organic fertilizers and insufficient concern for soil health by farmers
- Poor weather conditions, including spring frost and hailstorms reduce productivity.

Despite persisting low yields, India has risen from the tenth largest to the fifth largest producer of apples in the world over the last two decades, and this is mainly due to declining production in some large producing countries. While yields in India have grown by a paltry compounded annual growth rate of only 3.3 percent over the last 20 years, this modest performance is actually the third fastest among the top 10 producing countries, behind China (9 percent) and Chile (3.4 percent) (figure 5.6). During the same period, the compounded annual growth rate has either been negative in some large producing countries such as France (-3.7 percent), the Russian Federation (-1.2 percent) and Italy (-0.9 percent)—or relatively low in countries such as Poland and Turkey with a compounded annual growth rate of 3 percent and

1.6 percent, respectively. Brazil reported relatively better performance of 4 percent. Overall, India's production of about 2.5 million MT (2014) was only behind China, the United States, Turkey, and Poland—making India the fifth largest apple producer in the world.<sup>8</sup> And if India's could improve yields to the level of China's—without any change in the area under apple cultivation—total production would rise to over 6 million MT propelling India to second place in global production.

#### Domestic apples serve low-value on-season demand

The bulk of domestically produced apple serve low-value on-season demand. The dominant channel for marketing apples is through the *mandi* system which offer little incentives for value preservation because the product is handled by brokers and commission agents. These marketing agents do not take ownership of the product. They are paid a fixed portion of the sales revenue and therefore do not have clear incentives to preserve value. The

<sup>&</sup>lt;sup>8</sup> Based on data compiled from Food and Agriculture Organization (FAO).



Figure 5.6 Global apple production trends

Source: Authors compilation based on data from Food and Agriculture Organization (FAO) Note: Year 2014 includes only China, the United States, Turkey, India, Chile, Russian Federation, Brazil and Ukraine

period for harvesting apples extends from June to November,<sup>9</sup> the peak harvest season is narrow and spans only two months. The seasonal glut and the fact that the dominant traditional *mandi* channel offer little incentives for postharvest value preservation, means that domestic apples are only able to serve low-value on-season demand from June through November. Furthermore, the current state of cold storage technology in India only extends freshness between four and eight weeks after harvest. This means cold-stored apple compete with fresh apples because of the staggered harvesting months across major producing areas. It means there are hardly sufficient premiums to cover cold storage expenses. Apple exports from India to neighboring countries such as Bangladesh and Nepal also occur during the harvesting months, partly because the exporter chain tends to be supplied by the traditional domestic *mandi* chain.

#### Imported apples capture high-value offseason demand

Imported apples enter the market when supplies of domestic fresh apples are depleted and prices are rising. The production in India is not enough to meet year-long demand, which continues to increase due to increasing population, growing disposable incomes, and

 $<sup>^{9}</sup>$  In Himachal Pradesh, which was the focus for field studies for this background paper, harvesting begins as early as June from the lower altitudes (~1500m) and extends up to November from higher altitudes (>2500m).

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health awareness. Imported apples begin to arrive around November of each year when supplies of fresh domestic apple eases off and prices are rising (figure 5.7). The primary sources of Indian apple imports are Chile, China, and the United States. Other sources of imports include Afghanistan, Belgium, France, Islamic Republic of Iran, Italy, New Zealand, and Turkey—but volumes from these countries are relatively small. For many years the United States had been the main source of imports, supplying India with the red delicious apple which is very similar to the varieties grown in India. However, production of red delicious apples in the United States has declined from about 31 percent of total production in 2004 to about 25 percent of total production in 2012. On the other hand, China has over time increased production of red delicious apple, and this has led to substitution of U.S. apple with imports from China such that China eventually overtook the United States as the major exporter to India. Other factors that have enabled China to gain import share in India include: (1) proximity to India which translates to faster delivery-it takes approximately 20 days to transport apples from China to India compared to 50 days from the United States to India; (2) competitive prices. Average import prices from China in 2013–14 were Rs 62 ver-sus Rs 77 from the United States;<sup>10</sup> and (3) increased consumer awareness and preference for commonly grown varieties in China—for example, Fuji and Gala varieties.<sup>11</sup>



#### Figure 5.7 Pattern of import inflow (2013–15)

Source: Authors compilation based on data from APEDA

Although China and the United States share the same harvesting season with India, imports from these countries arrive in the off-season after costly postharvest management abroad. The off-season demand in India is high enough to recover these costs and the import duty levy imposed by India, which is currently about 50 percent of value. The harvesting season in China and the United States largely coincides with the season in India, but the excess production and superior postharvest management technology, especially capacity of controlled atmosphere storage, enables exporters from these countries to deliver apples to India in the off-season. Imports from both China and the United Statesstart around the end of October, peak between the months of March to June and continue until July, even though harvesting season closes latest by between November and December in both countries (Reynolds and others 2005). On the other hand, the peak harvesting season in Chile and New Zealand is around May to June. During these months, imports from Chile and New Zealand become relatively more competitive primarily because they come in fresh without much costly postharvest management. While China has overtaken the United States to become the leading importer to India, this position might change in future due to emerging global trade patterns. For example, in 2015 the supply of Chinese apples for Indian imports has been limited on account of the recent opening up of U.S. markets for Chinese red and golden delicious apples.<sup>12</sup> On the other hand, U.S. apples have become more easily available after the Russia—the largest apple importer in the world—banned imports from the United States and the European Union. Overall, the patterns of global trade in apples are not stagnant and instead dynamically change depending on volatility of production and evolving tariff and nontariff trade barriers (figure 5.8).

Despite growth of apple imports, India remains a small player in the global market for apples. Although the share of imports in total apple consumption in India has witnessed a steady rise from near zero in early 2000s to about 9 percent by mid-2010s, imports to India account for less than 5 percent of global imports (figure 5.9). The major importing countries are China, Germany, Russia, and the United Kingdom. A common feature of these counties is that they enjoy per capita incomes that are higher than India. Furthermore, the per capita consumption of apples in India is about 1.35 kg per year—which is quite low compared to other countries. For example, the per capita consumption of apples is 36.8 kg per year in Turkey, 16.2 kg per year in France, 14 kg per year for China, and 9.7 kg per year in the United States. As per capita incomes continue to rise in India, it is expected that demand for apple consumption would increase and the demand would increasingly be met through imports unless there are significant increases in productivity and production (box 5.1).

<sup>&</sup>lt;sup>10</sup> Source: APEDA, Department of Commerce, Ministry of Commerce and Industry.

<sup>&</sup>lt;sup>11</sup> Fuji apples are the most commonly grown variety in China accounting for 70 percent of apple production. Gala's account for 6 percent of Chinese production, while Delicious and Qinguan, a local variety, account for 9 percent and 7 percent respectively. Source: USDA 2014.

<sup>&</sup>lt;sup>12</sup> The Packer, Fresh fruit and vegetable news magazine, 2015.



Figure 5.8 Trend in sources of imports into India (000MT)

Source: Authors compilation



#### Figure 5.9 Share of imports

Source: Authors compilation from FAO data

# The regulatory framework for marketing apples has drastically improved

Although the regulatory environment in Himachal Pradesh and Jammu and Kashmir was quite different prior to the reforms, it constrained apple marking in similar ways. Like the rest of the country, the historical regulatory environment for agriculture marketing in Himachal Pradesh and Jammu and Kashmir led to fragmented markets. But these states followed different paths to regulations. In Himachal Pradesh the Agriculture Produce

#### Box 5.1 Apple value chain in the United States

There are two broad apple value chains. The first involves packing houses with Controlled Atmosphere (CA) or Cold Stores. About 75–80 percent of produce is marketed through this chain which supplies modern retailers, wholesalers and exports. The second value chain which accounts for about 15–20 percent of the produce involves farmers marketing apples directly through farmers' markets. Apples are stored in CA facilities for durations ranging from six months to one year. The number of CA storage facilities in the United States is estimated to be almost double the number of cold stores.



Source: USDA.

The regulatory environment includes:

- The oxygen content and temperatures in the CA stores are maintained in accordance with the guidelines set by the State Legislatures
- The CA storage duration for different fruit varieties has also been prescribed
- Daily determination of air components and monitoring tests carried out in the facility have to be maintained and submitted to the State Legislature
- Maturity and condition standards for various grades of fruits have been defined
- The identity of fruits stored in a CA store are monitored post CA storage through the channels of distribution
- Penalties for CA store operators not following any of the defined legislations is levied An annual license and fee for CA store operations
- An annual license and fee for CA store operations

Marketing (APMC) Act provides the regulatory environment for marketing apples. In contrast, Jammu and Kashmir has never implemented agriculture marketing regulation in the form of an APMC Act. The Himachal Pradesh APMC Act was reformed in 2005, largely in accordance with the Model APMC Act released by the central government to drive agriculture marketing reform across the country. Until the late 1990s, a vast majority of apples from both Himachal Pradesh and Jammu and Kashmir, which together comprise 90–95 percent of production, were marketed through the Agriculture Produce Marketing Committee (APMC) *mandi* in Delhi—the Azadpur fruit and vegetable market. For Himachal Pradesh this is because (1) adequate marketing infrastructure in the form of a regulated trading platform (*mandi*) were few or nonexistent in the growing areas, (2) the regulations required sale to be made only at such a *mandi*, and (3) Delhi was not only a large consumption market but also centrally located along the trading route to other large In the case of Jammu and Kashmir the reliance on the Delhi Azxadpur market is due to limited marketing infrastructure and lack of organized large volume buyers close to the farms. Farmers had no option other than the long value chain including pre-harvest contractors, commission agents, forwarding agents and traders that primarily operated through the Azadpur *mandi* (Malik 2013).

The reliance of farmers on commission agents and brokers hindered investments in postharvest management because commission agents had little incentives to preserve value for produce they did not own. The majority of farmers—who are small and marginal-could not market apples in Azadpur because of low volumes and instead relied on commission agents. This dominant marketing chain led to very low transparency in transactions and farmers. It was difficult for farmers to know the actual price received by the agent at the *mandi*. Abundant literature exists on how this system led to farmers getting pulled into perpetual debt trap by the commission agents who also acted as money lenders to farmers to procure inputs and other working capital (Raj and others 2006). Although these problems affected almost all agriculture produce, they were relatively more prominent in apples because of a combination of the following factors: (1) limited availability of marketing infrastructure near the farm, (2) remote and difficult terrain in production areas, and (3) long distances between production areas and the major consumption centers in urban areas. Furthermore, the commission agents had no incentives to invest in postharvest value preservation as they could simply maximize revenue through sheer volumes without making costly investments in cold-storage.

The historical regulatory environment created barriers to information flows such that farmers could not receive feedback on product characteristics, attributes demanded by the market, and consumer willingness to pay. Only few licensed market functionaries had the right to purchase directly from the farmer. And these aggregators would resell the produce to wholesalers at the Azadpur APMC market. While at Azadpur, the produce would be further passed on to subwholesalers or other traders who would in turn sell the produce to retailers in other consumption centers across the country (Singh 2008). The result was an inefficient system in which farmers were not only disconnected from market feedback, but also had to wait for months to be paid by the agents. It is not surprising therefore that when imported apples started flowing in, both farmers and intermediate traders and farmers were largely unaware that the Indian consumer was willing to pay premiums for better quality and year-round availability of apple. If this basic market feedback on consumer preferences was available to farmers, they could have probably invested in postharvest management over the years and improved packing, grading, and so on.

# The regulatory environment has drastically improved in recent years, beginning with APMC reforms, and this has encouraged investments in postharvest infrastructure

including controlled atmosphere facilities. The Himachal Pradesh APMC Act was amended in May 2005. There were many elements to the reforms, including allowing for direct purchasing arrangements from farmers. One of the immediate impacts of these reforms is that they encouraged investments in Controlled Atmosphere (CA) by private companies such as Adani Agrifresh and Devbhumi. Other impacts of reforms include establishment of private markets—at least one private market with a permanent structure and several temporary private markets for direct purchase by traders. The government also plans to upgrade and build capacity building at existing mandis close to the growing areas.<sup>13</sup> These reforms have provided alternative marketing channels for apples over and above the Azadpur mandi.<sup>14,15</sup> The government of Himachal Pradesh has also made attempts in the recent past to develop and enforce standards in packaging of apples. Farmers have traditionally packed more fruit into boxes than the boxes' rated capacity to save on logistics and packaging costs, either on their own initiative or at the request of traders and agents. This practice caused bruising and spoilage of apples, especially during transportation, which typically involved overloaded trucks driven through long, winding, and often poorly maintained roads in mountainous areas. The government's initiative to enforce standardized packaging has the potential to go a long way in limiting damage and spoilage of the fruit in transit.

Because there were no overt regulatory restrictions against direct buying from farmers in Jammu and Kashmir, there was a faster response to the influx of imports in terms of investments in postharvest management by farmers and traders. The influx of imports indicated potential for greater value realization, such that traders and farmers in Jammu and Kashmir invested in postharvest management (farm-based apple pack houses and controlled atmosphere storages) well before in Himachal Pradesh. For example, the first controlled atmosphere storage for apples was established in Jammu and Kashmir in 2004 by FIL Industrieswhile it took until 2006 for the first CA to be established in Himachal Pradesh being by Adani Agrifresh.<sup>16</sup> Jammu and Kashmir has taken further initiatives to improve the state of marketing infrastructure by focusing on developing infrastructure near farm markets

<sup>&</sup>lt;sup>13</sup> Himachal Pradesh State Agricultural Marketing Board.

<sup>&</sup>lt;sup>14</sup> Estimates by some large apple traders and commission agents interviewed for this study put the share of apples that were sold through Azadpur *mandi* at over 90 percent until late 2000s which has now reduced to between 30 and 60 percent. Some of these volumes may come via local *mandis* in the growing states.

<sup>&</sup>lt;sup>15</sup> However, the state continues to levy market fees on all apple produce that is sold in the state irrespective of the location of its sale. While this levy was abolished for a short period, the decision was overturned (for apples while being retained for most other fruits and vegetables) within months in May 2014, just before the harvest season, apparently on account of the significant revenue loss the state would have had to contend with if the levy on apples had been withdrawn.

<sup>&</sup>lt;sup>16</sup> Interview with management.

and promoting fruit growers cooperative marketing societies.<sup>17</sup> Among other initiatives, to encourage the fruit growers and to promote trade, the state government abolished toll tax on export of fruit from 2002 to 2003. Sprayers and pumps are also provided to fruit growers on subsidized rates. Both the states of Jammu and Kashmir and Himachal Pradesh provide support to farmers by implementing a market intervention scheme wherein C-grade (culled, badly damaged) apples are procured at guaranteed prices. In Himachal Pradesh, these apples are largely used for processing by the state owned fruit processing company. To provide a cushion to farmers from the threat of crop loss, which has proven to be a significant issue on account of frequent hailstorms that cause extensive destruction or damage to the apple crop, Himachal Pradesh has implemented a weather-based crop insurance scheme since 1999/2000. The Jammu and Kashmir government also announced in mid-2015 that it intends to cover 70 percent of the area under apple cultivation under a similar scheme. The Himachal Pradesh government also provides an 80 percent subsidy for anti-hail nets. Himachal Pradesh is also implementing a project on Apple rejuvenation under Rashtriya Krishi Vikas Yojna in which old apple orchards are being rejuvenated and replaced with the new, improved and regular bearing spur varieties. In addition, the World Bank is supporting the government of Himachal Pradesh with an innovative Horticulture Development Project which is now under preparation.

# Government support for cold storage and controlled atmosphere facilities

Overall, cold storage facilities are considered inadequate despite massive government interventions in the past few years. For example, between 2008/09 and 2009/10 the government doubled expenditures on cold stores through various programs in the space of one year (table 5.2). It is projected that additional capacity of 32 million tons needs to be installed over the next decade to handle marketable produce (GoI 2013). Going forward, government efforts will be coordinated through the recently launched Mission for Integrated Development of Horticulture (MIDH), which will integrate the work of the following ongoing schemes: National Horticulture Mission, Horticulture Mission for North East & Himalayan States, National Bamboo Mission, National Horticulture Board, Coconut Development Board and Central Institute for Horticulture, Nagaland. In addition to MIDH, various state sponsored schemes and the Rural Infrastructure Development Fund could provide funds for cold chain development. The mandate of MIDH covers the entire gamut of horticulture subsector development, including improving productivity through extension of appropriate technologies, supporting diversification from traditional crops into horticulture, promoting partnerships and synergies across actors in horticulture supply chains, capacity building and

<sup>&</sup>lt;sup>17</sup> Economic Survey, 2014–15, Government of Jammu and Kashmir.

	Funds	crore)	
Scheme	2008/09	2009/10	2010/11
National Horticulture Mission (NHM)	15.52	101.33	105.78
National Horticulture Board (NHB)	40.85	51.42	50.09
Horticulture Mission for North–Eastern and Himalayan States (HMNEH) for PHM Including Cold Storage	4.05	2	13.75
Agricultural and Processed Food Products Export Development Authority (APEDA) for Common Facility Including Cold Storage	36.5	18.72	26.2
Ministry of Food Processing Industries (MoPI)	8.23	43.5	22
National Cooperative Development Cooperation (NCDC)	5.8	6.26	5.73
Total	110.95	223.23	223.55

#### Table 5.2 Funds released for development of cold storage (2008-09 to 2010-11)

Source: <u>www.Indiastat.com</u>

human resource development, and promoting processing for value addition, and development of market infrastructure.

To achieve the target of additional 32 million tons' cold storage capacity over the next decade, the government of India is considering various measures to boost cold storage infrastructure. The main approach is to encourage private investments through public-private partnership model of viability gap funding and various incentive schemes. The economic rationale of viability gap funding is that the investment would give positive returns to the nation (is economically viable) but returns to the investor are not positive (is not financially viable) without a grant. Under this approach, the government provides a portion of the investment cost as a grant. The size of grant should be just big enough to bridge the gap and make the project financially viable. The model typically works well where investors are assured of a captive stream of revenues, for example in infrastructure type projects such as roads, railways, and airports. It is not clear whether captive revenues in form of user fees are tenable in cold chain facilities unless users could be foreclosed from switching to other service providers or establishing their own facilities. In the absence of captive revenues, grants and subsidized loans from government schemes could be good for addressing a credit market imperfection on supply of funds if that were the reason cold chain infrastructure is not well established. A potential drawback of supply-side infusion of cheap funds is they could lead to inefficient investments in excess capacity in some locations and inadequate capacity where needed.

The government has contributed over Rs 400 crore in the form of subsidy<sup>18</sup> to private companies that to develop controlled atmosphere storages primarily for

<sup>&</sup>lt;sup>18</sup> Rs 62 cr investment with subsidy amount of Rs 26cr has come since 1st April 2010. Source: NHB; figures before April 1, 2010, estimated by extrapolation.

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# Figure 5.10 Growth of near-farm CA storage capacity (MT)



Source: Prepared from data compiled from select CA stores and CA store equipment manufacturers and news reports

apples—and the total investments are over Rs 1,300 crore. Controlled atmosphere (CA) technology<sup>19</sup> extends the freshness of apples by up to 12 months. Investments in CA capacity has expanded rapidly in the last decade, through various subsidy schemes, with about 70 percent of this capacity is located in production zones closer to the farms<sup>20</sup> and the remaining 30 percent closer to consumption markets. Figure 5.10 shows the growth of capacity supported by the government through subsidy schemes. In addition, there are a number of schemes implemented by different ministries, missions, and corporations to support postharvest management more generally. A detailed discussion of the main schemes supporting postharvest management is provided in annex 5.1.

### Apple value chains

#### Mapping and characterization of the value chains

A value chain analysis was carried out to examine the impact of controlled atmosphere storage to the supply chain stakeholders, particularly farmers, and draw lessons for improving the performance of postharvest management in the apple and other horticulture supply chains. The analysis compares the qualitative and quantitative aspects of the key value chains. The following value chains were identified: traditional chain involving pre-harvest contractor and without cold storage or controlled atmosphere storage (VC I); traditional chain without pre-harvest contractor and without cold storage or controlled atmosphere storage (VC II); storage through controlled atmosphere stores (VC III); storage through cold stores (VC IV). The study focused on the key apple growing state of Himachal Pradesh, and within the state the key growing area of Shimla district. Himachal Pradesh was selected for the study because

<sup>&</sup>lt;sup>19</sup> CA storage involves careful control of not just temperature but also of oxygen, carbon dioxide and humidity levels. These storages employ a nonchemical process where Oxygen levels in the sealed rooms are reduced, usually by the infusion of nitrogen gas, from the approximate 21 percent in the ambient air to 1 percent or 2 percent with temperatures being kept at a constant 32 to 36 degrees Fahrenheit. Humidity is maintained at 95 percent and carbon dioxide levels are also controlled. Exact conditions in the rooms are set according to the apple variety.

<sup>&</sup>lt;sup>20</sup> CA capacity estimates based on data from NHB, several interviews, ICE Magazine, Jan-Mar 2014 supported by Global Cold Chain Alliance (GCCA) and news reports.

a greater proportion of the production from the state is storable in controlled atmosphere storage (figure 5.11). Annex 5.2 provides a description of the value chains.

#### **Comparative margins across value chains**

The controlled atmosphere (CA) stores are capturing the best quality apples and those apples are fetching farmer's relatively higher gross margins, but other agents in the chain capture relatively more benefits compared to farmers. Table 5.3 compares the margins received by farmers in the controlled atmosphere storage value chain (VC III) benchmarked against the traditional chain without pre-harvest contractor and without cold storage or controlled atmosphere storage (VC II). The rationale for benchmarking against VC II is because it is the most dominant value chain. The gross margins for apples that go to the CA store are the highest—about 55 Rs Per kg. The different months of sale refer to the month when apples were released for sale by the CA store. Farmer margins do not change because the benefits of storage are all captured by the owner of the CA store and others downstream. As expected, the findings show the gross margins of the CA store were highest when apples were stored longer and sold in March 2015. The margins improved from Rs 7 per kg when the produce was sold in December 2014 to Rs 17 per kg when the apples were sold in March 2015—a more than 100 percent gain within 3 months of storage. Similarly, wholesaler and retailer margins improved with longer storage—even though these agents do not directly incur the costs of CA storage. Their improved margins is attributed to increased



#### Figure 5.11 The study area for apple value chains

			VC III (Controlled atmosphere storage)					
			VC	2014 harvest Dec' 14	2014 harvest Jan '15 sale	2014 harvest Feb '15 sale	2014 harvest Mar '15 sale	_
	1	VC I		sale price	price	price	price	VC IV
	Share of final price (%)	50	61	54	52	44	41	59
ner	Marketing costs (Rs/ kg)	0.0	П	1.8	1.8	1.8	1.8	10
Farr	Gross margin (Rs/kg)	28	41	55	55	55	55	47
	Share of final price (%)	16						
harvest ractor	Marketing costs (Rs/ kg)	13						
Pre- conti	Gross margin (Rs/kg)	4						
	Share of final price (%)			16	14	20	19	
otore	Marketing costs (Rs/ kg)ª			12	12	12	12	
ĕ.	Gross margin (Rs/kg)			7	5	17	17	
Ŭ	Share of final price (%)	4	3					3
mission t	Marketing costs (Rs/ kg)	0	0					0
Com	Gross margin (Rs/kg)	4	3					3.3
	Share of final price (%)	10	14	13	16	12	14	18
lesaler	Marketing costs (Rs/ kg)	6	4	12	12	12	12	5.1
Vho	Gross margin (Rs/kg)	4	10	3.4	8.4	5.4	10.4	16
-	Share of final price (%)	21	23	17	18	24	26	20
ller	Marketing costs (Rs/ kg)	9	10	10	10	10	10	10
Reta	Gross margin (Rs/kg)	13	12	10	12	25	30	12
Consu	Imer price	106	100	118	123	145	155	112
Wastage		Volume storage There i Loss of Loss of on bad ageing i	e loss o and no s neglig value value roads, n the a prtation	f 3–7% takes p egligible at othe gible volume lo in VC I, II and t arises from dar wrong or only ubsence of suffi	place at the retail er points ss at any other s to an extent IV, is mage due to poo broad level grad cient cold and co	level and 2–39 tage across cha s however grea r handling, pacl ing in addition pontrolled atmos	" (weight loss) of tins ter and not estii kaging, transport to reduced quali sphere storage a	luring mated. cation ty from ind

#### Table 5.3 Comparison of costs and margins across chains and actors

Note Marketing costs captured here do not include cost for CA storage given that this value chain covers only CA stores that are owned and operated by traders and, as mentioned in the note under the table, costs and margins do not include overheads, capital expenditure and interest elements. Nevertheless, even in the case of the few rental stores that the author came across, the cost of rental charged was the same for up to 5 months of storage.

Source: Authors calculations from primary survey data

prices in their selling markets relative to buying prices, mainly because by March the supply of domestic apple in India is at the lowest and prices are relatively higher. Wholesaler margins increased by about 200 percent while retailer margins improved also by about 300 percent which suggests wholesalers and retailers are the ones benefiting the most from CA storage. However, it is important to note than CA stores also are wholesales in addition to delivering to other wholesalers—and therefore the margins of CA stores also include the wholesale node of the chain. The retailers in this chain are modern retailers in major urban centers. Their relatively higher gains are largely because their marketing costs do not change with the duration of CA storage but the consumer prices are higher. The marketing costs of wholesalers also do not change with duration of CA storage. But, the marketing costs of CA store owner increases with duration of storage.

Overall, the value chain analysis show that farmers are the least beneficiaries from CA storage and most of the benefits to farmers are due to transfer of marketing costs (sorting, grading, and packaging) to CA stores, rather than price changes-and this is because farm-gate prices change only marginally. In comparison to the traditional chain without pre-harvest contractor and without cold storage or controlled atmosphere storage (VC II), the farmers save about Rs 10 in marketing costs with CA storage (VC III) and gain Rs 14 in gross margin. It means more than 70 percent of the margins (Rs 10) are from cost savings and prices contribute less than 30 percent (only about Rs 4 per kg). It means the price differences between CA purchased apple and apple delivered to other chains is small, despite the fact that CA stores purchase the best quality apple. But in the CA chain prices are pre-announced, stable, and payment is faster-and for these reasons farmers would prefer to sell to the CA store. In addition, the farmers save on costs of sorting, grading, and packaging. However, not all farmers are able to sell to CA stores, and even for those selling to CA stores they are not able to sell all their produce. This is because CA stores impose stringent quality standards and select only the best grade A Apples, which are estimated to be in the range of 50–60 percent of the total production in Himachal Pradesh.<sup>21</sup> The aversion of CA stores to risk is relatively high and is perhaps explained by the fact that CA capacity is well below production leading to low competition for apples. The CA storage capacity in Himachal Pradesh is less than 40,000MT while average annual production is between 500,000MT to 700,000MT. Relative to other actors in the chain the CA store is faced with high capital investments. And both CA store and farmers are faced with relatively more price risk compared to other actors. For farmers the price risk is relatively higher because there are no guaranteed market prices at the time when farmers are engaging in costly farm management operations in apples. For CA stores the price risk emanates from the fact that the market prices that would prevail several months after CA storage are not known in advance. All other

<sup>&</sup>lt;sup>21</sup> Estimates from interviews with farmers and farmer association in Himachal Pradesh; In Kashmir this proportion is even lesser at 30 percent A grade, 40 percent B grade and 30 percent C grade production.

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agents make short term decisions on buying and selling which reduces their exposure to risk. On capital investment cost, most of the CA capacity established in Himachal Pradesh has received generous government subsidies, which reduces significantly their exposure to risk and increases their returns to investment.

#### Impact of controlled atmosphere stores on producer prices

There is no clear evidence that the CA store capacity has improved the general price levels faced by farmers and any price effects are likely to be marginal. The farmer's gross margins for apples sold to the CA store are relatively higher mainly due of savings on cost of marketing services. In particular, more than 70 percent (about Rs 10 per kg) of the margins are from cost savings and prices contribute less than 30 percent (Rs 3 per kg). Furthermore, this price gain is only for the best quality grade A Apples. There is no reason to believe that the relatively higher price for best quality apples is transmitted to lower quality apples. The opposite effect might occur, that is the prices for lower quality apples might be depressed because other agents who buy without differentiating prices across grades bargain prices with the knowledge that the farmer has already sold best quality apples. An analysis of general price level for apples was conducted using real apple producer prices during the harvesting season in both Himachal Pradesh and Jammu and Kashmir (figure 5.12). The analysis shows a general upward sloping trend for Himachal Pradesh, but with huge volatility, which suggests that prices have at least not decreased since investments in CA stores expanded—beginning around 2006—and that they may have increased. The prices in Jammu and Kashmir also show significant volatility but without any upward trend. Furthermore, any price changes since the CA capacity was expanded cannot be wholly attributed to the CA stores because there are many other potential determinants of producer prices-including volume of supplies and expectations of selling prices by players downstream, which would be influenced by rising per capita incomes and consumers' willingness to pay, among other factors.

# Conclusions and lessons for improving postharvest management

Strengthen programs to increase apple productivity by addressing the main causes: poor production technology, including old orchards with low yields and poor agronomic practices. While leading producers like China and Chile have improved yields dramatically over the last two decades, yields in India have remained stagnant and are the among peers. For example, in 2003/04 the yield stood at about 7.6 MT/ha and then consistently decreased in the next five years until the bumper harvest of 2010/11 when yields reached the highest recorded levels of 10 MT/ha. But in the next year (2011/12) the yield dramatically fell by about 70 percent to 6.8 MT/ha and then decreased further the year after to reach 7.9MT/ha in 2015. India's average yield of about 8 MT/ha compares poorly to

Figure 5.12 Apple producer real prices in Himachal Pradesh and Jammu and Kashmir during harvest season



Source: Prepared from data from NHB

leading producers both in the developed and emerging world. For example, the yield in Chile is 49 MT/ha which is about six times the yield in India. In Italy the yield is 40 MT/ha and in the United States 34 MT/ha. Furthermore, the yields in neighboring China are about 20 MT/ha which is more than twice the yields in India. The stagnant productivity in India is mainly due to low technology which is linked to a host of factors including:<sup>22</sup>

- Monoculture of a few old cultivars that have degenerated over the years. For example, in Himachal Pradesh, old cultivars such as royal delicious and rich red account for most of the area under apple cultivation
- Lack of adequate extension and promotion of better yielding varieties have not only caused lack of awareness of clonal rootstocks but also limited supplies of the planting material
- Lack of awareness of advanced apple farming techniques like high-density apple plantations on clonal rootstocks
- Highly seasonal and often erratic rainfall in apple producing areas coupled with the fact that the production areas are hilly have reduced efficiency with which available moisture is used by the crop
- Low use of organic fertilizers and insufficient concern for soil health by farmers
- Poor weather conditions, including spring frost and hailstorms reduce productivity.

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<sup>&</sup>lt;sup>22</sup> Compiled from Economic survey 2014–15 of government of India, NHB, FAO.

Although the capacity for controlled atmosphere (CA) storage has expanded rapidly close to production areas, only a small proportion of domestic apples is stored in such facilities, because the capacity is small and there is no sufficient quantity of apples of CA-storable quality. The CA technology<sup>23</sup> extends the freshness of apples by up to 12 months. Investments in CA capacity has expanded rapidly in the last decade, through various subsidy schemes, with about 70 percent of this capacity located in production zones closer to the farms<sup>24</sup> and the remaining 30 percent closer to consumption markets. However, the capacity remains small compared to overall production volumes. For example, in 2013/14

# Figure 5.13 Production volumes and controlled atmosphere storage capacity (2013/14)



Source: Authors compilation from various sources (incl. data from NHB and interviews with several industry players)

Note: "Rest of the country" actually refers to: (1) locations close to consumption centers, primarily Delhi and Chandigarh, and (2) locations close to production areas in Uttarakhand and Arunachal Pradesh

production of apples in India was about 2.5 million MT, but only about 118,000MT of CA storage was available (figure 5.13), comprising of about 30 storages spread throughout the country. In the case of Himachal Pradesh, only about 5 percent apples are sold directly to CA stores around the state. The rest (about 95 percent) is distributed through the traditional distribution channel comprising of network of mandis located in Himachal Pradesh, Delhi, and Chandigarh. In recent years, private *mandis* are emerging as another distribution channel and there are also private direct buyers purchasing apples in bulk at the farms to sell to other states. Direct purchasing has been made possible due to reforms to the Himachal Pradesh APMC Act. Apples are also stored in cold storages but the technology used in India is only able to extend freshness of apples for

only two months. This duration of storage is not only enough to capture off-season demand, but it also means that cold-stored apple would compete with fresh apples harvested late in the season. Therefore, cold-stored apples fetch relatively lower premiums due to competition with freshly harvested apples.

### Investments in cold storage and controlled atmosphere facilities alone will not address the postharvest management challenges and therefore it is important to

<sup>&</sup>lt;sup>23</sup> CA storage involves careful control of not just temperature but also of oxygen, carbon dioxide and humidity levels. These storages employ a nonchemical process where Oxygen levels in the sealed rooms are reduced, usually by the infusion of nitrogen gas, from the approximate 21 percent in the ambient air to 1 percent or 2 percent with temperatures being kept at a constant 32 to 36 degrees Fahrenheit. Humidity is maintained at 95 percent and carbon dioxide levels are also controlled. Exact conditions in the rooms are set according to the apple variety.

<sup>&</sup>lt;sup>24</sup> CA capacity estimates based on data from NHB, several interviews (see ICE Magazine, Jan-Mar 2014 supported by Global Cold Chain Alliance (GCCA) and news reports.

consider balanced support to various agents in the value chain for perishables. The cold store or controlled atmosphere store is one point in a value chain and the benefits of investing at only one point in the chain are limited. Instead cold chain development should take a broader view to create investments that are interlinked at different points of the chain by first identifying the specific purpose a cold store will serve in preserving quality, reducing waste and/or maximizing value of the produce and, more importantly, what other conditions need to be met before and after the investment. The focus on providing incentives to establish cold chain infrastructure has led to a situation where private entrepreneurs rush to create infrastructure, fueled by grants, often without understanding the produce supply chain. For example, estimates of food wastage for various fruits and vegetables indicate that most of the loss occurs at the farm level—especially during harvesting, storage, and grading—which suggests there should be a lot of focus on technology to improve efficiency in these services. (see figures 5.14 and 5.15).

Consider a regulatory environment that better aligns the incentives for cold chain development and that would have to be a regulatory alignment that allows advanced forms of vertical coordination and expansion of modern retailing. This would lead to demand-driven establishment of cold chain infrastructure (as opposed to the current supply-side approach) and capacity of efficient scale and location. Fresh and processed food consists of about 60 percent of the retail market, but most of food retailing is unorganized and consists of fragmented "mom and pop' units that operate in spot markets with weak backward linkages to supply chains. Spot markets are far less likely to stimulate demand for investments in cold chain facilities. On the other hand, there is enormous scope for creating demand for cold chain facilities through vertically coordinated supply chains. For example, modern retailing at the consumer end could initiate backward linkages to source high-quality produce and create demand for postharvest marketing services and spur investments in enabling facilities such as cold chains infrastructure. Modern retailers, whether small or large, would require dedicated chain of suppliers to reduce transaction costs of selecting desired quality. Those relationships spiral backwards to the farmer while passing along information about attributes that consumer's desire in produce and available premiums for quality. If the incentives are right and premiums are paid to the party providing postharvest marketing services, demand for cold chain facilities can be created at a scale and location that is economically efficient. And where dedicated supply chains emerge, retailers could profitably provide financing for such investments, as would be the case in vertically coordinated chains.

Consider a program to establish farmer-owned postharvest management assets following successful models in dairy where farmers have been organized to cooperatives and now producer companies that have developed assets in milk processing. There is scope to further expand controlled atmosphere capacity in production areas. But these investments should be a package that includes upgrading the production technology (varieties and management practices) to not only raise productivity and production, but also improve the



Figure 5.14 Harvest and postharvesting losses by source in key fruits

Source: "Estimation of quantitative harvest and postharvest losses if major agricultural produce in India, All India Coordinated Research Project on Post-Harvest Technology," Central Institute of Post-Harvest Engineering and Technology (CIPHET)



Figure 5.15 Harvest and postharvesting losses by source in key vegetables

Source: "Estimation of quantitative harvest and post-harvest losses if major agricultural produce in India, All India Coordinated Research Project on Post-Harvest Technology," Central Institute of Post-Harvest Engineering and Technology (CIPHET)

quality of production. In addition, farmers could also be organized into producer companies (not necessarily cooperatives) that would receive long-term financing to establish controlled atmosphere infrastructure that is owned by producer organizations. This model could borrow a lot from the successes in the dairy sector where even a farmer with one cow could join a village cooperative that has been facilitated by the National Dairy Development Board to invest in pot-production milk chilling. The village cooperative would be a member of a Milk Union that has been facilitated to invest not only in dairy processing, but also in improving the technology of dairy production among affiliated farmers—for example, by providing better genetics through artificial insemination with semen sourced from semen stations owned

by cooperatives and providing feed produced by feed manufacturing factories that are also owned by cooperatives.

Consider models of private-public partnerships or productive alliances between farmers and private investors in controlled atmosphere stores—together with developing a warehousing receipt system for perishables, perhaps building on the experience of potato in West Bengal. In the current model where all the support has gone to the private investor the farmer is hardly able to rent the capacity, unless the CA store owner deems storing apples there to be too risky and allows farmers to rent the space. In this case a farmer would be engaging in a business activity that is deemed too risky by an agent that has better market information—which means under current models renting would almost always be unprofitable. However, this could change with models of private-public partnerships (PPP) that guarantee a private investor that a portion of the capacity would be available to an organization of farmers for example, cooperative or producer companies. The PPP agreement would be based on a rigorous analysis of financial models of CA stores to establish, among other parameters, the correct level of guarantee fee payable to the private investor. The government could provide a guarantee through a third party engaged by the government to provide this investment guarantee. To minimize the government actually having to pay the guarantee, efforts should be made to provide incentives to farmers to use the capacity dedicated to their organizations. The warehouse receipt system is an instrument that has worked to incentive farmers to use storage warehouses in the cereal sectors. The receipt allows farmers to trade the produce while it is stored and address their short-term needs for liquidity. Although it is challenging to implement on perishables, there are some successful examples in the potato segment in West Bengal where cold stores are issuing tradable receipts to farmers and traders against the value of potato stored. This model could be replicated in apples.

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# Annex 5.1 Main schemes supporting postharvest management include

## **Department of Agriculture and Cooperation**

- Credit linked back ended assistance to attract private companies for the creation of integrated postharvest infrastructure, including setting up of cold storages, modern packhouses, transportation, processing units, ripening chambers and retail infrastructure. Subsidy at 35 percent of the admissible cost in general areas and at 50 percent in case of hilly and scheduled areas is provided to beneficiaries.
- Integrated Scheme for Agricultural Marketing (ISAM), through the subscheme Agricultural Marketing Infrastructure (AMI), subsidy is available for construction of cold storages when created as part of Integrated Value Chain (IVC) Projects. Subsidy at 33.33 percent in case of North Eastern (NE) States, Sikkim, Andaman and Nicobar and Lakshadweep Islands, hilly areas, Registered FPOs, Panchayats, Women, SC/ST entrepreneurs and their cooperatives and Self-help groups. Subsidy is at 25 percent for all other categories.
- Credit linked back ended subsidy at 35 percent of the admissible cost of New Reefer Vehicle(s) in general areas and 50 percent in hilly and scheduled areas

## Assistance by Ministry of Food Processing Industries (MoFPI)

- Grant-in-aid at 50 percent of the total cost of Plants and Machinery and Technical Civil Works in general areas and 75 percent for NE Region and difficult areas subject to a maximum of Rs 10.00 crore for (any two of the first three or the fourth)
  - Minimal Processing Center at the farm level with facilities such as weighing, sorting, grading waxing, packing, pre-cooling, Controlled Atmosphere (CA)/Modified Atmosphere (MA) cold storage, normal storage and IQF.
  - Mobile pre-cooling vans and reefer trucks.
  - Distribution hubs with multi product and multi CA/MA chambers, cold storage/Variable Humidity Chambers, Packing facility, CIP Fog treatment, IQF, Ripening chamber and blast freezing.
  - Irradiation facility
- Grant-in-aid for development of common infrastructure for mega food parks, up to Rs 50 crores. Common infrastructure has cold-chain components

## Assistance under National Mission on Food Processing (NMFP)

 Capital Investment Subsidy at 35 percent of bank/FI appraised project cost excluding the cost of land, pre-operative expenses, margin money for working capital and contingency, subject to a maximum of Rs 5 crore in general areas. For difficult areas such as North Eastern States, hilly and ITDP areas, this is 50 percent of the eligible project cost, subject to a maximum of Rs 5 crore.

- Interest subvention on the term loan availed from banks/financial institutions: 6 percent a year for first 5 years of operation or repayment period, whichever is less with a cumulative limit of Rs 2.00 crore in general areas. For North Eastern States, Hilly and ITDP areas, it would be 7 percent a year, with a maximum ceiling of Rs 3.00 crore.
- Grant-in-aid at 50 percent of the eligible project cost for the general areas and 75 percent in North-East Difficult Areas respectively for Primary processing and collection center in rural areas up to Rs 2.5cr
- Credit linked back ended grants-in-aid at 50 percent of the cost of New Reefer Vehicle(s)/ Mobile pre-cooling van(s) upto a maximum of Rs 50.00 lakh

#### Assistance by APEDA

 100 percent grant in aid to APEDA or any other Government or Public Sector agency and at 25 percent of the cost subject to maximum of Rs 10 lakh per beneficiaries in other cases for setting up specialized storage facilities such as CA/MA cold storages, deep freezers etc

# Assistance by National Co-operative Development Corporation (NCDC)

 Subsidy at 20 percent and 25 percent of the project cost for Under Developed (UD) and Least Developed (LD) states for setting up of New Cold Storages/CA stores/MA stores, Expansion/modernization of existing cold storages with facilities such as drying, sorting, grading, waxing, packing, and pre-cooling.

#### **Fiscal incentives**

- Section 80-IB of the Income Tax Act provides deductions in respect of profits from industrial undertakings related to Cold Chain. For the first 5 years the deductions are at 100 percent and then at 25/30 percent for next 5 years
- Under Section 35-AD of the Income tax Act 1961, deduction at 150 percent is permitted for expenditure incurred on capital investment in setting up a cold chain facility
- Concessional rate of custom duty at 5 percent on imported equipment for cold chain facility under the project import benefits
- All refrigeration machineries and Parts used for installation of cold storage, cold room or refrigerated vehicle, are exempted from Excise Duty
- Many activities pertaining to cold chain are included in the exempted and the negative list for the purpose of service tax

## **Other initiatives**

- National Centre for Cold Chain Development (NCCD), an autonomous center for excellence, has been established as a registered society to work in close collaboration with industry and other stake holders to promote and develop integrated cold chain in India
- Allocation of Rs 5,000 crore for the Warehousing Infrastructure fund for the year 2014/15. This fund is made available as a low interest funding window to cold-chain stakeholders and is operationalised through the National Bank for Agriculture and Rural Development (NABARD)
- Reserve Bank of India in its guidelines dated 23.04.2015 classified loans to food and agrobased processing units and Cold Chain under Agriculture activities for Priority Sector Lending

# Annex 5.2 Detailed description of apple value chains

#### Value Chain I: Fresh produce chain through pre-harvest contractor



In this chain, the farmer cultivates his land but outsources everything else starting from harvesting up to final sale to a pre-harvest contractor (*"thekedar"*). A pre-harvest contractor is often another farmer from the same/nearby village who maintains networks with agents and traders. The contractor collates volumes from several small farmers who may not have the inclination (or resources) to deal with the traditional multi-layered marketing system which involves the hassle of carrying one's produce to the nearest regulated market or entrusting the produce to an agent, waiting to hear back on the price of sale and waiting further for actual payment to come through.

In this case, the farmer carries out the cultivation activities in-house unlike in another prevalent model where the farmer may contract out the entire chain from production to sale to a third party in exchange for a lumpsum payment.<sup>25</sup> Unlike this model which, for all practical purposes, is an informal "contract farming" arrangement, used typically by large farmers, the value chain that we discuss here is mostly used by small farmers who, while they can tend to the farms themselves, are disinclined to get involved the with the vagaries of marketing inherent in the existing system.

The pre-harvest contractor typically visits the farmer's orchard a few days before the harvest to inspect and agree with the farmer on a lumpsum amount that the contractor would pay the farmer for buying the expected produce. The contractor then carries out the marketing processes from harvesting up to final sale, his margin being the amount that he earns from sale less the lumpsum amount paid and his marketing costs. Thus the contractor takes a calculated risk on harvesting losses, market price and marketing costs for which he earns a margin.

While this practice was prone to exploitation of farmers in the absence of freely available price information in the remote growing areas, in recent times, with improved communication systems, farmers have greater bargaining power.

Also, reform of the APMC act which permitted direct purchase has led to buyers from all over the country coming to the growing areas over the last few years, often establishing temporary setups near the growing areas, to procure directly from farmers during season months.

<sup>&</sup>lt;sup>25</sup> In the latter model, end-to-end outsourcing is done often on account of the fact that the orchard owner does not reside on or near the farms and may have migrated to the metro cities.

#### Value Chain II: Fresh produce chain through commission agent



In this chain, in addition to cultivating his land and harvesting the produce the farmer also gets involved with marketing. Farmers often have relationships with a dedicated agent or agents with whom they transact for selling their apple on their behalf at the APMC *mandis*. The commission agent arranges for the pickup of harvested, graded and packaged apples from the farm, transport and sale transaction of the produce at the *mandi* for which he gets paid a commission over and above the costs incurred.

In practice, commission agents play a role that goes much beyond that of a handing and transaction agent. These agents, especially the larger ones, often "finance" the transactions on behalf of farmers by paying the farmer a part of the estimated sale value upfront before a sale is made and then adjusting the same when the sale is actually made. This payment could even come in the form of an interest bearing advance that the farmer avails of from the agent for procurement of inputs and other working capital for running the orchard.

This is by far the most prevalent chain for sale of apples from Himachal Pradesh and, until a few years ago, was practically the only available channel (along with its variants Value Chain I and Value Chain 4) for sale and distribution of apples.

# Value Chain III: Stored produce chain through controlled atmosphere storage



This chain gives farmers the option of making a sale close to their farms directly to near-farm CA storage owner-operators who also function as traders. While this chain came into being about 10 years ago with the commencement of operations of the first CA store in Himachal Pradesh in 2006, the volumes traversing through this chain have witnessed a quantum jump in the last four to five years only.

The preparation for procurement starts at least 3 months before harvest, typically from the month of May, when CA stores carry out a survey on the farms, decide on hubs and identify hub operators in villages to perform the role of coordination, dissemination of price information and for distribution of crates in which farmers would bring their produce to the CA store.

Procurement officers are full time staff who maintain relationships with farmers and regularly survey farmers' orchards and meet with the farmers, at times involving agriculture

experts (mostly scientists retired from the government or institutes) to advise them on cultivation and harvesting practices.

The hub operator works with procurement staff to collect groups of farmers with whom discussions are held and their feedback on the previous years' experience and the current year's expectation of harvest is taken.

By 1st week of June, an estimate of the likely volume of production is taken and a procurement strategy is outlined based on the same. Around July end farm visits are undertaken again to check various parameters like starch levels for which field staff carry handheld equipment. A few days before the harvest starts, around 10th August, another visit is undertaken and if issues are found in some orchards' produce, the respective farmers are told not to bring their produce.

Farmers carry their produce to the CA store which is located within or close to the growing areas (within the hilly areas of Himachal Pradesh) based on price offered for purchase by the CA store valid for a particular period lasting from a day to a week. Price information is disseminated through local media and text messages cascaded through the hub operators appointed by the CA store located in key growing areas. These hub operators also provide farmers who choose to bring their produce to the CA store with crates that are owned by the CA store for a fee paid to them by the latter. Quality specifications (grades) along with price offered for each grade are clearly laid out by the CA stores based on which farmers typically bring only that share of their produce which is likely to be accepted. CA stores overtly discourage farmers from carrying low-grade produce to the store either by offering below-market prices for the same or by rejecting outright a lot with low-grade produce beyond a threshold percentage. Farmers bear transport cost while unloading cost at the CA store is borne by the store. For a store of 6,000MT, a total of 1,500–2,000 farmers may be engaged from within whom, 700–800 may actually bring produce.

A visual check is undertaken at the store gate as a first level quality check after which accepted produce is loaded onto state-of-the-art mechanized grading lines, usually imported from their international manufacturers, for a thorough and finer grading.

A clear and finer grading is undertaken in this chain to ensure that only produce that is likely to be able to survive in the CA store is accepted. This is also because the premium-paying buyers of offseason apples, who have the choice of buying imported apples easily available in offseason, are more discerning when it comes to quality of produce. CA store owners, being also traders, therefore naturally apply a fine grading to ensure that the maximum possible markup may be obtained after loading the costs of expensive capital equipment and operating costs on the purchase price.

Based on the grading determined by the automated grading equipment, payment as per the declared price is released to the farmer for each grade accepted, typically either as a cheque on the spot or through electronic clearing to the farmer's bank account.

The apples are stacked in boxes (bins) inside chambers of the CA store where they stay until the store owners decide to start releasing them. Quantum and price at which apples are released periodically is a decision based on the store owner's knowledge of prevailing prices of apples available either from the import chain or, up to two to four months after close of harvest, from the normal cold stores and their perception of the availability and movement of these prices in the coming days/weeks. In any particular year, CA stores may start release as early as November or as late as February and mostly exhaust supplies by April depending upon the actual and projected demand supply situation in addition to a judgment on the actual expected shelf life extendibility in CA stores for apples procured in the last harvest.

The apples thus released are distributed through a distribution network of agents and wholesalers though there have been a few instances of direct sale by the CA stores to large institutional buyers like organized retailers.

#### Value Chain IV: Stored produce chain through normal cold storage



Unlike CA stores, normal cold storages have long been used in the apple supply chain in a variety of ways. While normal cold storages are limited in their ability to extend life beyond two to four months and may not be as consistent in terms of quality retention vis-à-vis CA stores, these storages are significantly cheaper to setup<sup>26</sup> and operate given their much more basic technology involving only refrigeration as against the CA store's multi-parameter control. Normal cold storages also lend themselves better to frequent replenishment and withdrawal from the store affording traders greater flexibility in their usage.

For these reasons, cold storages may be used at multiple points in the supply chain depending upon the supply chain actor's individual preferences and market scenario. So a trader may buy produce at the *mandi* following the Value Chain I or 2 described above and then sell some volumes right away, store some volumes in a cold store rented or owned by him for a few days near the market in anticipation of a favorable movement in prices to withdraw and offload the stock as soon as this happens within season and store some more volumes in a cold store for a longer term (two to four months) with the intent to benefit from price rise in offseason.

As against this, apples stored in CA stores can only be withdrawn in larger lots (the minimum quantity to be withdrawn being the capacity of a single chamber in a multi-chamber

<sup>&</sup>lt;sup>26</sup> Estimates of the share of capital investment required to setup the same capacity of normal cold storage versus CA storage range from 25 percent to 50 percent depending upon specifications.

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CA store<sup>27</sup>) making CA stores amenable only to longer term storage (at least 2 but upto their maximum potential of 10–12 months) for offseason sale.

While cold storages, like CA stores, are often owned and operated by traders as against being third party storage service providers, unlike in the case of CA stores, there is no practice of farmers carrying produce to cold stores for purchase by the cold stores directly. Cold stores are typically used as an additional link opportunistically in the prevalent chain (Value Chain I and II above) as against giving rise to a distinct and independent channel in its own right.

<sup>&</sup>lt;sup>27</sup> A single chamber is typically 100–200 MT. So a 5000 MT CA store may have 34–35 chamber. For the investor in CA stores, smaller size of each chamber translates into a greater cost per MT of total capacity.

# Chapter 6

# Promoting agroprocessing value chains

## Why case study on potato?

Potato offers important lessons to expand processing and other segments of agribusiness. Before the 1990s, potato processing was limited to unorganized and household processing, but following the reforms which allowed 100 percent foreign direct investments (FDI) in processing, the potato processing industry attracted significant investments, especially from multinational companies. The first potato chips industry with the Brand Name Golden Crisp was established in 1977 at Faridabad in Haryana state, followed by Binnie's and Uncle Chips in 1988/89 at Noida in Uttar Pradesh. Since the reforms on FDI, the potato chip segment has grown from just 4 or 5 companies in 2003 to about 30 Indian and multinational companies involved in the manufacture of potato chips, flakes, french fries, and so on. Some of the big names in the organized sector include PepsiCo, Frito Lay India, Haldiram, Potato King, Balaji Wafers, and McCain India. The success story of these players tempted other players to enter the market, including Gee Pee Foods, ITC, Little Bee Impex, Merino Group, and others (Singh 2010). Table 6.1 shows potato processing volume and share of major organized Potato Processors Companies (PepsiCo, ITC, Balaji, Haldiram, and so on) in India. PepsiCo has installed the largest processing capacity and accounts for about 47 percent of the total processed potato in 2011.

Potato is now the most widely processed commodity in India. The Central Potato Research Institute (CPRI) estimates that about 8–10 percent of the production is processed. Potato chips form the dominant category of potato products, accounting for 60–80 percent of the potato snack business and accounting for over 60 percent of the total potato processing capacity in the country. Other processed potato products include fries, potato flakes, and traditional snacks such as *Tikkis* and *samosas*. PepsiCo India is credited with pioneering the organized snacks market in India and have remained a leader in this category. Among all

	Installed processing capacity								
Company	2006	2011	Actual in operation in 2011						
PepsiCo	80,000	150,000	130,000						
ITC	0	50,000	33,000						
Balaji	20,000	50,000	38,000						
Haldiram	10,000	22,000	22,000						
Parle	0	50,000	15,000						
Total	110,000	322,000	238,000						

Table 6.1 Inst	talled potato	processing c	apacity (	(MT	) in I	ndia
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processed potato products, it is estimated that there is more competition in chips where both multi-national companies and domestic players like Haldirams, Balaji Wafers, and Prakash Snacks are battling for market share. However, according to the industry estimates, PepsiCo is a clear leader in the potato chips segment where it occupies about 60 percent of the market compared to ITC, which occupies 8 percent (Mukherjee 2015). PepsiCo leads in overall packaged snacks segment with more than a 50 percent of market share, compared with ITC's 16 percent. And this is after ITC gained share in finger snacks where it now enjoys a 27 percent share compared with PepsiCo's more than 46 percent (Mukherjee 2015). French fries is the second most popular processed product and McCain Foods is understood to hold a significant share of the market.

Potato is the most consumed among non-cereal foods and its per capita consumption is increasing. Demand for potato comprises of table potato, demand for processing, and exports. Average annual potato consumption in the country was 21 kg per person whereas the per capita consumption of West Bengal and Uttar Pradesh states was 43 kg and 35 kg a year, respectively (NSSO 2011). Potato per capita consumption has shown a generally upward trend, more significantly in rural households where it increased from about 14 kg in 1987/88 to 20 kg in 2009/10. In urban households the consumption grew at a lower rate from about 14 kg to 16.6 kg over the same period. However, the urban potato consumption is probably under-estimated as it does not account for the increasing non-home consumption of potato products served by fast food chains (mainly fries) and processed potato chips (NCAER 2014). About 68.5 percent of potato is consumed as a vegetable. Potato processing sector accounts for between 8 and 10 percent and has shown immense growth in the recent past. About 0.28 percent of potato is exported. Wastage in potato due to postharvest losses is estimated at 9 percent (Jha and others 2015). About 10 percent of production is retained as seed (SFAC 2012) (table 6.2).

India is the second largest producer of potato in the world. Potato could be regarded as the most important vegetable crop in India, and the third most important food crop in the world in terms of production, after rice and wheat. In 2013/14, area under potato was 20 million ha, while the total production was 377 million ha. The four leading producing

Potato Use	In Million MT	% Share of Total Production
Processing	2.67	8.2
Seed	3.42	10.51
Post-Harvest losses	4.07	12.50
Exports	0.09	0.28
Table consumption	22.3	68.51
Total Production	32.55	100.00

Table 6.2 Break-	up of Potato	Use and	Consumption	(average	2007-2009	)
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Source: CPRI, Shimla as reported in SFAC 2012.

countries: China, India, Russia, and the United States—accounted for more than 50 percent of the global production. India and China alone accounted for about 30 percent of the global production (table 6.3). Other major potato producing countries include Germany, Ukraine, Poland, Belarus, Netherlands, France, United Kingdom, Turkey, and Islamic Republic of Iran (FAOSTAT 2015).

Table 6.3 Area, production and yield of potato in major producing countries (2013–14)

Major countries	Area (million ha)	Production (million MT)	Yield (MT/ha)
China	5.6	95.9	17.1
India	2.0	45.3	22.8
Russian Federation	2.1	30.2	14.5
United States	0.4	19.8	46.6
World	19.3	376.5	19.5

Source: (FAOSTAT, 2015)

Uttar Pradesh and West Bengal account for about 50 percent of the sown area and 60 per-cent of potato production in the country (table 6.4). The yield in the two states is higher than the average yield in India, with West Bengal having relatively higher yield compared to Uttar Pradesh. Other major potato growing states are Uttar Pradesh, West Bengal, Bihar, Punjab, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Himachal Pradesh and Assam. Figure 6.1 presents the area, production, and yield for potato in India over the period 2004 to 2013. During this period, the area under potato increased from about 1.5 to 2 million ha, while production increased from 27.9 million MT to 45.3 million MT. Most of the increase in pro-duction came from the increase in area, while yield improvement over the study period was marginal.

	Area (million ha.)			Produ	Production (million MT)			Yield (MT/ha.)		
Year	Uttar Pradesh	West Bengal	All India	Uttar Pradesh	West Bengal	All India	Uttar Pradesh	West Bengal	All India	
2010/11	0.60 (32.4)	0.37 (20)	1.86	3.6 (32.1)	13.4 (32)	42.3	24.4	33.0	22.7	
2011/12	0.57 (30)	0.38 (20)	1.91	4.  (34.0)	9.7 (23.4)	42.5	24.9	25.7	21.8	
2012/13	0.56 (28)	0.39 (19.4)	1.99	14.4 (32)	11.4 (25.1)	45.3	23.9	30.0	22.8	
2013/14	0.56 (28)	0.41 (21)	1.97	3.8 (33)	9.0 (22)	41.6	24.4	21.9	21.0	
2014/15	0.60 (22)	0.41 (15)	2.69	3.  (29)	12.0 (26)	45.95	21.7	29.1	22.2	

#### Table 6.4 Area, production and yield of potato in major producing states, 2010/11-2014/15

Source: (NHRD 2015)

Note: Figure in parenthesis is percent share to total

Production million mt



Yield tonnes/ha

About 75 percent of the cold storage capacity in India is used to store potatoes. There has been a steady increase in the number and capacity of cold stores in the past decade. The number of cold storages in 2004 was 4,748 with a capacity of 19.5 million MT, which increased to 6,891 in 2014 with a capacity of 31.8 million MT. The main potato growing states, Uttar Pradesh and West Bengal, account for over 60 percent of the cold store capacity. Uttar Pradesh alone has 2176 cold storages with combined capacity 13.63 million MTs against total potato production of 14.31 million MT. These are mostly concentrated in Agra,

Area million ha

Meerut, Firozabad, and Baduan districts. Cold storage capacity in Uttar Pradesh has seen a steep rise from 1.08 million MT in 1979/80 to 13.63 million MT in 2014/15. In particular, Agra district alone constitutes about 7 percent of India's cold store capacity (Department of Agriculture and Cooperation 2011). The main reasons behind rapid spread of CS facilities in Agra include: access to electricity due to proximity to the golden triangle; rapid increase in potato production in Agra in the 1990s and 2000s; rapid growth in demand for potatoes in the off-season near Delhi as the size of the city has expanded and incomes have increased. West Bengal ranks second with 502 cold storages, having combined capacity of 5.90 million MT as against 10.20 million MT potato production during 2014/15.

Potato prices are rising and increasingly volatile. More than 80 percent of the potato crop is grown in the winter season (Rabi) under irrigation. Production in the rainy season (Kharif) takes place mainly in Karnataka, Maharashtra, Himachal Pradesh, Jammu and Kashmir and Uttaranchal. The seasonality of potato production is reflected in the prices. Figure 6.2 presents the farm-gate price of comes to the market in January through February. Prices continue to be low until April. Prices start to increase from April to October and that is the time when most of the potato is marketed. In addition, potato prices are increasingly volatile which indicates value chains are increasingly facing challenges in meeting demand.



Figure 6.2 Monthly wholesale price of potato at Agra Market, 2005-15

Source: (NHRD 2015)

# Comparative analysis of processed and table potato value chains

The objective of the comparative analysis of processed and table potato value chains is to draw lessons on how policies affect outcomes in the agribusiness sector. In particular, the analysis examines how the major policy change of delicensing and allowing FDI in 1991 has shaped investments and growth in the potato processed segment and how these lessons may inform policy debate on other segments of agribusiness-for example, FDI in modernized food retailing. There are many value chains for table potato. For the purposes of this study the most advanced table potato value chain was selected to ensure a useful comparability with processed potato value chain in terms of investments and production technology as well as postharvest management. A salient feature of the most advanced table potato value chain is that the retailing is done through modern food retail outlets such as supermarkets. The value chain analysis was conducted in the major potato growing states of Uttar Pradesh and West Bengal. These states account for about 50 percent of the sown area and 60 percent of potato production in the country. Furthermore, potato yields in the two states is higher than the average yield in India, with West Bengal having relatively higher yield compared to Uttar Pradesh. The specific study locations are Hooghly in West Bengal and Agra in Uttar Pradesh.

#### Processed potato value chain

The processed potato value chain is based on a multinational processor that vertically coordinates the entire chain and links farmers with input markets, insurance markets, while providing price insurance. In order to meet the requirement of specific potatoes for processing, the processor is working closely with farmers in the states of Punjab, Maharashtra, Tamil Nadu, Karnataka, Gujarat, Haryana, Madhya Pradesh, Bihar, Uttar Pradesh and West Bengal. The chain is vertically coordinated, largely based on trust and developing long term relationships with farmers rather than formal contracts. Currently, more than 24,000 farmers are participating in this chain of which about 60 percent of the farmers are small and marginal. Under this model support is provided to farmers in terms of supply of high-quality seeds, technical knowledge, linking farmers with financial markets (commercial banks) to obtain loans, facilitating crop and weather insurance along with assured buy-back of produce at pre-determined and agreed prices. The objective is to provide all encompassing support to farmers to enable them to meet the quality requirements while smoothing their incomes through linkages with insurance markets for production risks. The processor insures farmers against price risk. The linkages with farmers is implemented through identified cooperatives or locally evolved farmers' organizations or lead farmers in the area. These farmer organizations identify suitable farmers who can meet the quality requirements. The processor procures potatoes as per the price agreed in advance, and in addition offers premiums to encourage better performance in terms of quality of potatoes.

#### Major actors

The following are the major actors in the processed potato chain. The *processor* has an agreement with local vendors who in turn link with the farmers. The terms and conditions are specified, including volume to be supplied, quality parameters, base price and incentives for vendors and farmers, and so on. The processor provides quality potato seeds to the farmers. Also, the processor works with input companies, financial agencies, and extension agencies to provide other inputs such as credit and loans. The processor procures potatoes from farmers at the terms specified at the beginning of the season. Vendors in turn have informal arrangement with farmers in vicinity. Vendor-farmer links are purely based on trust, as there is no written/formal arrangement. The vendors have a role that involves networking wit famers, training, monitoring, and importantly providing credit for seeds and chemicals to the farmers. Vendors also have to invest in postharvest activities like grading, sorting, packaging and transporting up to truck point. *Farmers* undertake production of processed potato as per the norms specified by the processor and deliver the produce to vendors at the farm or truck point at pre-agreed contract price. Once the potatoes reach truck point, the processor transports produce to either a processing plant or contracted cold storages. Input companies such ensure supply to quality input to the farmers. *Banks* provide soft loans to farmers or vendors for seeds, chemicals, and so on. *Cold-store owners* in the vicinity have contract with the processor to ensure partial or full use of the cold store for storing potatoes to be used for processing.

#### Primary production

Seeds are the major component of cost of production, but processed potato seed was cheaper as compared to table potato seeds available in the market. This is because the processor provides seeds (high-quality proprietary seeds) at a discounted price on Rs 2400 per quintal. The processor also provides standard chemical kit to the farmers at a discounted price of Rs 3960 per acre. Average fertilizer dose for the farmers in study area was 1.06 MT/ ha at a cost of Rs 9,900/ha. Average cost of cultivation was Rs 1,33,164 per ha. Average productivity of processed potato in study area was found to be 26 MT/ha. Based on the average productivity, average margin in 2014/15 realized by collaborative farmers was Rs 74,837/ha. The detailed costs breakup is given in table 6.5.

#### Risk sharing and financial services

Production as well as price risk is lower for farmers linked with processors.<sup>1</sup> Production risk is minimized because extension agents are working closely with farmers to monitor the crop for disease outbreak and also use weather information to advice farmers. Furthermore, there have been efforts to link the farmers with insurance companies to mitigate

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<sup>&</sup>lt;sup>1</sup> Punjabi 2008.

Cost Components	Rs Per ha	Per ha (%)
Seed	39375	29.6
Chemicals	30019	22.5
Fertilizers	9900	7.4
Machineries	4545	3.4
Irrigation	1875	1.4
Labor	47450	35.6
Total Cost	133164	

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Source: Survey data

production risk. The processor has tie-ups with insurance companies like National insurance and the Industrial Credit and Investment Corporation of India which provide weather insurance. The prices are pre-announced ahead of the planting season to so farmers can make more informed decision about area under potato crop. For example, in 2014/15 the processor purchased potatoes from the farmers at pre announced price of Rs 8 per kg. Access to finance is critical for potato as it is capital intensive and requires the purchase of large quantities of bulky seed and the application of high-cost inputs. Weak access to credit leads to low working capital, little production technology, and low yields. Without access to credit small-scale farmers find it difficult to compete in potato production (Lutaladio and others 2009). The processor has linked vendors with banks, including State Bank of India to provide loans at competitive rates and the loans are passed on to farmers to purchase seeds and chem-icals. Through these linkages farmers that had been crowded out of credit market are able to obtain credit at competitive rates.

#### Vertical coordination

The processed potato chain exhibits strong vertical coordination. The vendor is a key player in the vertical coordination arrangement. Vendor is normally a local person hired by the company as a liaison person between farmers and company. All information in the chain is passed through the vendor and the chain is relatively short compared to table potato because the vendors and processors are the only agents between farmers and consumers. The vendor also ensures availability of seeds and other inputs at the farm level and is involved in monitoring the crop along with the company agronomists (Punjabi 2008). Furthermore, the processor coordinates with different stakeholders. The processor develops its high-quality proprietary planting material at its in-house facility. It has developed food chain partnership with agro-input companies for developing standard tool kit for farmers to avoid farmers from being cheated through spurious products. It has a food chain partnership advanced plant

protection guidance focusing on effective late blight management. And the processor also has a team pool of experienced agronomists to provide extension advice.

#### Investments

**Research and development.** One of the major challenges the processor faced when it entered the processed potato industry was access to quality seeds for processed grade potatoes. The key challenges were limited research on processing varieties and the performance of released varieties. Although indigenous processing varieties were available, their performance was low. Furthermore, the regulatory environment restricted importing varieties used for processing. Until the 1990s, most of the research at the CPRI focused on varieties meant for table purpose only (Pandey and others 2009). None of the 31 Indian potato varieties released by the CPRI in the country since 1958 were able to meet the standards for processing when processors became active in India in the nineties. (Wustman and others 2011). Atlantic and Lady Rosetta varieties had been widely recognized in the United States as best performing varieties for chip making, but there were restrictions on imports of seeds of these varieties. To overcome the challenge, the processor partnered with the CPRI and developed new varieties of processed potatoes.

The investments in research and development included testing the varieties in different locations and developing specific package of practices for different locations (Chaturvedi 2007). Furthermore, the processor was able to obtain special permission to import the Lady Rosetta and Atlantic varieties for the purpose of breeding with local varieties—in collaboration with the CPRI. The new varieties were released to farmers after extensive trials and a package of agronomic practices suitable to the local agroclimatic conditions was developed in collaboration with the CPRI (Punjabi 2008). The package of practices developed includes use of high-quality inputs (seeds, chemicals), standard spacing, fertilizer and chemical dosage, method of harvesting, postharvest management, regular monitoring and to ensure supply of quality planting materials. The breeder and foundation seeds from these facilities are multiplied to produce seeds that are planted by farmers. The main benefits of these investments include ensuring that farmers have access to pure and disease-free seeds which improves yields (which benefits the farmer) while providing quality potato that can be processed (which benefits the processor) without posing health risks to consumers. About nine varieties have been developed through these arrangements.

In addition, the processor has linked up with agrochemical companies to develop advanced plant protection chemical kits. The comprehensive plant protection packages were developed to suit the respective geographies depending pest and disease status. The plant protection kit has led to farmers using the right products. The processor has also invested in new farm equipment like potato harvester, bed harrow, soil chiseler, seed planter, and potato seed grader to lower cost of mechanization for small farmers. Technology of postharvest management. The processor has invested significantly in developing and collaborating with technologically advanced controlled atmosphere facilities. The following are salient features of this technology. Third, and perhaps most important is the controlled atmosphere technology—which controls not just temperature but also humidity, carbon dioxide and nitrogen—with capacity for induction of ethylene gas, if required, which transforms the facility into ripening chamber. The state of art control systems allows multi-location viewing and control of the storage parameters. The sensors in the storage computerized, and based on the specified parameters, the computer will automatically control all parameters. Only processed potatoes are stored under this technology—with specialized sorting cum cleaning machine, telescopic conveyors, space-finder, and so on, handling equipment and the humidification system, chlorpropham (CIPC) fumigation system, and the centralized control system. Furthermore, unlike traditional cold storages where thermocol and rice husk is used as insulating agents, this technology relies on polyurethane foam for better insulation and efficiency.

**Processing.** On processing, the processor made enormous investments in processing facilities over time and the success of these investments led to further capital injections by both multinational and local companies such that the processed potato industry has now become a big segment of food processing. As a global food and beverage company, the processor is dedicated to producing the safest, highest-quality and best-tasting beverages and foods in every part of the world. The processor observes both its internal as well as external standards and procedures for food safety. It has received numerous certifications, including by (1) Australia's TQCSI, which confirms that products are manufactured in a food safety environment and the manufacturing process has adequate controls to track products; (2) the American Institute of Baking, which is one of the best auditing bodies for confirming process and product safety; (3) ISO 14000, which confirms that the manufacturing process ensures environmental safety; and (4) U.S. Occupational Health and Safety Assessment Series (OHSAS) 18001.

#### Table potato value chain

#### Major actors

The table potato value chains in Uttar Pradesh and West Bengal are very similar in terms of the actors except that markets in Uttar Pradesh are regulated by the state while in West Bengal they are not. The main players in the chain are farmers, traders in the primary *mandi* (Hooghly in West Bengal and Agra in Uttar Pradesh), cold stores in production areas, traders in secondary *mandi* (Delhi/Kolkata) and supermarket procuring agents. The key actors and the roles they perform are described as follows. *Farmers* engaged in potato production in Agra/Hooghly district sell their potatoes to traders in Agra/Hooghly Markets. Farmers also engage in storing the crop in cold storage. Basic grading, sorting, based on size is done at farm level. *Cold storage owners* in Agra and Hooghly undertake storage of

potatoes owned by farmers or traders in the region. Potatoes are stored in cold storages from February/March to October/November. The cold storage owners offer several services to the farmers in order to ensure the operation of the cold stores at full capacity. Many coldstore owners tie up with traders and *mandis* to sell the potatoes at the premises of the storage itself. Also, they extend credit to the farmers to ensure that the cold store is used to maximum capacity. This credit is in turn extended by banks to cold storage owners as working capital or collateral against stocks or building. Commission Agents at Primary market (Agra) are engaged in sale of fresh potatoes to the traders in Agra/Delhi and other markets. There are no commission agents in Hooghly market because the market is not regulated. Unlike other commodities, potatoes are mostly traded at cold storages and only limited volume is traded from primary mandis like Agra or Hooghly. The traders of primary markets at Agra/ Hooghly purchase potatoes from farmers and sell to traders/Commission Agents in secondary markets in Delhi/Kolkata. Traders in primary markets also engage in storing potatoes to capitalize on off-season prices. Supermarkets in Delhi and Kolkata ("More" and Big Bazar" are prominent supermarkets in both cities), engage in procuring potatoes from the primary markets in the production area, thus minimizing the intermediaries and lowering the costs in the chain. They engage in sale of commodities to the customers in the cities through supermarket stores. The supermarkets in Delhi are buying directly from the traders in the production region in Agra, hence bypassing the trader's/commission agents in Delhi. In the case of Kolkata, some supermarkets are purchasing from the wholesale markets in Kolkata. However, because markets are not regulated, there are no registered commission agents. Hence only the traders in Kolkata are engaged in the supermarket chain for Kolkata.

#### Primary production

Although there is a fair amount of similarity in the cost of production across states, a closer look at the detailed breakup indicates significant differences in cultivation practices. Farmers in Uttar Pradesh use their own seeds while farmers in West Bengal purchases it mostly from Punjab. As reported by Kumar and others (2004), West Bengal is not a traditional seed belt for potato because of agroclimatic conditions. It depends on other states for potato seeds. According to Central Potato Research Institute, West Bengal is entirely dependent on its seed requirement to from north mainly from Punjab (CPRI 2007). Therefore, the cost of seeds per hectare in Uttar Pradesh and West Bengal is Rs 31,965 and Rs 57,226 respectively, implying that almost 47 percent of total cost of cultivation for table potatoes in West Bengal is due to seeds only whereas in Uttar Pradesh this cost is about 28 percent only. Fertilizer and chemical pesticides cost per hectare was significantly higher in Uttar Pradesh as compared with West Bengal. In Uttar Pradesh and West Bengal, per hectare cost of fertilizers is Rs 24,659 and Rs 11,531, respectively. Cost of chemical pesticides per hectare is Rs 2,544 and Rs 4,206 respectively in Uttar Pradesh and West Bengal. An important observation is that the use of machinery is significantly higher in Uttar Pradesh accounting for about 25 percent of total cost of production whereas in West Bengal it is less than 4 percent (figure 6.3).



Figure 6.3 Percentage breakup of cost of cultivation in Uttar Pradesh and West Bengal

Source: Survey Data

The postharvest management services provided by farmers includes grading, sorting, bagging, loading, and transportation to cold storage and cold storage services (through rental). Farmer's postharvest costs are higher in Uttar Pradesh (Rs 2750/MT) as compared to West Bengal (Rs 1972/MT). As shown in figure 6.4, the cost for grading and sorting and bagging are higher in Uttar Pradesh along with the cost of cold store rental. The cost of bagging is higher because of the type of bags used. Mostly jute bags were used in Uttar



Figure 6.4 Postharvest cost incurred by farmers in Uttar Pradesh and West Bengal (Rs/MT)

Source: Study Survey

Pradesh which are relatively more expensive while Hessian bags or Mesh Bags were being used by farmers in West Bengal, mostly because of lower price.

#### Risk sharing and financial services

Farmers bear the production risk as well as most of the price risk. As in the case of all agricultural commodities, the price of the commodity spikes and crashes during times of low and high production. The conduct of the traders and cold storage owners is quite different in these situations. At the time of a bumper harvest, the traders are not interested in purchasing and holding the crop, as they do not expect to earn significant profits from price rise. In this case, it is mostly the farmers who store in the cold storages in anticipation of better prices. On the contrary, at the time of low production and high market prices, the traders in the production areas aggressively engage in purchase of potatoes with the expectation of high margins during off-season. The conduct of the cold store owners is also very different in the two situations. A bumper harvest assures high-capacity utilization hence they do not have to aggressively engage in procuring potatoes for storage. But when production is low, the cold store owners aggressively purchase to ensure maximum capacity utilization and they would typically offer incentives to farmers—for example, credit.

#### Vertical coordination

There are no strong forms of vertical coordination as the table potato chain relies on spot markets, especially in Uttar Pradesh where markets are regulated by the state. In Uttar Pradesh, potato farmers bring their produce to commission agents of primary (APMC) markets like Agra. Price discovery for fresh potato trade is done by open auction system. Applicable charges such as commission, market access, labor, and so on, are levied on each transaction. Retailers from Agra as well as traders from secondary markets like Delhi participate in the auction. Supermarkets in Delhi purchase from traders of Agra directly, thereby bypassing the traders at Delhi. Supermarkets operating in Delhi have a distribution center where they undertake grading and sorting before shipping the produce to the retail outlets. The chain of marketing fresh potatoes is somewhat different in West Bengal because the markets are not regulated by the state. Potato farmers in Hooghly sell their produce to local traders in nearby markets. Since traders are not required to register with the markets, even small traders can procure and sell from the markets in Hooghly and Kolkata. Price dis-covery is through negotiation only. The Agricultural Marketing Board does not have much control on potato trade in West Bengal. Supermarkets in Kolkata are in a nascent stage. Cur-rently, they have not invested in distribution centers. Traders in Kolkata perform grading, sorting, packaging and sometimes transportation to the supermarket's retail outlets. In both the states, about 20–30 percent of the potatoes are sold as fresh potatoes right after harvest during the months of February and March, while the rest goes through cold storage.

#### Investments

**Research and development.** The CPRI is a leading research institute of Indian Council of Agriculture Research (ICAR) charged with undertaking research on potatoes in the country. The key mandate of the CPRI is to undertake basic and strategic research for developing technologies to enhance productivity and to produce disease-free basic seed of different notified varieties developed by the institute. As on November 2013, the CPRI had developed 43 table potato varieties. Kufri Jyoti, Kufri Chandramukhi and Kufri Pukhraj are the main potato varieties grown in West Bengal. Kufri Jyoti is grown in about 80–85 percent of the area followed by Kufri Chandramukhi and Kufri Pukhraj. Kufri Bahar is the main variety planted in Uttar Pradesh. Thus for the table potatoes, the main agency investing in research is the Government of India.

**Production technology.** The main technology at the production stage was the heavily mechanized potato production in Uttar Pradesh. Progressive farmers engage in purchase of agricultural machinery. Often times, government subsidy is available for the purchase of agricultural equipment. Further, agri-equipment dealers and service providers who provide machinery for hire, inform farmers about the potential benefits of farm equipment. In addition, farmers are using inputs purchased from dealers of agrochemicals.

Technology of postharvest management. There is not postharvest management of table potatoes other than cold storage. However, in the existing cold stores, the technology is not very advanced. Some supermarkets have invested in distribution centers and cold stores, but the investment in technology is minimal. More importantly, the supermarkets have not undertaken any significant investment in developing and improving backward linkages and they also do not have any vertical coordination with farmers. Instead they rely on the same production as in the traditional table potato chain.

Marketing. Markets in both states have weak infrastructure. The situation is much worse in West Bengal as there are numerous small markets, whereby even the basic infrastructure is not available. Supermarkets have invested to develop centralized procurement center which would include weighing, grading and sorting facilities—and instead rely on markets with poor infrastructure.

# Lessons for stimulating agroprocessing with strong backward linkages

Develop public-private partnerships that have strong backward linkages with farmers. But such partnerships could only be scaled up if a regulatory environment that allows unfettered vertical coordination is developed—because that would help align the incentives of various players in agricultural value chains. The multinational potato

processor invested in advanced forms of vertical coordination with strong backward linkages that have enormously benefited the farmer in many ways. Coordination systems have far-reaching effects on performance of supply chains. A typical supply chain would include input supply, farm-level production, postharvest handling such as grading and standardization, assembling and bulking of commodities, processing, and retailing to consumers. Each stage involves a transaction in services or physical transformation. There are many ways to organize transactions. The table potato chain operates through spot markets where buyers and sellers have little or no coordination arrangement and the terms of a transaction are negotiated on the spot and physical delivery also takes place on the spot. The trader goes to an APMC market to buy potato, without commitment to purchase from any particular seller. A transaction takes place if the buyer finds produce of suitable quality and agrees terms with the seller. Delivery takes place immediately and there would be no commitment for a repeat transaction. On the other hand, the processed potato chain is vertically integrated. Parties agree on terms of a transaction, for example price, quality parameters, and volume before engaging in a transaction—in this case before even planting takes place, which is an advanced arrangement. It is really a "co-production" model where the processor provides inputs such as planting materials and the farmer provides land and crop management. Risk sharing is an integral part of these arrangements, both production and price risk. For these arrangements to succeed the parties must have same understanding of the terms of a transaction, including verifiable quality attributes that are better described using grades and standards. Without grades and standards, the ex-post transaction costs of enforcing contracts could be prohibitive leading the market to revert to spot transactions. The most useful grades are those that sufficiently convey all the information about quality of produce. Grades and standards have formed a basis for rewarding better quality production and better handling practices. For grades to work as incentives they must be associated with premiums sufficient to at least compensate the cost of production incurred to attain the grades., low technology of postharvest management, more wastage, and so on.

Vertically coordinated value chains are more remunerative to farmers compared to spot markets that are encouraged by the APMC regulatory framework. Farmer in the processed potato chain receive better margins. The cost of production per hectare for table potato in Uttar Pradesh, table potato in West Bengal, and processing potato in West Bengal was calculated to be Rs 1,15,733 Rs 1,20,376 and 1,33,163 respectively. Comparatively, the yield for table potato in Uttar Pradesh was 35 MT/ha, while the yield for table and processed potato in West Bengal was around 26 MT/ha. Therefore, we benchmark table potato using the higher yields and lower cost of production in Uttar Pradesh—and this is to ensure that the comparisons take the best outcomes on costs and yields in table potato. The processors pre-announced prices in 2014/15 was Rs 8000 per MT, whereas information from farmer survey suggests that average market price for table potato in Agra (Uttar Pradesh) in 2014/15 was 4189 per MT. The value of production for farmers in the processed chain was Rs 2,08,000/ha. The comparative figures for table potato farmers in Uttar Pradesh

was Rs 145777/ha. Based on the cost of production and price realization, the gross margins accounting for average yield for processed potato farmers was Rs 74837/ha, while for table potato farmers the grow margin was Rs 30044/ha respectively—which is about 50 percent lower than in processed potato.

Farmers in vertically coordinated value chains have better access to input markets, production technology, finance, risk-sharing, technology of postharvest management, and remunerative output markets. Farmers in the processed potato chain have bet-ter access to financial services such as credit and insurance. Production risks in processed potato are mitigated by (1) extension agents are working closely with farmers to monitor the crop for disease outbreak and also use weather information to advice farmers; (2) link-ing the farmers with insurance companies to mitigate production risk. The processor has tie-ups with insurance companies like National insurance and the Industrial Credit and Investment Corporation of India which provide weather insurance. The prices are pre-an-nounced ahead of the planting season and therefore farmers are insured against price risk and can also make more informed decision about area under potato crop. For small farmers in potato production, access to finance is critical to meet working capital requirements because potato cultivation requires the purchase of large quantities of bulky seed and the application of high-cost inputs. Weak access to credit leads to low working capital, little production technology, and low yields. The processor has linked vendors with banks, including State Bank of India to provide loans at competitive rates and the loans are passed on to farmers to purchase seeds and chemicals. Through these linkages farmers that had been crowded out of credit market are able to obtain credit at competitive rates. In addition, farmers have been better connected with input markets for agrochemicals, provided with disease-free planting materials, and have access to better technology of postharvest management.

The policy reforms which allowed 100 percent FDI in food processing enabled the processer make enormous investments in potato processing, which then stimulated investments by other players-including competitors-in research and development of planting materials, farm machinery for potato production and handling, technology of postharvest management, processing facilities, and so on. On research and devel-opment, the processor partnered with the CPRI and developed new varieties of processed potatoes. The investments in research and development included testing the varieties in different locations and developing specific package of practices for different locations. In addition, the processor developed package of practices developed includes use of high-qual-ity inputs (seeds, chemicals), standard spacing, fertilizer and chemical dosage, method of harvesting, postharvest management, regular monitoring and to ensure supply of quality planting materials. On technology of postharvest management, the processor has invested in controlled atmosphere technology -which controls not just temperature but also humidity, carbon dioxide and nitrogenwith capacity for induction of ethylene gas, if required, which transforms the facility into ripening chamber. On processing, the processor made enormous

investments in processing facilities over time and the success of these investments led to further capital injections by both multinational (figure 6.5) and local companies such that the processed potato industry has now become a big segment of food processing. As a global food and beverage company, the processor is dedicated to producing the safest, highest-quality and best-tasting beverages and foods in every part of the world. The processor observes both its internal as well as external standards and procedures for food safety. It has received numerous certifications, including by (1) TQCSI (Australia), which confirms that products are manufactured in a food safety environment and the manufacturing process has adequate controls to track products; (2)

# Figure 6.5 Approved FDI inflows in food processing



Source: Prepared from data from Department of Industrial Policy and Promotion (DIPP), Government of India

American Institute of Baking (United States), which one of the best auditing bodies for confirming process and product safety; (3) ISO 14000 certification, which confirms that the manufacturing process ensures environmental safety; and (4) Occupational Health and U.S. Occupational Health and Safety Assessment Series (OHSAS) 18001.

Develop a program to support unorganized processing segment to observe quality and food safety standards—which provides important public goods, scale-up, become attractive for organized investments, and generate inclusive growth and better jobs than it is currently providing. The processor in the case study of potatoes applies technology that is not available to the unorganized sector. In addition, the processor observes food safety standards that the unorganized sector is probably not aware of and not required to apply because they are unregistered. The unorganized sector is a very large part of agroprocessing.

		Organized secto	or	Unorganized sector			
	2000/01	2011/12	Annual growth (%)	2000/01	2010/11	Annual growth (%)	
Factories/enterprises	58,000	91,000	4.12	14,050	14,030	-0.01	
Employment	3,992,000	5,447,000	2.87	27,897	25,007	-1.09	
Fixed assets (Rs million)	1,286,181	26,595,763	6.83	687,455	1,177,244	5.53	
Output (Rs million)	3,913,677	8,948,691	6.82	1,205,372	1,623,245	3.02	
Input (Rs million)	3,280,456	8,087,151	9.55	742,933	968,445	2.69	
Gross value added (Rs million)	681,889	1,511,575	7.51	459,173	649,734	3.53	

#### Table 6.6 Structure and size of agroprocessing industry (base year 2004/05)

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For example, in 2011 there were about 91,000 factories or enterprises in the organized sector compared to over 14 million in the unorganized sector, which translates to about 100 times more units in the unorganized sector (table 6.6). But the organized sector is larger by more than 26 times in terms of fixed assets, more than 89 times larger in terms of output, more than 8 times larger in terms of value of inputs used. Further-more, the two segments are almost equal in terms of gross value added. In terms of jobs, the unorganized sector employs more people-about 25 million compared to about 5.5 million in the organized sector, although the jobs in the organized sector are likely to be better jobs. The unorganized sector caters to small towns and centers where incomes are relatively low, food safety standards are low, and the burden of malnutrition. There are important public goods to be derived by supporting the unorganized food processing sector, including food safety and nutrition enhancement through not only observing food quality standards but also micro-fortification of processed products coming out of the unorganized sector. There-fore, a program of support is needed to support this segment so that it could also scale-up, become attractive for organized investments, and spur inclusive growth and better jobs than what is currently providing. However, evidence from other countries suggest that formaliza-tion alone would not guarantee food safety. Therefore, a program to support the unorganized sector should include transfer of appropriate technology and assets, as well as capacity build-ing of not only the processors, but also their supply chains—including farmers, aggregators, and consumers.

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# Chapter 7

# Promoting inclusive value chains for modern food retailing

# Structure, conduct, and performance of modern food retailing

Modern food retailing accounts for only about 9.8 percent of the food retailing segment (both primary and processed agriculture products).<sup>1</sup> Global experience indicates that modern food retailing could bring many benefits. For example, in Brazil modern retailers have established direct backward linkages with farmers and improved the value chains in many ways, including providing incentives for agents to invest in postharvest management (Farina 2002). Similar cases about in countries such as South Africa, Kenya, China, and Thailand. There is evidence that modern retailing leads to adoption of grades and standards and improved cultivation and handling practices leading to lower food loss. Many of these benefits are due to direct procurement relationships with farmers, farmer cooperatives, and large wholesalers (Reardon and others 2005). In India a large part of food retailing is in the traditional unorganized segment, which is basically small family owned shops. While a significant majority of the share of retail sales continues to be through traditional retail outlets, the share of modern retail has risen over the last two decades, but it still lags far behind many countries at the same level of development—middle-income countries. Modern food retailing in India started growing in the past two decades due to broader growth in the economy. Modern food retailing accounts for only about 9.8 percent of the food retailing segment (both primary and processed agriculture products) (figure 7.1). In contrast the modern segments share in food service (restaurants, hotels, and so on) is much higher at about 13.3 percent of the food

<sup>&</sup>lt;sup>1</sup> As of FY14; derived using the National Account (GDP) Statistics in "India Retail Report, 2015" by Images Multimedia Pvt. Ltd.



Figure 7.1 Share of modern food in overall food retail

Source: Authors compilation

services sector. This could be attributed to the fact that the food services sector does not have regulations that limit flow of foreign capital.

The current models of food retailing do not involve any form of vertical coordination with famers and this could be attributed to lack of knowledge on organizing agricultural value chains and the capital intensive nature of these investments-which means this segment is outcompeted by modern non-food retail. The flow of much needed capital required to expand the modern food retail has primarily been restricted to domestic sources. While Indian businesses have made some investments, they have not developed any forms of vertical coordination arrangements with farmers and instead they've largely relied on existing value chains. Instead they have invested only on the front end modern retail outlets that serve both food and nonfood categories, including clothes, electronics, and automotive goods. There is consensus among managers of these retail outlets that non-food retail is less risky than food retail and it also provides a higher return to capital. In many cases, the modern retail outlets maintain a small share of fresh food produce because that is what attracts customers to the stores. There is also consensus that modern retail in fresh food products comes with high upfront costs of operational expenditures on piloting and developing models of efficient procurement and supply chain, in addition to costs of logistics that must be incurred upfront (World Bank 2014). Non-food retail business is more attractive when faced with high cost of capital and therefore that has been the focus of modern retail outlets in India. The end result is that there have not been much investments in developing models knowledge on organizing agricultural value chains that work in the context of the prevailing regulatory environment. The high capital requirements coupled with high cost of capital in the domestic financial markets makes this segment more attractive for cheaper foreign capital

from multinational companies that have developed successful models of modern food retailing elsewhere that could be curated in the context of the prevailing regulatory environment.

Even the most advanced model of modern food retailing in fresh produce does not exhibit advanced forms of vertical coordination. The most advanced model of modern retailing in fresh produces involves direct procurement from the farm through a collection center set up by the supermarket. Based on interviews with top supermarket retailers, this model is being used in procurement of 80 percent of fresh produce by one of the largest fresh produce retailers. In this model, the retailer would typically procure bulk volumes of widely grown vegetables (okra, leafy vegetables, cauliflower, cabbage, bitter guard, and so on) and fruits. The produce is sourced from farms located close to the consumption centers. And the collection center would be closer to the farmers than a *mandi* to provide incentives for a farmer to sell directly to the collection center. However, the transactions are spot and there is no commitment that the collection center would buy from any farmer in the vicinity and vice versa—no vertical coordination. Other models of modern food retailing include: (1) modern retailers outsources procurement to a consolidator based on agreed quality parameters and pays commission; (2) modern retailer procures from a *mandi*, on a day-to-day basis, through wholesalers that understand the require quality parameters; (3) modern retailer outsources the management of the entire fresh produce supply chain and fees on shelf space in retail outlets.

Therefore, it is not surprising that prices obtained by farmers selling to modern retail chain are not different from what farmers get in a traditional chain. As part of this report we conducted a value chain analysis for onions from Maharashtra. The study team documented five key onion value chains in the study area as discussed below. The first channel involves farmers selling onions in rural markets directly to individual and institutional consumers (for example, hotels). The second channel involved an "aggregator" who is either a group of farmers themselves or independent aggregators that collect onions from farmers the produce and sell in *mandis*. The third channel, which was the most dominant channel, involved multiple mandis. Farmers or aggregators would sell to the Lasalgaon mandi and the onion would then be supplied to Vashi *mandi* and distributed to traditional unorganized retailers. The fourth channel is the "Exporter Chain" where farmers in the Nasik area sell onion in Lasalgaon mandi and the onion is exported directly to the other countries through traders. The fifth channel involves modern retail supermarkets in Mumbai or Chennai. The supermarkets have no backward linkages with farmers and this chain is supplied by the same onions that could have gone to other chains. In fact all chains are not distinguishable at the interface of farmer and mandi. The farmer receives the same prices in all chains and is not aware of where the onions are market after auctioning at the mandi. The distribution of margins and costs in the onion value chains are provided in figure 7.2.



#### Figure 7.2 Margins and costs in onion value chains

However, the modern retail chain provides farmers with second largest share of marketing margins and consumers with lowest retail prices, and this suggests both performance indicators could be improved with vertical coordination. In the modern retail chain involving supermarkets in Mumbai, only the farmer and supermarkets incur costs. The other marketing agents are commission agents and traders, but they are only engaged in coordinating transactions and are paid fees without incurring costs. Farmers incur

about 70 percent of the cost while the supermarkets incur the remaining 30 percent through grading, sorting, bagging, transportation, and storage in retail outlets. But when it comes to margins the farmers get about 40 percent of the chains margins, the commission agents and traders get 7 percent, and the supermarkets get about 54 percent of the margins. In the case of supermarkets in Chennai, the share of total costs incurred by farmers, marketing agents, and retailers are respectively 55 percent, 40 percent, and 5 percent. And the share of total margins are 40 percent for farmers, 20 percent for commission agents and traders, and 40 percent for supermarkets. In the exporter value chain, the share of total costs incurred by the farmer, trader, and the exporter are 38 percent, 14 percent and 47 percent respectively, while the share of margins for each of these agents is 47 percent, 30 percent, and 23 percent, respectively. In the unorganized retail chain, the distribution of costs among farmers, commission agents and traders, and retailers is approximately 62 percent, 25 percent, and 12 percent, while the distribution of margins to these groups is 36 percent, 21 percent, and 43 percent respectively.

## The policy environment

Until September 2012, FDI was entirely prohibited in multi-brand retailing. In September 2012, the government for the first time allowed 51 percent FDI but on several conditions. The key conditions included: (1) a minimum investment of \$100mn must be brought in by the foreign investor; (2) at least 50 percent of the investment brought in must be infused as capital investment in backend infrastructure<sup>2</sup>; (3) at least 30 percent of the value of procurement manufactured/processed products purchased must be sourced from Indian "small businesses" with total investment in plant and machinery not exceeding \$1mn. If the "small business" grows beyond this investment after starting supplies to the Retailer, it would no longer be counted toward the 30 percent requirement; (4) retail outlets may only be setup in and around cities with a population of at least  $1 \text{ mn}^3$ ; (5) as far as fresh agricultural produce is concerned, the government would have first right to procurement and Retailers may only sell these in unbranded form; (6) through the ecommerce channel would be prohibited. Importantly, the policy stated that it was only meant to be an enabling policy with no compulsion on any state government to accept it. Thus, the decision to implement this policy was delegated to the individual states. No foreign retailer made any announcements or investment commitments after the release of this policy, but there was interest in the policy and many investors asked for further clarifications from government. In June 2013, the government made clarifications and released the revised FDI policy August 2013 (box 7.1).

<sup>&</sup>lt;sup>2</sup> Any investment in storefronts would not be counted and backend infrastructure would include processing, logistics, distribution, packaging, quality control, and so on.

<sup>&</sup>lt;sup>3</sup> According to some modern retailers interviewed for this study, limiting setup of stores to only larger towns limits the retailers' ability to buy all grades from farmer, therefore limiting impact. This is claimed to be so because the demand for B and C grade produce is higher in smaller towns.

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#### Box 7.1 Revised FDI policy released in August 2013

- 1. 50 percent of only the initial \$100mn to be invested (as against the overall investment) would need to be invested in the backend. Any further backend investments were left at the discretion of the Retailers
- 2. "Small businesses" from which at least 30 percent of the value of procurement of manufactured/processed products would need to be would include those with investment in plant and machinery of up to \$2mn as against \$1mn earlier. Such company would continue to qualify as a "small business" even after it outgrew this size after starting its relationship with the Retailer
- Investment made in backend facilities even in states that do not decide to implement the FDI policy would count toward the \$50mn required investment
- 4. Those states which agree to implement the policy will not have the flexibility to change the existing conditions prescribed in the FDI policy. They would however be free to impose additional conditions which fall under the purview of the state laws and regulations.
- 5. The decision on which cities these Retailers could operate in and around of was delegated to the states as against limiting these to those with population over Imn earlier
- 6. The 30 percent sourcing requirement from "small businesses" which did not include procurement of fresh farm produce was relaxed to include "procurement from agricultural and farmer cooperatives"
- 7. Karnataka and Himachal Pradesh were added to list of states that had agreed to permit FDI

Furthermore, it was clarified that:

- The entire \$50mn required to be brought in for backend investment would necessarily have to be invested in greenfield facilities. Any amount brought in as investment to buy out or take equity stake in existing backend infrastructure/company would not count toward the 50 percent investment required in the backend.
- Operations of the multi brand entities were required to remain confined to multi-brand retail stores only and would not be permitted to engage in any wholesale trading or B2B activities.
- All stores would necessarily have to be owned and operated by the investing company and no franchised stores would be permitted
- Sales through online channels (ecommerce) by FDI Retailers will not be permitted

The policy on FDI in multi-brand retail include several features that discourage foreign investors. First is the reality that the policy is at the discretion of states and not a national policy. This means a prospective investor would have to deal with different regulatory environment that may change at different times. It creates significant risks for both front-end and back-end investments on efficient supply chains. The requirement for retailers with FDI to own and operate all their stores on their own does not allow them to expand through the franchising route. It is noteworthy in this context that the revolutionary growth of quick service restaurants in India was fueled by the franchising route by foreign brands such as McDonald's and Pizza Hut—involving franchising arrangements with Indian entrepreneurs. The entity that operates front end stores is not permitted to also engage in wholesale activities and even

if a wholesaling entity is housed in a separate company by the same retailer, the wholesaling entity is not permitted to supply more than 25 percent of its sales to the retailer. This limits the leverage that retailers can obtain to expand and drive efficiency in the supply chain by sourcing from their own wholesaling arm located in any state irrespective of its stance on FDI in retail. The requirement to infuse the entire \$50mn mandated for backend investment only in the form of capital investment will not take into account the sizeable operational expenses in piloting and developing models of efficient procurement and supply chains, besides the relatively higher costs of logistics that must be incurred for reliable services (World Bank 2014). The inability to makes sales through ecommerce channels further limits the FDI retailers' ability to establish ICT enabled supply chains with farmers. The requirement to infuse the entire \$50mn mandated for backend investment only for greenfield projects does not allow acquisition of existing facilities or investment in equity stakes in companies owning such backend infrastructure. This not only raises the investment costs but also makes it harder for investors to integrate the traditional unorganized supply chains into the modern retail.

Already doing business in India is not easy as the country ranks poorly in doing business rankings and the policy on FDI in multi-brand retailing further complicates the business climate. Overall India ranks number 142 among 189 countries when it comes to ease of doing business. India is ranked at number 158 in terms of starting a business—any business—and for a foreign investor interested in starting a food retail business that rank would probably be much lower given the requirements of the policy on FDI in multi-brand retailing (figure 7.3). On dealing with construction permits, which would be needed to establish front-end outlets, India is ranked 184 out of 189. On enforcing contracts, which would be needed to work with the national investor bringing the 50 percent of investment cost—among others, India ranks almost at the bottom—186 out of 189 countries.

## Conclusions

Opening up food retailing to multinational companies that have the knowledge to organize agriculture value chains and which come with relatively cheaper capital could stimulate backward linkages that are beneficial to farmers. But efforts must be made to ensure the emerging channels are integrated with and inclusive of the unorganized retail sector. Good lessons could be drawn from reforms that allowed 100 percent FDI in agroprocessing in 1991. The reforms increased the supply of capital to the agroprocessing sector and led to increased investments without creating disinvestment in other sectors. There is no evidence that FDI in agroprocessing displaced the unorganized agroprocessing segment because it has remained a large part of the sector with gross value added almost at part with the organized segment in 2011, while employing more people—25 million people compared to about 5.5 million in the organized sector. There is need to develop inclusive



Figure 7.3 India's position on various "doing business" factors

Source: Doing Business 2015: Going beyond efficiency, World Bank

models of modern food retailing that include the unorganized segment, perhaps first in pilot mode followed by scaling up, but that requires partnerships with entities that have both knowledge and cheaper cost of capital. Many countries have struggled with protecting an indigenous sector from being displaced by foreign investors. There is evidence that many countries in Europe (Belgium, France, Germany, Norway, Scotland, and Spain) had given the small retailer various forms of assistance, including grants, training and retraining programs, and even retirement pensions—in order to integrate with modern retailing or to protect their livelihoods. There is need to develop inclusive models of modern food retailing that include the unorganized segment, perhaps first in pilot mode followed by scaling up, but that requires partnerships with entities that have both knowledge and cheaper cost of capital.

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## Policy and investment priorities

## **Policy priorities**

The historical regulatory environment of the Agriculture Produce Market Committees Act caused long value chains, created information barriers, encouraged spot markets, and discouraged vertical coordination. The cumulative effect has been low investments in postharvest management and agribusiness. The requirement that wholesale trade could only occur at the *mandi* not only created a long and fragmented chain but also barriers to information. The commission agents and brokers along the chain do not take ownership of the produce and instead are paid a percentage of the sales value of the produce. It means they have no real incentives to invest in postharvest management. Furthermore, the commission agents and brokers mainly sell in auction markets where produce is hardly differentiated on any quality parameters. It means these agents could maximize commissions through volume rather than incurring costly postharvest management. The long value chain means that demand signals from consumers would have to be passed through many actors, including commission agents and brokers, before it reached farmers. Long value chains tend to drop information along the way, which makes it harder for farmers to respond to market demands. Another feature of the regulations is that they discouraged contracting between farmers and agribusiness as well as other forms of vertical coordination. All transactions were spot, in the sense that price and other terms of the transaction are discovered at the time of the transaction and delivery is made on the spot. Therefore, farmers were not able to form coordination arrangements that would have reduced transaction costs, improved efficiency, stabilized expectations on price and other parameters, and ultimately increased investments in postharvest management.

Accelerate agriculture marketing reforms to eliminate the monopoly of APMC and promote a unified national market—backed with investments in agriculture marketing

to improve effectiveness of reforms. Several states have delisted fruits and vegetables from the jurisdiction of APMC Act. Madhya Pradesh is perhaps the pioneer to this path of reform when the state delisted fruits and vegetables from the APMC Act in 2012, followed by Assam and Chattisgarh later in 2012. The reform provides for a simple but clear regulatory environment that could open up horticulture marketing to vertical coordination arrangements between farmers, traders, and agribusinesses. It eliminates the earlier confusion in other states where even after allowing direct marketing, APMC's expected traders that bought produce directly from farmers to still pay fees even though trade occurred outside the Committee owned facilities (maandis). However, not all the fruits and vegetables have been delisted in all states—for example, Assam specifically delisted only 23 fruits and 6 vegetables, Delhi delisted only in 3 selected markets, Meghalaya exempted potato from delisting, West Bengal exempted onion and potato from delisting, and so on. On the other hand, there are states which have not reformed their APMC Acts but instead issued certain directives that mimic reforms. There is need to accelerate reforms in states where they have not happened. The reforms could be complemented with investments in various aspects of agriculture marketing to strengthen their effectiveness as opposed to stand-alone reforms.

Ultimately, the reforms should be geared toward a regulatory environment that allows unfettered vertical coordination-because that would help align the incentives of various players in agricultural value chains. This is important because there is evidence that (1) coordinated value chains are more remunerative to farmers compared to spot markets that are encouraged by the APMC regulatory framework; and (2) vertically coordinated value chains provide farmers with better access to input markets, production technology, finance, risk-sharing, technology of postharvest management, and remunerative output markets. The multinational potato processor invested in advanced forms of vertical coordination with strong backward linkages that have enormously benefited the farmer in many ways. Coordination systems have far-reaching effects on performance of supply chains. The table potato chain operates through spot markets where buyers and sellers have little or no coordination arrangement and the terms of a transaction are negotiated on the spot and physical delivery also takes place on the spot. On the other hand, the processed potato chain is vertically integrated. Parties agree on terms of a transaction, for example price, quality parameters, and volume before engaging in a transaction—in this case before even planting takes place. It is really a "co-production" model where the processor provides inputs such as planting materials and the farmer provides land and crop management. Risk sharing is an integral part of these arrangements, both production and price risk. Farmer in the processed potato chain receive better margins. Farmers in the processed potato chain have better access to financial services such as credit and insurance. The prices are pre-announced ahead of the planting season and therefore farmers are insured against price risk and can also make more informed decision about area under potato crop. For small farmers in potato production, access to finance is critical to meet working capital requirements because potato cultivation requires the purchase of large quantities of bulky seed and the application of high-cost inputs.

Weak access to credit leads to low working capital, little production technology, and low yields. In addition, farmers have been better connected with input markets for agrochemicals, provided with disease-free planting materials, and have access to better technology of postharvest management.

A modern food retailing sector can be promoted through policies that crowd-in FDI by multinational companies, which come with relatively cheaper capital, and have the knowledge to organize agriculture value chains and stimulate backward linkages that are beneficial to farmers. There is a clear role for public policy to ensure the emerging channels are integrated with and inclusive of the unorganized retail sector. Good lessons could be drawn from reforms that allowed 100 percent FDI in agroprocessing in 1991. The reforms increased the supply of capital to the agroprocessing sector and led to increased investments without creating disinvestment in other sectors. There is no evidence that FDI in agroprocessing displaced the unorganized agroprocessing segment because it has remained a large part of the sector with gross value added almost at part with the organized segment in 2011, while employing more people—25 million people compared to about 5.5 million in the organized sector. There is need to develop inclusive models of modern food retailing that include the unorganized segment, perhaps first in pilot mode followed by scaling up, but that requires partnerships with entities that have both knowledge and cheaper cost of capital. Many countries have struggled with protecting an indigenous sector from being displaced by foreign investors. There is evidence that many countries in Europe (Belgium, France, Germany, Norway, Scotland, and Spain) had given the small retailer various forms of assistance, including grants, training and re-training programs, and even retirement pensions—in order to integrate with modern retailing or to protect their livelihoods. There is need to develop inclusive models of modern food retailing that include the unorganized segment, perhaps first in pilot mode followed by scaling up, but that requires partnerships with entities that have both knowledge and cheaper cost of capital.

Agribusiness sector can help reduce malnutrition through food fortification. Experience shows that regulations which provide for mandatory fortification are not only the most effective and sustainable, but also provides more equitable access, more potential to reach the majority of the population, offers the industry a level playing field in terms of cost structure, encourages competitive pricing of fortified products, and eliminates need for costly marketing. The choice of delivery options and appropriate targeting is crucial to reach the most vulnerable populations. If food fortification is to have the desired public health impact, there has to be broad coverage, especially coverage of groups where deficiencies are high. Therefore, the choice of an appropriate delivery option should be carefully considered, whether mandatory fortification, voluntary fortification or mixed approaches. Globally 86 countries have legislation to mandate fortification of at least one industrially milled cereal grain. In contrast, voluntary fortification gives the private food industry the option to fortify and fortified products are marketed as "value-added" products rather than just products. Voluntary fortification has significantly lower potential for public health impact as the approach is dependent on industry interest and uptake, consumer awareness, demand and price sensitivity—thus limiting the ability to reach the most vulnerable, especially from the lower socioeconomic status. However, mandatory fortification requires legislation and government commitment and the process may take several years. Therefore, the legislative agenda for mandatory fortification should go hand-in-hand with an interim strategy to promote voluntary fortification.

## Investment priorities

Develop programs to bridge the productivity and investment gaps in various segments of agribusiness—including bovine meat products, vegetables oils and fats, processed rice, sugar, food products. India's productivity is less than MIC comparators in the following segments: bovine meat products, vegetables oils and fats, processed rice, sugar, food products not elsewhere classified, and beverages and tobacco products. And the productivity gaps are significant. The sectors where India's productivity surpasses both the middle-income country average and China and in bovine meat products. Similarly, India faces significant capital investment gaps in in all segments of agribusiness, except vegetable oils and fats. For example, in the segment "bovine meat products" India needs to increase capital investment by 114 percent and 93 percent to respectively catch up with the MIC average and China. If these gaps are bridged the agribusiness sectors would become an important source of jobs. The share of agribusiness in GDP would significantly increase and the overall economy would expand with gains in welfare. The trade balance will be in favor of India as exports would increase and imports would decline.

Agribusiness would make enormous contribution to jobs—by employing 17 percent more people if India could bridge the productivity and investment gaps relative to middle-income comparators—and by employing about 40 percent more people if India catches up with China in terms of productivity and capital investments. India's productivity is less than MIC comparators in the following segments: bovine meat products, vegetables oils and fats, processed rice, sugar, food products not elsewhere classified, and beverages and tobacco products. And the productivity gaps are significant. The sectors where India's productivity surpasses both the middle-income country average and China and in bovine meat products. Similarly, India faces significant capital investment gaps in in all segments of agribusiness, except vegetable oils and fats. For example, in the segment "bovine meat products" India needs to increase capital investment by 114 percent and 93 percent to respectively catch up with the MIC average and China. If these gaps are bridged the agribusiness sectors would become an important source of jobs. The share of agribusiness in GDP would significantly increase and the overall economy would expand with gains in welfare. The trade balance will be in favor of India as exports would increase and imports would decline.

Consider policies that raise the supply of capital to the agribusiness sector without causing disinvestment in other sectors or attract foreign capital. The preceding analysis shows that while growth in agribusiness, fueled by bridging the capital investment and productivity gaps with MICs would expand agribusiness and create many jobs, there is a danger that this would cause disinvestment in other sectors. Such trade-offs could be mitigated if the economy is managed in a way that raises the supply of capital—for example by (1) policies that out-compete other countries in attracting foreign direct investments (FDI) and (2) expanding banking services while providing incentives for savings to increase the level of capital from domestic sources. A good lesson on this is the policy of un-licensing and allowing 100 percent FDI in agroprocessing in 1991. This increased the supply of capital to the agroprocessing sector and led to increased investments without creating disinvestment in other sectors. There is no evidence that FDI displaced the unorganized agroprocessing segment because it has remained a large part of the sector with gross value added almost at part with the organized segment in 2011 while employing 25 million people compared to about 5.5 million in the organized sector.

Develop a program to support unorganized processing segment to observe quality and food safety standards (which provides important public goods), scale-up, become attractive for organized investments, and generate inclusive growth and better jobs than it is currently providing. The organized sector applies technology that is not available to the unorganized sector, and observes food safety standards that the unorganized sector is probably not aware of and not required to apply because they are unregistered. However, the unorganized sector is a very large part of agroprocessing. For example, in 2011 there were about 91,000 factories or enterprises in the organized sector compared to over 14 million in the unorganized sector, which translates to about 100 times more units in the unorganized sector. But the organized sector is larger by more than 26 times in terms of fixed assets, more than 89 times larger in terms of output, more than 8 times larger in terms of value of inputs used. Furthermore, the two segments are almost equal in terms of gross value added. In terms of jobs, the unorganized sector employs more people—about 25 million compared to about 5.5 million in the organized sector, although the jobs in the organized sector are likely to be better jobs. The unorganized sector caters to small towns and centers where incomes are relatively low, food safety standards are low, and the burden of malnutrition. There are important public goods to be derived by supporting the unorganized food processing sector, including food safety and nutrition enhancement through not only observing food quality standards but also micro-fortification of processed products coming out of the unorganized sector. Therefore, a program of support is needed to support this segment so that it could also scale-up, become attractive for organized investments, and spur inclusive growth and better jobs than what is currently providing. However, evidence from other countries suggest that formalization alone would not guarantee food safety. Therefore, a program to support the unorganized sector should include transfer of appropriate technology and assets, as well as capacity building of not only the processors, but also their supply chains—including farmers, aggregators, and consumers.

Consider a program to establish farmer-owned postharvest management assets following successful models in dairy where farmers have been organized to cooperatives and now producer companies that have developed assets in milk processing. There is scope to further expand controlled atmosphere capacity in production areas. But these investments should be a package that includes upgrading the production technology (varieties and management practices) to not only raise productivity and production, but also improve the quality of production. In addition, farmers could also be organized into producer companies (not necessarily cooperatives) that would receive long-term financing to establish controlled atmosphere infrastructure that is owned by producer organizations. This model could borrow a lot from the successes in the dairy sector where even a farmer with one cow could join a village cooperative that has been facilitated by the National Dairy Development Board to invest in pot-production milk chilling. The village cooperative would be a member of a Milk Union that has been facilitated to invest not only in dairy processing, but also in improving the technology of dairy production among affiliated farmers—for example, by providing better genetics through artificial insemination with semen sourced from semen stations owned by cooperatives and providing feed produced by feed manufacturing factories that are also owned by cooperatives.

Consider models of private-public partnerships or productive alliances between farmers and private investors in controlled atmosphere stores as well as agroprocessors. To enable such partnerships to work it would be important to develop a warehousing receipt system for perishables, perhaps building on the experience of potato in West Bengal. In the current model of postharvest management support for apples the has gone to the private investor and the farmer is hardly able to rent the capacity, unless the CA store owner deems storing apples there to be too risky and allows farmers to rent the space. In this case a farmer would be engaging in a business activity that is deemed too risky by an agent that has better market information—which means under current models renting would almost always be unprofitable. However, this could change with models of private-public partnerships (PPP) that guarantee a private investor that a portion of the capacity would be available to an organization of farmers for example, cooperative or producer companies. The PPP agreement would be based on a rigorous analysis of financial models of CA stores to establish, among other parameters, the correct level of guarantee fee payable to the private investor. The government could provide a guarantee through a third party engaged by the government to provide this investment guarantee. To minimize the government actually having to pay the guarantee, efforts should be made to provide incentives to farmers to use the capacity dedicated to their organizations. The warehouse receipt system is an instrument that has worked to incentive farmers to use storage warehouses in the cereal sectors. The receipt allows farmers to trade the produce while it is stored and address their short-term needs for liquidity. Although it is challenging to implement on perishables, there are some successful examples in the potato segment in West Bengal where cold stores are issuing tradable receipts to farmers and traders against the value of potato stored. This model could be replicated in apples.

Any strategy, project, or program to increase productivity and investments in agribusiness should include interventions that lead to a much larger pull effect on primary agriculture than the underlying intersectoral linkages offer. The effects on sectoral contribution to GDP indicate that bridging the investment and productivity gaps with MICs will increase the size of agribusiness by 74.6 percent while primary agriculture increases 2.8 percent. And when India catches up with China, tthe size of agribusiness will double, while primary agriculture will increase by only 10.5 percent. This reflects a small pull effect on primary agriculture, mainly due to weak underlying intersectoral linkages. The job linkages are also modest. Simulations suggest that bridging the gaps with middle-income countries increases agribusiness jobs by 17 percent, while jobs in primary agriculture are increased by 5.2 percent; catching up with China will increase agribusiness jobs by about 40 percent and agriculture jobs by 2 percent. The weak linkages, especially in terms of size of GDP, impose a challenge for programs that seek to increase productivity or expand investment in agribusiness. Such programs would need to stimulate stronger linkages that are implied by the underlying structure of the economy. This would enable farmers to benefit from growth of agribusiness in terms of linking farmers to agribusiness and ensuring that farmers are able to earn better incomes.