CHAPTER 5
AGRICULTURAL VALUE CHAINS

How Cities Reshape Food Systems

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KEY MESSAGES

- Rapid growth of cities is driving change in agricultural value chains—key factors include increased commercial flows of agricultural goods, diet transformation, and the large role of commercial markets in meeting urban food needs.
- Megacities in developing countries are transforming value chains for high-value crops and for traditional staple food crops.
- The "quiet revolution" affecting staple-food value chains is increasing productivity through:
  - Increased investment in technology and modern inputs, including fertilizers and improved seeds, by farmers close to cities.
  - Use of mobile phones by farmers to better position themselves in markets.
  - Greater vertical integration resulting from the growing scale of midstream and retail sections of the value chain—such as cold storage, rice mills, and supermarkets.

POLICY AND RESEARCH NEEDS

- What is the impact of the food value chain segments beyond the farmgate on employment, prices, and food security for both rural and urban populations?
- What role are urban markets playing in shaping agricultural value chains?
- How are evolving agricultural value chains affecting opportunities for small producers?
- How can governments best kick-start changes in agricultural value chains, including through investment in road and communications infrastructure, reliable electricity grids, and agricultural research and development?

Food systems are changing rapidly in developed and developing countries alike.[1] Explosive growth of cities along with the rapid emergence of an urban middle class are driving this transformation of food systems in developing countries.[2] Urban growth leads to larger flows of agricultural produce from rural to urban areas as well as changes in the types of food marketed and consumed. Most urban residents rely on food markets, which provide a significantly higher share of food for urban populations than for rural populations.[3] For many farmers in developing countries, urban food markets are becoming the most important end destination for their produce.

Urban and rural populations in developing countries have significantly different diets—on average, urban populations are both willing and able to spend more money on food. Branded and packaged foods are expanding rapidly in these urban markets. Annual growth rates of retail sales of packaged food products in developing countries are estimated to be much higher than in developed countries.[4] Urban residents also eat increasingly more food away from home (that is, in restaurants).[5] Moreover, in a number of developing countries, richer urban consumers are shifting consumption away from staples toward so-called high-value crops such as vegetables, fruits, dairy, meat, and fish.

The growing population eating "urban diets" combined with increases in rural-urban market flows in recent decades have led to changes in the food supply chains that link producers to urban consumers. First, modern retail—supermarkets run by cooperatives or by the private sector—has emerged rapidly in developing countries. A large body of research explores the impact of modern retail on both consumers and producers.[6] In many developing countries, traditional markets are still the predominant outlet, however. Second, the increasing importance of high-value crops has produced new marketing system structures—such as modern cold storage facilities—that reflect the particular characteristics of these products, as compared to staples, such as perishability.[7] Third, vertically coordinated agrifood chains have improved and expanded, leading to changes in mechanisms for input supply and output procurement.[8]

This research benefited from support provided by the Feed the Future Innovation Laboratory for Food Security Policy, funded by the Bureau of Food Security of the United States Agency for International Development.

Traditional value chains for major crops and staples are changing too. Despite the importance of staple crops, few researchers have looked at the evolution of domestic rural-urban supply chains for these crops as societies become increasingly urban. For example, there are no integrated and cross-country studies of the various segments of the supply chain; nor good estimates of the share of final prices received by farmers as compared to the shares of the other components of the value chain; nor evidence on levels of wastage.

A STUDY OF TRADITIONAL VALUE CHAINS

To better understand how these traditional value chains are responding to urbanization and other drivers, our research team studied the rural-urban value chains that bring two major crops, potato and rice, to the capitals—all megacities—of three Asian countries (Bangladesh, China, and India), as well as teff, a major cereal, to the capital of Ethiopia. Surveys were carried out in the four study countries for each segment of the value chain for these crops to begin to answer questions about the value chain's changing structure, technology adoption, prices, margins, quality, and wastage.[9]

These crops are essential to diets in these countries. Rice is by far the most important staple in each of the Asian countries studied, although the annual quantities consumed per capita range from 160 kg in Bangladesh to 77 kg and 70 kg in China and India, respectively. The consumption of potatoes is much lower than rice, but it is still a major crop in these three countries, with annual consumption at 33 kg per capita in China and 18 kg in India.[10] In Ethiopia, teff is by far the most important cash crop by value and the most important crop in terms of area planted.[11] Teff production was valued at US$2.5 billion in 2013/2014, accounting for 32 percent of the total value of Ethiopia's cereal sector. The value of the commercial surplus alone—that part of production that is sold—was estimated at US$750 million, equal to the commercial surplus of all other cereals combined in the country.

TRANSFORMATION OF VALUE CHAINS

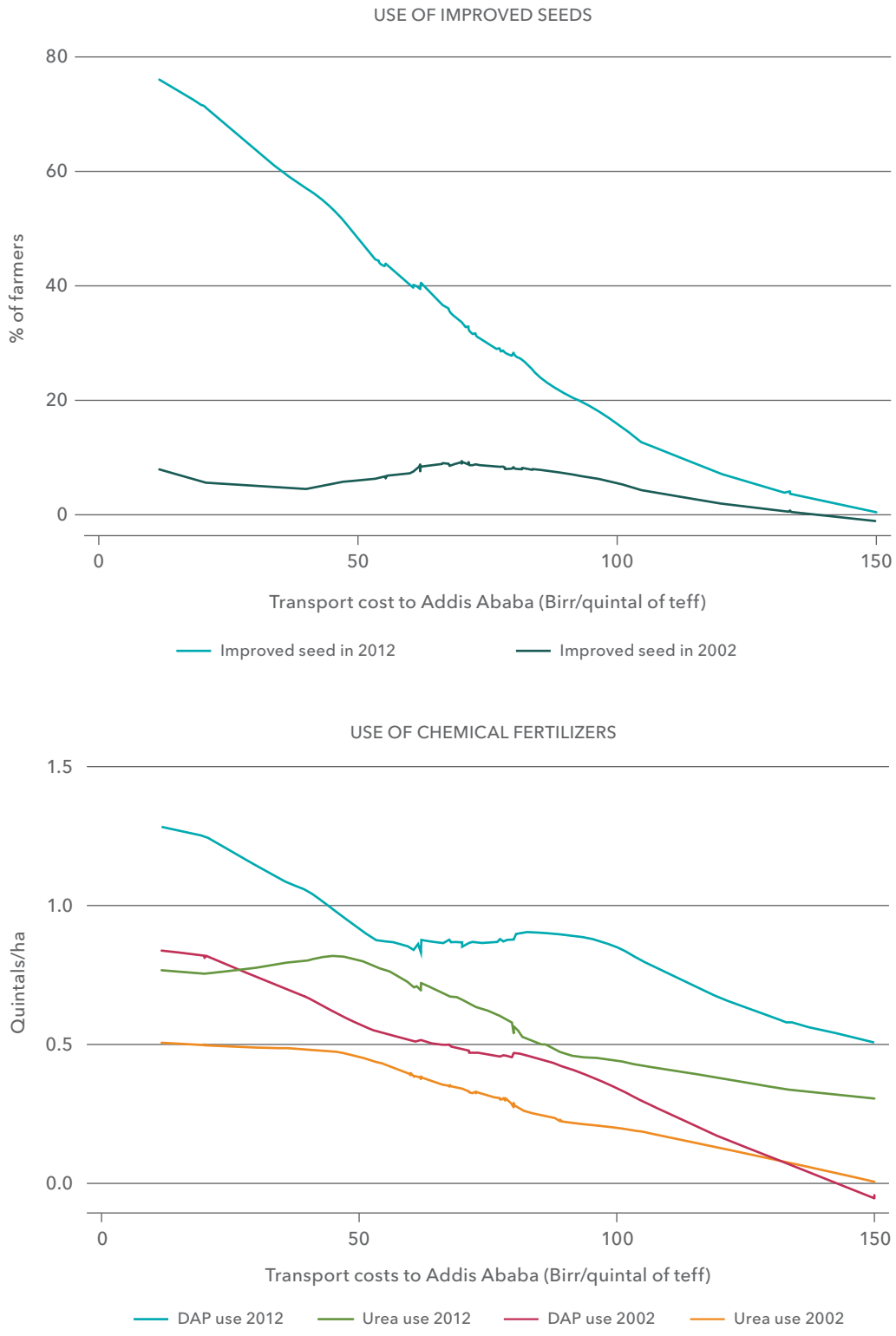
A number of transformations are occurring in commercial value chains that link farms to the city for these three crops, according to the surveys' findings. Many common assumptions about these value chains may no longer hold true as they evolve in an increasingly urban world. How are traditional food value chains changing?

URBAN PROXIMITY MATTERS. Since the burst of change in production of staple crops during the Green Revolution, uptake in agricultural technologies seems to have slowed. Productivity growth in a number of countries is widely thought to have reached a plateau and stalled. Today, there is call for renewed investments in technology development to address the global food crisis.[12] However, looking at the supply zones of the four capital cities reveals substantial change in both technology use and in farming inputs in the last decade.[13] Surprisingly, despite these changes, yields have changed little except for rice in China. This is partially explained by the fact that some farmers have switched to lower-yielding but higher-quality varieties to benefit from higher prices in the marketplace.

Cities have played a key role in technology adoption (Figure 1). In Ethiopia, farmers located closer to the capital, Addis Ababa, where transport costs are lower, are reported in a preliminary study to have adopted modern inputs more frequently.[14] Fertilizer use is more prevalent in areas closer to the city, and most agricultural intensification—as measured through the increasing use of chemical fertilizers—is occurring in these well-connected areas. Increasing fertilizer use seems to be driven by better availability of fertilizers, improved incentives closer to cities because of higher output prices in relation to fertilizer prices, and better knowledge of best practices disseminated by extension agents. Improved seeds have spread quickly as well. Few farmers indicated that they used improved seeds 10 years prior to the survey in 2012. But by the time of the survey, use of improved seeds had increased dramatically to almost 80 percent of the farmers who live close to Addis Ababa. People in more remote areas did not adopt improved seeds.

MOBILE PHONES SHAPE MARKETS. When farmers in developing countries sell their crops, it is widely thought that they may face low prices because they are poorly informed about the market, or find themselves at the mercy of a field broker or constrained by tied credit.[15] However, the surveys found that a significant number of farmers engage

FIGURE 1 Transport costs and adoption of modern technologies in Ethiopia



Source: Adapted from B. Minten, S. Tamru, E. Engida, and K. Tadesse, "Transforming Staple Food Value Chains in Africa: The Case of Teff in Ethiopia," *Journal of Development Studies* 52, no. 5 (2016): 627–645. Reprinted with permission.

Note: DAP = diammonium phosphate fertilizer. Birr is the currency of Ethiopia. A quintal is equal to 100 kg.

knowledgeably in the market and the role of brokers is limited. Most transactions are in cash, with advances and credit playing little role at the farm level. Moreover, access to information has increased significantly with the widespread availability of mobile phones.[16] A large share of farmers interviewed in commercial zones near large cities own mobile phones, ranging from a high of 97 percent in China to a low of 27 percent in Ethiopia (Table 1). In the three Asian countries, almost one-quarter of farmers in commercial zones had reached a price agreement by phone in their last transaction.[17] For rice and potato supply chains in Dhaka, rice chains in Beijing, and potato chains in Delhi, almost all farmers who used phones contacted multiple traders before engaging in a transaction. Overall, 40 percent of staple suppliers in these rural-urban supply chains had contacted multiple buyers by phone in the context of their last transaction. Access to phones is clearly empowering farmers and changing marketing systems in developing countries. The low number of phone users in Ethiopia illustrates the large variation across countries in farmers' access to phones, which is still in an early phase in that country.[18]

THE GROWING SCALE OF MARKETS IS CHANGING VALUE CHAINS. The post-farmgate segments of the value chain—after the product leaves the farm—are often thought to be stagnant and dominated by small traditional processors and traders. However, in India and Bangladesh, large-scale operations, notably large cold storage operations run by private companies, are playing an important role in potato value chains, and are widely used by traders and small- and large-scale farmers. These cold storage operations are increasingly involved in markets for inputs (such as providing improved seeds), outputs (such as linking farmers with traders), and credit.[19] In all three Asian countries studied, the rice milling industry is undergoing restructuring and modernization. In Bangladesh, the milling segment is becoming more concentrated: the share of small mills is declining in the trade of both farmers and rice wholesalers.[20] Rice mills in all countries—especially the medium

TABLE 1 Mobile phone use by commercial farmers near major cities

	Unit	Production areas in commercial zone of			
		Dhaka	Beijing	Delhi	Addis Ababa
STAPLE CROP		**RICE**	**RICE**	**RICE**	**TEFF**
% of farmers who own a cell phone	%	80	97	73	27
Use of phone in last transaction					
Farmers who were in contact with buyer by phone	% Yes	71	47	19	12
If used...					
Farmers agreed upon price on the phone	% Yes	58	34	51	71
Other buyers contacted	% Yes	90	95	50	-
Average number of phone calls concerning this transaction		2.5	2.5	2.5	-
VEGETABLE CROP		**POTATO**	**POTATO**	**POTATO**	
% of farmers who own a cellphone	%	82	92	97	
Use of phone in last transaction					
Farmers who were in contact with buyer by phone	% Yes	31	19	78	
If used...					
Farmer agreed upon price on the phone	% Yes	66	18	60	
Other buyers contacted	% Yes	98	51	99	
Average number of phone calls concerning this transaction		4.8	3.7	7.6	

Source: E. Nakasone, M. Torero, and B. Minten, "The Power of Information: The ICT Revolution in Agricultural Development," *Annual Review of Resource Economics* 6 (2014): 533–550. Reprinted with permission.

and large mills—have made substantial investments in upgrading their equipment. In China, large mills are becoming increasingly vertically integrated with large retailers and large wholesalers.[21] In Bangladesh and India, a shift is underway from loose to packaged rice, but packaging includes only mill information and no branding. In China, the rapid emergence of packaged and branded rice, especially from medium and large mills, is changing markets.[22]

QUALITY COMMANDS HIGHER PRICES, EVEN FOR STAPLES. Undifferentiated commodities are usually thought to dominate the staples market, with little role for differentiation based on product quality because people are not willing or able to pay for higher-quality food. Most studies looking at the effect of quality in marketing systems have focused on the emergence of high-value products—fruits and vegetables, dairy, meat, and fish—and different marketing requirements for these products.[23] However, our study revealed increasing demand for quality in staple products—average urban consumers are willing to pay substantial price premiums for better-quality staple foods.

SUPPLY CHAINS ARE SHORT AND MARGINS ARE SMALL. Food supply chains are often thought to be long, and longer chains are expected to lead to inefficiencies that increase the margin between the market price and the farmgate price—what the farmer receives. For example, a case study of India argues that most agricultural trade is mediated by a large number of intermediaries, which not only inflates prices but also slows the movement of products from farmers to consumers, leading to large transit costs.[24] However, we find that supply chains for crops are much shorter than commonly assumed. In the case of Ethiopia, usually just two intermediaries exist between agricultural producers and urban retailers.[25] The margins between producers and consumers for the most common variety of rice vary from US$80 per ton in China to US$120 per ton in Delhi (Table 2). Despite the fact that rice has to be transported over a much longer distance in China compared to the other countries, rice margins are still significantly lower. For this common variety of rice, farmers obtain 69 percent, 74 percent, and 87 percent of the final retail price in India, Bangladesh, and China, respectively. In the case of teff in Ethiopia, the share to the farmer reaches 79 percent. These are high shares in final retail prices, especially when compared to developed countries. For example, in the United States, potato farmers are estimated to receive only 15 percent of the final retail price.[26]

MARGINS INCREASE WITH QUALITY, BUT FARMERS SEE LITTLE BENEFIT. Interestingly, the share of the final retail price accruing to the post-farmgate segments of the value chain is larger, both in relative and absolute terms, for higher-quality products (which command a higher retail price) (Table 2).[27] Given increasing demand for these higher-quality products, the importance of the post-farmgate segments of value chains is expected to grow. The difference between the value of the post-farmgate segments for common variety and high-quality rice, as measured by the margin between producers and consumers, is significant—a difference of US$40 per ton in Bangladesh, US$120 per ton in China, and US$130 per ton in India. The farmgate price is only slightly higher for high-quality rice than for low-quality rice in India and Bangladesh, so for the farmer, the labor rewards for growing high- and low-quality rice are not significantly different. However, in Ethiopia, where the margins for higher-quality and lower-quality teff are similar, farmers do receive a higher price for the higher-quality variety. In the case of rice, farmers do not currently benefit from the relatively higher retail prices or the increased willingness to pay for quality staples. This is to be expected when farmers can easily switch from one variety to another. Most of the rewards as well as extra costs of producing a higher-quality product (related, for example, to storage, branding, packing, grading, milling, and polishing) are captured by the post-farmgate segment, not the farmer.

WASTE IS LIMITED. Traditional supply chains for staples are thought to be burdened by high rates of food wastage. For example, a study in India found that average losses in horticulture value chains reach 12 percent and in potato value chains, 11 percent.[28] In Bangladesh, an earlier study valued the annual loss due to wastage in the potato value chain at about US$70 million, using an estimate of 25 percent loss.[29] In contrast, our study found that wastage rates are significantly lower than previously assumed. In Bangladesh, the share of potatoes wasted in the value chain or not used for consumption was found to be 5.2 percent in the harvest period and

6.4 percent in the off-season (that is, after storage) of the total quantity entering the value chain (Table 3). Even lower rates of wastage were found in India. Waste is higher in China, possibly because of the significantly longer distances that potatoes are shipped. While some have argued that electricity cuts in Bangladesh and India might lead to major losses of potato in cold storage, all cold stores surveyed had access to diesel generators that kept them functioning during cuts, although at a higher cost. Waste during storage was quite low, estimated at 1.2 percent in Bangladesh and 0.1 percent in India. The lower than expected wastage might be due to bad measurements in previous studies of total wastage. But it is also possible that the diffusion of mobile phones and improved roads have reduced wastage along traditional value chains.[30] In addition, postharvest handling is important to waste rates, but it appears that many improved practices and investments have already been put in place, reducing waste from this stage to modest levels.

IMPLICATIONS FOR FOOD SECURITY

Although the food security debate has largely focused on the farm sector, midstream actors (traders, processors) and downstream actors (retailers) also play an important role in the formation of food prices. Driven by urbanization, the increasing demand for quality and convenience, and the availability of better technologies for cold storage and milling, the role of midstream and downstream agents is likely to continue growing. These post-farmgate segments are often neglected in discussions of food security, however. An obvious policy question is how to best facilitate this "quiet revolution" in traditional agricultural value chains. Interestingly, we found that the government played an important role in kick-starting changes in all four surveyed countries. Governments invested heavily in infrastructure, subsidies (such as for cold storage operations in India), or agricultural research and development (especially in China and India).[31] Although these governments were previously heavily involved in the distribution of agricultural inputs, Bangladesh and China have increasingly moved out of input supply, except for seeds. At the same time, the changing demands of consumers and the resulting expansion of market opportunities are creating incentives for the private sector to step in and restructure the functioning of value chains.

FIVE KEYS TO STRENGTHENING AGRICULTURAL VALUE CHAINS

Five findings are clearly important to the policy debate on food system transformation, food security, and agricultural value chains:

TABLE 2 Average price structure for commercial farmers for common and better-quality crop varieties

Sales price	Unit	Value chain to consumers in			
		Dhaka	Beijing	Delhi	Addis Ababa
		RICE			TEFF
		Most common variety [a]			
Farmer price [c]	USD/kg	0.28	0.54	0.27	0.67
Margin	USD/kg	0.10	0.08	0.12	0.18
Retailer price	USD/kg	0.38	0.62	0.39	0.85
		Better-quality variety [b]			
Farmer price [c]	USD/kg	0.30	0.57	0.31	0.77
Margin	USD/kg	0.14	0.20	0.25	0.15
Retailer price	USD/kg	0.44	0.77	0.56	0.92

Source: Authors' calculations.

Note: [a] common variety: Bangladesh—coarse; India/China—common rice; Ethiopia—mixed teff

[b] better-quality variety: Bangladesh—medium rice; India/China—fine/non-aromatic rice; Ethiopia—white teff

[c] assuming a conversion ratio of 65 percent (no value attached to byproducts), rice equivalent

TABLE 3 Wastage in the potato value chains

	Unit	Wastage rates		
		Dhaka	Beijing	Delhi
WASTAGE IN VALUE CHAIN TO CONSUMER				
Farmer	%	1.2	2.2	0.0
Cold storage	%	1.2	-	0.1
Rural wholesaler	%	1.7	3.1	0.0
Urban wholesaler	%	0.3	1.5	0.2
Urban retailer	%	2.0	3.2	3.0
Total wastage in harvest period	%	5.2	9.9	3.2
Total wastage in off-season	%	6.4	-	3.3
WASTAGE AT RETAIL LEVEL				
Size of last transaction	kgs	220.0	476.6	50.7
Total wastage in last transaction	kgs	4.4	15.1	1.5
Wastage:				
Thrown away immediately after purchase	kgs	1.1	-	0.7
Thrown away because unable to sell in time	kgs	3.1	-	0.8

Source: Authors' calculations.

1. As developing countries' economies grow and urbanization takes off, greater attention on the part of policy makers to the post-farmgate segment of staple-food value chains is required. Post-farmgate activities have important impacts on employment and prices, and therefore on food security for urban as well as rural populations. Rapidly emerging small- and medium-sized agribusinesses in the post-farmgate segment are rising in importance, but are often neglected in policy discussions.[32]
2. Urban markets are rapidly growing and will continue to shape agricultural and food economies in these countries. These markets should be taken into consideration as cities are increasingly becoming engines of agricultural and food system transformation.
3. While much policy debate centers on direct government operations in food value chains, such operations were generally quite small in the staple value chains studied. The implication is that the bulk of activity in agricultural value chains is private sector (traditional or modern) activity. Thus, emphasis should be placed on enabling the private sector's involvement and providing incentives for the sector to support national food security objectives.
4. The indirect role of the governments in the four countries studied was important in enabling and at times providing incentives for the food system transformation:
   - Major investments in the 1990s and 2000s in rural areas, through research and development, distribution of seed, and infrastructure, including in irrigation canal systems, road and railway systems, rural wholesale markets, power grids, and mobile phone communication grids, were essential to the transformation in the midstream of value chains observed by the study.
   - Investing in agricultural extension was important overall, although the data suggest a limited impact and availability of extension services in some areas, particularly in Bangladesh, China, and India.
5. As food and agricultural markets develop, quality and food safety standards will become increasingly important in these growing domestic markets of developing countries. More attention to these concerns is needed.