Ethiopia's Value Chains on the Move: The Case of Teff

Bart Minten, Seneshaw Tamru**, Ermias Engida**, and Tadesse Kuma‡*

** Program Leader and Senior Research Fellow, Development Strategy and Governance Division, International Food Policy Research Institute – Ethiopia Strategy Support Program, Ethiopia*

*** Research Officer, Ethiopia Strategy Support Program, Ethiopian Development Research Institute*

‡ Researcher, Ethiopian Development Research Institute

April 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

We study the value chain of teff, Ethiopia's most important staple food crop by area and value. Based on large-scale primary surveys, we find significant changes in the last decade. First, there is increasing adoption of modern inputs (chemical fertilizer, improved varieties, and herbicides) by farmers, especially by those living close to urban centers. Second, quality demands are rising and there are important shifts from the cheap red varieties to the more expensive white ones. Third, we see an increasing willingness-to-pay for convenience in urban areas, as illustrated by the emergence of one-stop retail shops—that provide sales, cleaning, milling, and transport services—as well as by a sizable foodservice industry. Fourth, the share of rural–urban marketing, urban distribution, and milling margins in final retail prices is declining, indicating improved marketing efficiency over time.

Keywords: agricultural transformation, teff, value chains, Ethiopia

1. INTRODUCTION

Major changes are happening in agricultural and food markets worldwide and especially so in developing countries (e.g. Reardon et al. 2009; McCullough et al. 2008; Tsakok 2011). First, supermarkets are taking off quickly in a large number of developing countries (Reardon et al. 2003; Timmer 2009). Second, the share of high-value crops—such as fruits and vegetables, dairy products, fish, and meat—is rapidly increasing in the diet of consumers (Gulati et al. 2007; Mergenthaler, Weinberger, and Qaim 2009; Pingali 2007). Third, quality demands by consumers in developing countries are on the rise (Minot and Roy 2007; Minten, Murshid, and Reardon 2012). Fourth, food safety requirements for export agriculture from developing countries have important effects on the structure of value chains (Henson and Reardon 2005; Maertens and Swinnen 2009). Fifth, food-processing companies are increasing the degree to which they vertically integrate their operations and are becoming increasingly involved in production and marketing activities (World Bank 2005). Sixth, traditional value chains of food staples—as documented in Asia—are characterized by a process of increased upscaling, disintermediation, and branding (Reardon et al. 2012).

In the case of Africa, there is an overall consensus that there is large potential for improvements in agricultural production and market development since Africa has more than half of the world's uncultivated but agriculturally suitable land and has scarcely used its extensive water resources (World Bank 2013). Researchers have documented some of Africa's successful agricultural production development stories (e.g. Haggblade and Hazell 2010; Spielman and Pandya-Lorch 2009). For example, Smale, Byerlee, and Jayne (2011) and Smale and Jayne (2009) show for four African countries how the spread of modern maize varieties led to a significant increase in farmers' yields that contributed significantly to improved food production and food security in the region. Nweke (2009) shows how disease control programs have helped to increase cassava yields in Africa.

There is less evidence on changes in food markets in Africa, however. The performance of agricultural markets improved since the widespread implementation of structural adjustment programs, but there are still a large number of constraints (Kherallah et al. 2002). For example, the small-scale agricultural markets common across the continent are often associated with high transaction costs where personal relationships for assuring satisfactory quality and quantity are crucial (e.g. Fafchamps and Minten 2001; Fafchamps and Vargas Hill 2008; Gabre-Madhin 2001; Poulton, Kydd, and Dorward 2006). However, innovations and improvements are happening in African markets. Supermarkets are being established, even though their share in food markets is still tiny (Reardon et al. 2003). Africa increasingly is able to successfully compete in a number of food export markets even with more stringent quality and safety regulations (Maertens and Swinnen 2009; Minten, Randrianarison, and Swinnen 2009). Mason et al. (2011) also note declining marketing costs for maize over time in four African countries.

Despite the large potential for improvements in agricultural productivity and market performance in Africa, especially given rapid overall economic growth (which generally is linked to non-agricultural sectors of the economy), evidence on changes in domestic food value chains in Africa is still limited, possibly due to a lack of accurate and reliable data (Jerven 2013). Africa's food markets seem to be losing out, and Africa increasingly depends on food imports from the rest of the world. Rakotoarisoa, Lafrata, and Paschali (2011) argue that this poor performance is explained by high population growth, low and stagnating agricultural productivity, policy distortions, weak institutions, and poor infrastructure. Yu and Nin-Pratt (2011) find only small contributions from technological change to any agricultural growth observed in Africa. Others argue that there is a large urban bias in policies leading to disincentives for domestic African agriculture (Bezemer and Headey 2008; Demont et al. 2013).

The purpose of this paper is to understand to what extent domestic agricultural value chains are changing in Africa. We study in this paper in particular the changes that have been happening in the teff value chain in Ethiopia based on carefully fielded primary stacked surveys at different layers in the value chain. Teff is one of the most important crops for farm income and food security in Ethiopia, the second most populous country in Africa. It is Ethiopia's most important crop by area planted and value of production, and the second most important cash crop (after coffee), generating almost 500 million USD income per year for local farmers. In the major agricultural season of 2011/12 (meher), teff was grown by 6.3 million farm households in Ethiopia (CSA 2012).

This research contributes to the literature in two ways. First, we document important transformations that have been happening in the last decade upstream, midstream, as well as downstream in a staple food value chain in Africa. This is in contrast of a pervasive view that agricultural value chains in Africa are static and change slowly (e.g. Collier and Dercon 2009; Rakotoarisoa, Lafrata, and Paschali 2011). Second, in contrast with common practice in value chain analysis, relying for its data gathering often on qualitative and non-representative methods (Webber and Labaste 2009; Nang'ole, Mithöfer, and Franzel 2011), we fielded large-scale representative and quantitative surveys at each level of a food value chain. This has not been done before in Africa, or elsewhere for that matter.

We note very rapid changes in the value chain in the last decade. Upstream, we find quick adoption of new varieties, though from a low base, and the increasing use of chemical fertilizer, especially by those farmers living close to urban centers. Downstream, we find a transformation of a milling sector toward one-stop shops providing different additional services and a more efficient processing system, as measured by declining milling margins. Quality requirements are further changing throughout the chain, with an increasing trade in more expensive varieties seen. We further note the smaller share of marketing costs in the final retail price, indicating improved marketing efficiency. The rapid changes in this value chain seem to be driven by a number of factors, including public investments in agriculture (especially agricultural extension), income growth, urbanization, and improved communication and transport infrastructure.

While there is often pessimism on how agricultural production and market growth can be achieved in Africa, especially given the fast growing food needs (Collier and Dercon 2013), it seems that important changes can happen in a short period given an active public sector that delivers the needed public goods as well as proper incentives from the demand side. We also show that increasing intensification is happening especially quickly in those rural areas that are well connected to cities. This is important as, while Africa has much lower urbanization rates than in the rest of the world, urbanization is rapidly increasing in Africa as well: the urbanization rate is projected to be as high as 60 percent in 2050 (UN Population Division 2010). This then suggests that these cities will increasingly provide impetus to agricultural growth and rural transformation in Africa.

The structure of the paper is as follows. In section 2, we provide some background information on teff. Section 3 describes the data and methodology. In section 4, we look at teff upstream in the value chain (the farmers). In section 5, we look at teff downstream (the retailers in Addis Ababa). Section 6 discusses quality changes and changes in margins over the last decade throughout the chain. In section 7, we elaborate on some of the drivers for change. Section 8 concludes.

2. TEFF IN ETHIOPIA

Teff *(Eragrostis tef)* is a major staple food crop in Ethiopia. Teff is grown at middle elevations between 1,800 and 2,200 meters above sea level and in regions that have adequate rainfall. Compared to other cereals, teff is considered a lower risk crop as it can withstand adverse weather conditions (Fufa et al. 2011). While research on improved teff varieties has been done since the mid-1950s, investments have been limited and only a small number of improved varieties have been released, i.e. about 20 in total (Fufa et al. 2011). Its grain is mainly used for making *enjera*, a spongy flatbread, the main national dish in Ethiopia (as well as Eritrea). Teff is also valued for its fine straw, which is used for animal feed as well as mixed with mud for building purposes.

An important factor in any food market is quality. The most widespread distinction used in the teff value chain in Ethiopia relates to the color of the grain. The distinction between *magna* ("superwhite"), white, mixed, and red teff is widely used and well known by farmers as well as traders, and we will therefore use it as a measure for quality throughout this paper. Teff quality is also often evaluated by origin. While the quality of teff is also judged by a number of other factors, such as physical appearance, impurities, aroma, texture, and nutritional quality, these are often difficult to measure objectively.

Teff is the most important crop in Ethiopia, as measured by a number of indicators. In 2011/12, it was estimated that teff made up 20 percent of all the cultivated area in Ethiopia, covering about 2.7 million hectares and grown by 6.3 million farmers. The second most important crop was maize at 15 percent of all cultivated area.[1] However, given the relatively low yields of teff, the total national production of teff (3.5 million ton) was lower than maize (6.1 million ton) and sorghum

[1] The importance of teff area-wise has increased absolutely but stayed relatively the same over time. In 2003, teff made up 20 percent of all cultivated area as well while maize was making up 18 percent.

(3.9 million ton) (CSA 2012). When we look at the value of production of teff—using a simple average of producer prices collected by the Central Statistical Agency (CSA) in a large number of producer markets in the country—and compare it to other crops, we find that teff production in 2012 was valued at 1.6 billion USD, again the most important crop in the country.[2] If we use the commercial surplus data for the period 2011/12, teff value was estimated to be 464 million USD or one quarter lower than coffee (599 million USD), Ethiopia's most important export product. The value of commercial surplus of teff is equal to the commercial surplus of the three other main cereals combined in the country (sorghum, maize, and wheat). By any standards, teff is an important crop, for farm income as well as food security.

On the consumption side, teff is more readily eaten by urban households than by rural households. Berhane, Paulos, and Tafere (2011) show, relying on national household consumption data, that urban consumption per capita is as high as 61 kg per year. This compares to 20 kg per capita per year for rural areas. They further illustrate the high income elasticity for teff, evaluated at 1.10 in urban areas and 1.20 in rural areas. Teff is therefore an economically superior good that is relatively more consumed by the rich than by the poor. The lower consumption by the poor is also partly explained by the high prices of teff which are typically twice as high as the cheapest cereal, i.e. maize (Minten, Stifel, and Tamru 2012).

3. DATA AND METHODOLOGY

The purpose of the study is to understand how the teff value chain is transforming. We rely on data from major teff producing areas and follow the value chain from there to Addis Ababa, the capital of Ethiopia and, along with its metropolitan area, home to approximately 4 million people. To get at this information, two types of activities were organized. Interviews were conducted with key informants in the value chain in September and October 2012. That information was used to design questionnaires for each level in the value chain. These questionnaires were then fielded at the end of 2012 (November and December). The implemented instruments included surveys upstream in the value chain with teff producers and communities, midstream with rural and urban wholesalers and truckers, and downstream with cereal shops, mills, and cooperative retail.

Upstream in the value chain, we selected 1,200 teff farmers. The selection of these farmers involved several steps. First, the five zones with the highest commercial surplus of teff in the country were chosen. These five zones combined represented in 2011/12 38 percent and 42 percent of the national teff area and commercial surplus respectively. Second, within each production zone, the *woredas* were ranked from smallest to largest producer (in terms of area cultivated). We then divided the *woredas* in two, the less productive (cultivating all together 50 percent of the area) and the more productive *woredas* (cultivating all together 50 percent of the area). Two *woredas* were randomly selected from each group. Third, a list of all the *kebeles* of the selected *woredas* was then obtained. Two *kebeles* were randomly chosen from the top 50 percent producing *kebeles* and one from the low 50 percent producing *kebeles*. Fourth, a list of all teff producers in the selected *kebeles* was then made. They were ranked from small to large teff producers (based on areas cultivated). We then divided the farmers in two groups, the small production (cultivating all together 50 percent of the area) and the large production farmers (cultivating all together 50 percent of the area). A total of 20 farmers were then selected: 10 from the small production and 10 from the large production farmers. In total, 240 farmers were interviewed per zone.

Midstream, the following strategy was followed. First, 40 rural wholesalers were interviewed in each rural zone. For each *woreda*, the major trading town or temporary wholesale market used by farmers in that *woreda* was selected. A census of all traders in that market/town was then made. As the focus of the study is to understand the value chain from rural areas to Addis Ababa, ten traders that ship teff to Addis Ababa were then randomly selected from this list in these towns/markets. Four such towns/markets were selected for each zone. Second, in Addis Ababa, 75 wholesale traders and brokers were interviewed in total. Reflecting the approximate size of the wholesale market for teff, one-third was interviewed on the Ehil Beranda wholesale market and two-thirds on the Ashwa Meda market. About 25 wholesalers were randomly selected on Ehil Beranda (13 without and 12 with shops) and about 50 (25 with and 25 without shops) on Ashwa Meda. Wholesale traders were asked to identify the zones from where they obtained teff. It is estimated that 92 percent of the teff that is sold in Addis Ababa is from the five production zones that we surveyed.

Downstream, we relied on a stratified sampling scheme to select a representative sample of teff retail shops in Addis Ababa. Based on the map of the city, we created five geographical strata with two neighboring similar sub-cities in each stratum. We then randomly selected one sub-city from each stratum, giving us in total five sub-cities to work with. Next, we collected information from the city's Trade and Industry Office, which provided us the complete lists of teff outlets in

[2] The median producer price for mixed teff in the 2011/12 was 8.5 Birr/kg, significantly higher than wheat (6.45 Birr/kg), maize (4.1 Birr/kg), and sorghum (4.9 Birr/kg).

each sub-city. We then randomly selected outlets to be interviewed. First, all the consumer cooperatives and *kebele* shops selling teff were surveyed at the sub-city level. Second, in each selected sub-city, four *kebeles* [3] were selected randomly. In each selected *kebele*, all the flour mills were surveyed and 5 cereal shops were randomly selected and surveyed. In total, 282 retail outlets were interviewed.

Table 3.1 gives an overview of the selected agents for each level. We note significant differences between agents in the value chain. The level of education is lowest upstream for farmers with on average 5 years of education. This compares to about 8 years for the other value chain agents downstream. Few women are directly involved in the value chain post-farm: 5 percent, 0 percent, and 15 percent of the rural wholesalers, urban wholesalers, and urban retailers respectively are women. At the farm level, only 5 percent of the households are headed by women. Value chain agents have significant experience in teff, between 8 and 10 years on average. The value of assets owned is highest for the urban retailers, often because of the mills they own. We see also significant size variation in each category as shown by large standard deviations. The yearly sales of a farmer amount to 0.5 ton a year. This compares to 252, 694, and 36 ton per year for the rural wholesalers, urban wholesalers, and urban retailers respectively. A rural wholesaler thus needs yearly on average about 500 farmers to buy from for his teff business.

Table 3.1—Sample descriptives

	Unit	Mean	Median	Standard deviation
Farmers				
Number of observations		1200	-	-
Gender head of household	share male (%)	95.3	-	-
Level of education (years of schooling)	number	4.6	4.0	2.9
Experience in teff business	years	9.6	10.0	1.5
Value assets	1000 Birr	63.5	38.8	99.1
Yearly production of teff	quintals	11.2	8.0	14.3
Yearly sales of teff	quintals	5.2	2.5	11.0
Rural wholesalers				
Number of observations		205	-	-
Gender	share male (%)	94.6	-	-
Level of education (years of schooling)	number	7.9	9.0	3.9
Experience in teff business	years	9.5	8.0	7.8
Value assets	1000 Birr	242.4	71.5	374.0
Yearly turnover of teff	ton	252.6	134.3	448.4
Urban wholesalers/brokers				
Number of observations		75	-	-
Share brokers	share (%)	65.3	-	-
Share traders	share (%)	64.0	-	-
Gender	share male (%)	100.0	-	-
Level of education (years of schooling)	number	8.7	8.0	3.4
Experience in teff business	years	8.9	7.0	6.7
Value assets	1000 Birr	122.4	8.9	673.7
Yearly turnover of teff	ton	694.1	585.0	414.8
Urban retailers				
Number of observations		282	-	-
Share mills	share (%)	83.3	-	-
Share cereal shops	share (%)	9.9	-	-
Share consumer cooperatives	share (%)	6.7	-	-
Gender	share male (%)	84.7	-	-
Level of education (years of schooling)	number	7.7	8.0	4.4
Experience in teff business	years	8.2	5.0	7.8
Value assets	1000 Birr	337.4	78.7	801.6
Yearly turnover of teff	ton	35.9	25.0	55.4

Source: Authors' calculations.
Note: In late 2012, 18.0 Birr = 1.0 USD.

[3] *Kebeles* are the second administrative level for the city under a given sub-city (recently *kebeles* have been re-organized to *woredas* with slight changes in geographical coverage).

4. TEFF UPSTREAM IN THE VALUE CHAIN

4.1. Changes

Table 4.1 reports the self-reported changes over the last decade for the farmers that were part of the survey. Tillage frequency is on average high (4.4 times). As teff seeds are small, germination is hard in unbroken soil and famers have not changed tilling behavior over time, despite recommendations by the ministry to reduce tilling as well as extension efforts for the no-tilling method. Broadcasting is the common method used for teff sowing. Seed rates with this method are high—on average between 40 kg and 50 kg per hectare—and they have changed little over time. If anything, an increase over time is seen. Teff weeding is a laborious task that is critical for teff productivity. We find a slight—but significant—decline, seemingly linked with the increasing use of herbicide. Overall, we thus find little change over time in these production practices.

In the second part of Table 4.1, we look at modern input use. The increasing use over time of herbicides, usually the 2-4-D herbicide, from 31 percent of teff farmers 10 years earlier to 63 percent at the time of the survey, has helped to control the development of broadleaf weeds (Fufa et al. 2011). Pesticide use increased from 4 percent of the farmers to 11 percent. Seven percent of teff farmers used improved teff seeds 10 years prior to the survey.[4] This had increased to 35 percent of the farmers at the time of the survey. The use of chemical fertilizer increased from 51 (35) kg of DAP (urea) per ha 10 years before the survey to 88 (64) kg/ha at the time of the survey, on average almost a doubling.

We note large changes in the type of teff produced: we see an increasing importance of *magna* and white teff at the expense of red and mixed teff. As reported by the interviewed farmers, *magna* and white teff combined made up 49 percent 10 years before the survey. This had increased at the time of the interview to 70 percent, an increase by 21 percent. The share of red teff in production declined from 36 percent of total production to 20 percent. Similar changes were noted in focus group interviews at the *kebele* level (bottom of Table 4.1). The majority of the red teff was grown for own consumption, explaining the lower shares of red teff in the commercial surplus compared to the production by farmers. The change away from red and mixed toward white and *magna* teff is significant in all cases, as shown by a t-test.

There are several reasons for the decline in the importance of red teff over time. First, the prices for red teff are significantly lower than for white teff, giving farmers an incentive to focus on white teff for increased income. These higher prices of white teff seem to be driven by a number of factors including lower conversion ratios of red teff for the production of *enjera* [5], the longer shelf life of white teff *enjera* as confirmed by the majority of mills, indicating possible higher premiums for this trait, and the preferences of urban consumers for white teff if incomes allow.[6] Second, while red teff traditionally used to have higher productivity than white teff, this is now changing as high-performing white varieties (especially *quncho*) have recently become available (see below). On the other hand, only very few improved red varieties are currently available (Fufa et al. 2011).

[4] This is in the perception of farmers, as it is often not clear after a couple of generations if varieties are improved or not.

[5] Key informants indicated that 500 *enjeras* can be made from 1 quintal of red teff. This compares to 600 to 700 *enjeras* from white teff.

[6] There is, however, an increasing perception with richer customers that red teff has major health benefits (presumably because of higher iron content). 65 percent of the retailers "agreed" or "strongly agreed" with the statement that "red teff is increasingly been bought by rich consumers that are concerned about their health".

Table 4.1—Changes in production practices

	Unit	Number of observations	10 years prior to survey*	At time of survey	T-test** t-value	T-test** Pr(|T|>|t|)
Traditional production factors						
Number of tillings	number	1200	4.0	4.4	11.78	**0.00**
Seed use: *Magna*	kg/ha	91	44.4	41.9	-0.24	0.81
White	kg/ha	593	44.4	43.0	-0.60	0.55
Mixed	kg/ha	141	44.3	45.0	1.91	**0.06**
Red/Black	kg/ha	380	46.9	48.7	3.92	**0.00**
Number of weedings	number	1199	1.5	1.3	-7.87	**0.00**
Modern inputs						
Adoption of improved seed	share (%)	1199	6.5	35.2	-21.22	**0.00**
Use of chemical fertilizer: DAP	kg/ha	1128	50.6	87.9	21.26	**0.00**
urea	kg/ha	1121	35.0	63.8	18.31	**0.00**
Adoption of herbicides	share (%)	1197	31.0	62.9	-22.52	**0.00**
Adoption of pesticides	share (%)	1197	3.9	11.5	-9.28	**0.00**
Type of teff						
Farmers' interviews:						
Red teff	share (%)	1200	36.0	19.7	-16.28	**0.00**
Mixed teff	share (%)	1200	15.8	10.7	-6.20	**0.00**
White teff	share (%)	1200	42.6	54.9	10.54	**0.00**
Magna teff	share (%)	1200	5.6	14.7	10.68	**0.00**
Community focus group interviews:						
Red teff	share (%)	60	32.7	14.4	-6.28	**0.00**
Mixed teff	share (%)	60	31.8	21.6	-3.77	**0.00**
White teff	share (%)	60	26.5	40.2	3.62	**0.00**
Magna teff	share (%)	60	7.7	24.3	5.97	**0.00**

Source: Authors' calculations.
Notes: * As correct weighing factors for the situation ten years prior to the survey are unknown, the extrapolation factors at the time of the survey were used for ten years prior to the survey as our best approximation. ** Significant values at the 5% level are highlighted in bold.

4.2. Adoption of Modern Inputs

As we see important increases in modern input use, more in-depth analysis is done to better understand this change. The adoption of improved seeds has spread quickly over the last ten years but it is especially the *quncho* (DZ-Cr-387) variety that is now widely adopted in these major teff production zones.[7] The quick spread of *quncho* is remarkable given that the variety was only released recently. The first farmers in our survey zone only adopted *quncho* in 2010, three years prior to the survey. Follow-up questions were asked for teff farmers on the adoption of *quncho* (Table 4.2).
32 percent of the teff farmers stated that they ever used *quncho*. For those that ever used it, it was currently being used on 83 percent of the white teff area. The stated reasons for the adoption of *quncho* were multiple, including higher yields, lower seed rates, longer straw, and stronger stem. As *quncho* is a white teff, it fetches also a significantly higher price than mixed or red teff, explaining the attractiveness of the former. The major reasons given for not using *quncho* or improved seed at all or for using less improved seed than desired, is lack of supply. This is in contrast with chemical fertilizer where lack of cash is the most cited constraint (Table 4.2).

[7] *Quncho* is a combination of the *magna* quality DZ-01-196 and the white quality DZ-01-974. It has seemingly been successful because it combines the preferred *magna* characteristics of the DZ-01-196 and better yield performance of DZ-01-974 (Fufa et al. 2011).

Table 4.2—*Quncho* statistics

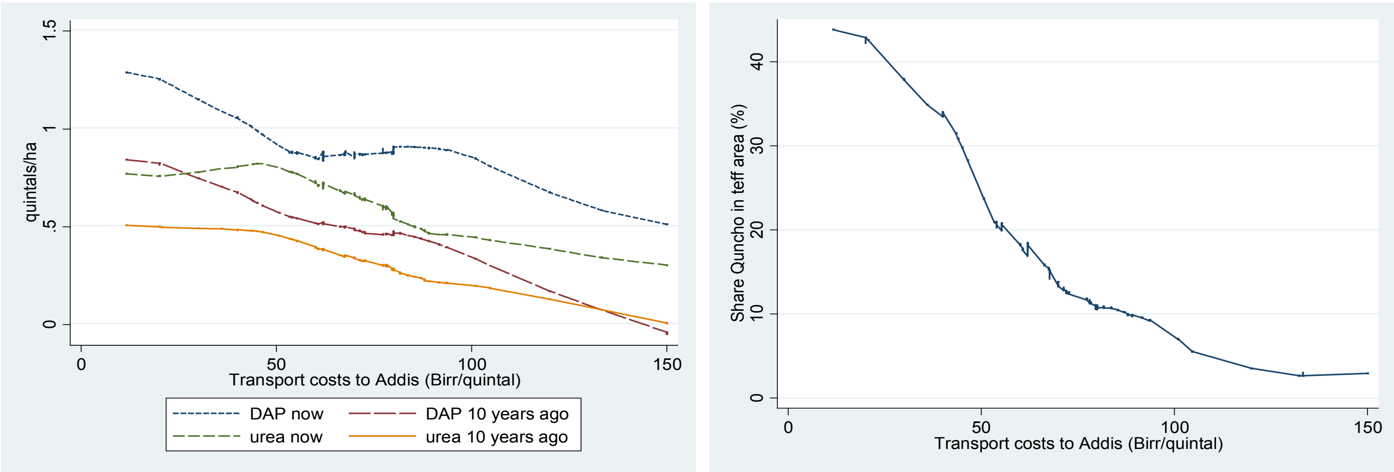
	Unit	Chemical fertilizer	Improved teff seed
The household ever used *quncho*	%	-	32
If yes:		-	
The household used *quncho* in 2011/12 (Meher/Belg 2011/12)	%	-	76
The number of years since the household uses *quncho*	number	-	2
Part of white teff area where the household uses *quncho*	%	-	83
Perceived advantages of *quncho* compared to other white teff varieties:		-	
a. Higher yield	%	-	89
b. Lower seed rates	%	-	83
c. Better price	%	-	91
d. Straw is longer; there is more fodder	%	-	89
e. Stem is stronger; there is less lodging*	%	-	87
Household used modern inputs in Meher/Belg 2011/12	%	93	34
For non-users:			-
Major reason for not using modern inputs:			-
No need because soil is good enough	%	22	-
I don't know how to best apply them	%	4	17
I was unable to find them	%	2	34
The quality of modern inputs is not good	%	-	3
There is too much hassle/transaction costs to obtain modern inputs	%	1	4
Modern inputs are too expensive	%	9	7
I lack the money at the time of need	%	33	12
Lack of transportation	%	-	0
I am happy with the traditional seeds	%	-	15
Other	%	29	1
Farmers tried to buy modern inputs but could not obtain them	% yes	13	18
For users:			-
Farmer was able to buy as much modern inputs as desired	% yes	69	75
Reason for not buying as much modern inputs as desired		-	-
I was unable to find more	%	10	65
There is too much hassle/transaction costs to obtain modern inputs	%	5	19
I lacked the money at the time of purchase	%	85	16
Lack of transportation	%	0	-
Other	%	0	-

Source: Authors' calculations.
Note: * Lodging is the falling over of the plant stem at maturity, as it cannot support the weight of the grain formed.

Figure 4.1 shows how the adoption of modern inputs varies over the distance to Addis Ababa. Both panels show a clear spatial pattern. Households that are located near Addis Ababa are more readily adopting *quncho*. While more than 40 percent of the teff area is planted with *quncho* for close-by areas, this drops to almost zero for the areas farthest out. This effect of distance likely indicates better access as well as better incentives for the adoption of improved varieties. Figure 4.1 also shows the stated changes in adoption of chemical fertilizer per hectare. Figure 4.1 shows again how more fertilizer use is especially prevalent in areas closer to Addis Ababa and most intensification of agriculture—as measured through the increasing use of chemical fertilizers—is happening in these well connected areas, as seen in other settings (Reardon et al. 2012; Wiggins 2000).[8] The increasing use of fertilizer seems driven by the better availability of fertilizers, incentives (through the higher relative prices of teff over time [Minten, Stifel, and Tamru 2012]), as well as the better knowledge of its use through efforts of extension agents (see further).

[8] While the recommended rate of fertilizer use in teff production is 100 kg of DAP and 100 kg of urea per hectare (Kenea, Ayele, and Negatu 2001), a minority of farmers do this in practice.

Figure 4.1—Chemical fertilizer and *quncho* adoption by distance to Addis Ababa



Source: Authors' calculations.

To further understand what factors are driving adoption, we run a double hurdle regression model (Cragg 1971) of modern input adoption at the plot level as dependent variables and plot and household characteristics as well as the transport costs to the major market Addis Ababa and to cooperatives as independent variables. In such a set-up, the "first hurdle" is used to estimate the factors that determine modern input use on a specific plot, while the "second hurdle" analyzes the determinants of the quantities of modern inputs used conditional on being used.[9] Table 4.3 shows what the determinants are of the adoption of these new technologies.

The results of this model (Table 4.3) show that distance to Addis Ababa affects both the choice to adopt chemical fertilizers and improved seed as well as the quantity of chemical fertilizer applied. On the other hand, it does not significantly affect the quantity used of improved teff seed. To assess the magnitude of these effects, we report, at the bottom of Table 4.3, average partial effects (APE) of transport costs to Addis Ababa that reflect the overall—including both the first and second hurdles—impact on modern input use.[10] The highly significant unconditional APE of transport costs on chemical fertilizer use of 38 indicates that a doubling of the transport costs to Addis Ababa reduces the fertilizer use by 38 kg per ha. In the case of *quncho* teff seeds, the share of the area planted declines by 17 percent for a doubling of the transport costs to Addis Ababa. These impacts of transport costs from urban centers on the adoption of modern inputs are thus substantial. Similar results are found for distances to cooperative unions, the—often exclusive—distributors of modern inputs. A doubling of the distance to cooperative unions reduces the fertilizer use by 13 kg per ha and the share of teff area planted with *quncho* by 3 percent.

[9] Ricker-Gilbert, Jayne, and Chirwa (2011) argue that this is often the most appropriate way to model modern input use in Africa, especially given the large number of farmers that do not use modern inputs, and consequently given the importance of modelling corner solutions correctly in such situations.

[10] Standard errors for the unconditional APE were obtained from bootstrapping the model with 100 repetitions.

Table 4.3—Determinants of *quncho* and fertilizer adoption

	Unit	Chemical fertilizer		*Quncho*	
		Coefficients	z-value*	Coefficients	z-value*
Use (yes/no) of modern inputs					
Transport costs to/from Addis Ababa	log(Birr)	-0.51	**-3.04**	-0.95	**-9.88**
Distance nearest cooperative	log(min.)	-0.20	**-2.68**	-0.13	**-2.45**
Characteristics plot					
Altitude	meters	0.00	**6.48**	0.00	1.48
Share red soil	share	-0.25	-1.17	-0.29	**-1.73**
Share brown soil	share	-0.16	-0.75	0.02	0.11
Share black soil	share	-0.12	-0.58	-0.14	-0.78
Share flat land	share	0.01	0.02	0.62	1.72
Share slightly sloped land	share	-0.59	**-1.69**	0.04	0.10
Characteristics household					
Gender of head of household	male=1	-0.44	-1.61	-0.02	-0.10
Age of head of household in years	years	0.00	0.21	0.00	0.15
Education of the head of household	years	0.02	**1.94**	0.01	**1.83**
Size of the household	number	0.00	-0.11	-0.03	-1.35
Household owns a mobile phone	yes=1	0.68	**3.94**	0.37	**3.56**
Household owns a donkey	yes=1	0.67	**5.39**	0.31	**2.95**
Total land owned	hectares	-0.01	-0.20	-0.12	**-3.60**
Household received visit of extension agent in last 2 years	yes=1	0.06	0.46	0.33	**2.98**
Household is a member of the cooperative	yes=1	0.19	1.53	0.21	**2.14**
Household is a model farmer	yes=1	-0.05	-0.35	0.18	**1.78**
Intercept		0.96	0.97	2.18	**2.99**
Quantity used of modern inputs (kg for fertilizer; % of teff area for *quncho*)					
Transport costs to/from Addis Ababa	log(Birr)	-49.52	**-4.91**	0.52	0.14
Distance nearest cooperative	log(min.)	-16.31	**-2.87**	-2.35	-0.99
Characteristics plot					
Altitude	meters	0.13	**6.02**	-0.01	-1.14
Share red soil	share	-20.25	-1.03	18.22	**2.12**
Share brown soil	share	50.26	**2.58**	4.52	0.58
Share black soil	share	16.17	0.93	-9.63	-1.38
Share flat land	share	81.80	**2.26**	-12.86	-0.82
Share slightly sloped land	share	45.20	1.19	-7.83	-0.46
Characteristics household					
Gender of head of household	male=1	-20.73	-0.96	0.39	0.05
Age of head of household in years	years	0.83	**2.21**	0.31	**2.04**
Education of the head of household	years	0.37	0.47	0.25	0.88
Size of the household	number	-7.70	**-3.25**	-0.60	-0.63
Household owns a mobile phone	yes=1	5.86	0.51	-0.79	-0.20
Household owns a donkey	yes=1	42.09	**3.67**	-4.91	-1.04
Total land owned	hectares	-25.37	**-6.21**	-3.35	**-2.34**
Household received visit of extension agent in last 2 years	yes=1	15.71	1.36	5.91	1.21
Household is a member of the cooperative	yes=1	31.29	**2.90**	-2.22	-0.54
Household is a model farmer	yes=1	22.04	**2.03**	-16.74	**-4.11**
Intercept		52.16	0.67	116.06	**3.81**
Sigma		125.14	**28.19**	28.23	**21.73**
Number of observations		1197		1199	
Wald chi2()		125.95		217.64	
Prob>chi2		0.00		0.00	
Average partial effect - APE (100 iterations)					
Transport costs to/from Addis Ababa	log(Birr)	-38.29	**-6.06**	-17.26	**-7.98**
Distance nearest cooperative	log(min.)	-13.16	**-4.06**	-2.99	**-3.07**

Source: Authors' calculations.
Note: * z-values of coefficients that are significant at the 5% level are in bold.

4.3. Modern Inputs and Teff Productivity

In an effort to understand how modern inputs contribute to higher teff production, we present in Table 4.4 a fixed effect—and control therefore for household specific characteristics—as well as a random effect Cobb-Douglas production function for teff (Table 4.4). The results show that increased fertilizer use and improved teff seed use are both major contributors to increased production. Depending on the specification, a doubling of DAP and urea use leads to an increase of between 16 and 33 percent in teff production or stated in an alternative way, an additional kg of fertilizer increases teff production by about 2 kg/ha in the case of DAP and by between 2 and 5 kg/ha—depending on the specification—in the case of urea.

The value–cost ratio (VCR) is the yardstick that is often used to evaluate profitability of fertilizer use. It is defined as $\left(\frac{O}{N}\right)\left(\frac{P_N}{P_O}\right)$ where O are the units of outputs produced from one unit of nutrient (N), P_N is the price of fertilizer, and P_O is the price of output. A rule of thumb is that a VCR greater than 2 is likely to provide enough incentive for farmers in developing countries to use fertilizer (Yanggen et al. 1998; Morris et al. 2007). In this case with median prices of teff at 1,009 Birr/quintal, of DAP at 1167.5 Birr/quintal, and of urea at 890 Birr/quintal, VCR for DAP use are around 2.3 while VCRs for urea use vary between 2.2 and 4.5 (depending on the specification). Use of both types of fertilizer for teff production in the areas surveyed is thus mostly profitable.

The results also show that farmers that have access to *quncho* seeds have 10 percent higher production compared to other improved or traditional seeds. These results thus suggest that the increased fertilizer use and improved seed adoption in these *kebeles* have led to significant increases in teff productivity.

Table 4.4—Teff production functions

Dependent variable=log(quintals)	Unit	Fixed effects		Random effects	
		Coefficients	z-value*	Coefficients	z-value*
Characteristics plot					
Area of plot	log(hectares)	0.52	**13.04**	0.52	**18.42**
Color of soil (default=red)					
Brown soil	yes=1	0.01	0.34	0.02	0.72
Black soil	yes=1	0.03	0.98	0.00	0.08
Mix soil	yes=1	0.06	1.23	0.02	0.46
Slope of the plot (default=flat)					
Slightly sloped	yes=1	-0.06	-1.57	-0.04	-1.32
Steep	yes=1	0.05	0.64	0.00	0.03
Teff harvest also last year on this plot (yes=default)					
No teff planted last year	yes=1	0.03	0.80	0.05	**2.39**
Do not know	yes=1	-0.04	-0.59	0.06	1.03
Soil is easy to plow	yes=1	0.06	**2.01**	0.09	**3.95**
Input use					
Number of tillings	number	0.02	1.12	0.02	**2.54**
Applied manure	yes=1	0.06	1.26	0.03	0.98
Color of seed (default=magna)					
White	yes=1	-0.03	-0.65	-0.01	-0.23
Mix	yes=1	-0.03	-0.54	-0.10	**-2.35**
Black/red	yes=1	-0.05	-1.09	-0.07	**-2.01**
Seed variety (default=*quncho*)					
Other improved seed	yes=1	-0.10	**-1.89**	-0.10	**-2.33**
Traditional seed	yes=1	-0.10	**-2.43**	-0.11	**-3.65**
Seed use	log(kg+1)	0.16	**3.93**	0.14	**5.57**
DAP use	log(quintals+1)	0.17	**1.88**	0.19	**3.10**
Urea use	log(quintals+1)	0.16	**1.81**	0.33	**5.36**
Number of weedings	number	0.01	0.56	0.03	**1.81**
Herbicide use	log(Birr+1)	0.04	**2.77**	0.00	0.31
Labor use	log(man-days)	0.25	**7.06**	0.21	**8.52**
Household characteristics					
Gender of head of household	male=1			0.13	**2.19**
Age of head of household in years	log()			0.00	**-2.20**
Education of the head of household	years			0.00	**1.83**
Size of the household	number			-0.01	-1.36
Household owns a donkey	yes=1			0.10	**3.22**
Household owns a mobile phone	yes=1			0.07	**2.33**
Household received visit of extension agent in last 5 years	yes=1			-0.08	**-2.38**
Total land owned	log(x+1)			-0.03	**-3.32**
Household is a member of the cooperative	yes=1			-0.03	-1.11
Household is a model farmer	yes=1			0.06	**2.06**
Distance nearest cooperative	log(minutes)			0.00	**-5.03**
Intercept		-0.01	-0.06	0.35	**1.97**
Number of observations		2773		2762	
Number of groups		1195		1194	
F()/Wald chi2		148.02		4694.33	
Prob>F/Prob>chi2		0.00		0.00	
R-square within		0.68		0.67	
R-square between		0.50		0.57	
R-square overall		0.53		0.59	

Source: Authors' calculations.
Note: * z-values of coefficients that are significant at the 5% level are in bold.

5. TEFF DOWNSTREAM IN THE VALUE CHAIN

5.1. Service Delivery and Competition

Teff retailing in Addis Ababa is mostly done by mills: they account for 70 percent of all the teff sold in Addis Ababa, while cereal shops and consumer cooperatives make up the remaining 18 percent and 9 percent respectively (Woldu et al. 2013). Over the last decade, several changes have happened in the procurement, processing, and milling of teff in Addis Ababa. First, mills traditionally only did milling; households typically would buy teff from a cereal shop or a market, take the teff home for cleaning, get the teff milled at the mill, and then prepare the *enjera* at home (as is still commonly the case in smaller and less-developed towns, as well as in rural areas). This traditional pattern has changed in Addis Ababa, with mills increasingly becoming one-stop shops. Most of them are now delivering different services, including sales of a wide range of cereals (and sometimes other products), cleaning of these cereals, and transport services (Table 5.1 presents un-weighted averages for the retail shops in the panel survey, i.e. those that were already there 10 years ago, as well as weighted averages for the complete sample at the time of the survey). On the other hand, over time, a large number of cereal shops have started adding milling and cleaning to the services they offer consumers. We see, however, no change in the number of mills in the teff retail shops (three on average).

Second, there is seemingly increasing competition between retail outlets. Retail outlets were asked to estimate the number of mills and cereal shops that were in the *kebele* 10 years before and at the time of the survey. We see a significant increase, from 6 to 10 mills and 3 to 4 cereal shops per *kebele* (Table 5.1). While 30 percent of the retail shops stated that queuing was a problem 10 years prior to the survey, often because of the lack of mills, only 17 percent of the retail shops state that this is a problem now. The increasing competition is further confirmed through qualitative statements. The majority of the urban retailers “strongly agreed” or “agreed” with the statement that the competition between mills has increased over time. The quick emergence of teff retail shops is further illustrated by an analysis of their start-up dates: 50 percent of the mills were established in the last five years.

Third, some retailers procure teff directly from rural areas and, thereby, cut out urban wholesale markets. However, this phenomenon is still rather rare. Using un-weighted averages of the panel retail shops, it is estimated that 83 percent of the teff supplies are obtained on urban wholesale markets and few changes are seen over time. Direct rural procurement is especially being done by the larger retailers, as shown in the weighted averages of the procurement sources (Table 5.1). Using this latter method, it is estimated that 27 percent of the teff sold in Addis Ababa does not go through the urban wholesale markets.

The investments in shop premises, mills, and stocks of cereals illustrate that some up-scaling has been occurring in the downstream portion of the teff value chain, requiring relatively heavy capital investments for some retailers. The significance of these investments by retailers is shown in Table 3.1, presented earlier in the paper, by the higher value of their assets relative to those of other agents in the value chain.

Table 5.1—Changes in the last ten years in operation of the retail outlets

	Unit	Panel - unweighted			Paired T-test**		Full sample		Unpaired T-test**	
		Number of obs.	10 years prior to survey	At survey	10 years ago vs now t-value	Pr(|T|>|t|)	Number of obs.	At survey (weighted)	10 years ago vs now t-value	Pr(|T|>|t|)
Technology and products sold per outlet										
Number of milling machines per outlet	number	100	3.1	3.3	4.42	**0.00**	256	2.8	-0.60	0.55
Number of crops sold in outlet	number	106	6.2	7.4	4.45	**0.00**	280	8.2	2.66	**0.00**
Services*										
Share of customers that get home delivery	%	74	59.6	66.9	2.81	**0.01**	266	64.0	0.22	0.82
Share of customers that clean at home	%	96	29.9	21.2	-3.69	**0.00**	250	15.6	-3.18	**0.00**
Share of customers that only come for milling	%	93	30.1	25.4	-2.55	**0.01**	245	17.6	-2.21	**0.02**
Competition										
Number of mills in the *kebele*	number	92	6.1	9.7	8.14	**0.00**	250	9.0	5.04	**0.00**
Number of cereal shops in the *kebele*	number	75	2.9	3.6	2.36	**0.02**	202	5.0	2.05	**0.04**
Often queuing of consumers	%	102	30.3	16.7	-3.28	**0.00**	271	17.5	-4.45	**0.00**
Procurement (share)*										
In Addis Ababa	%	103	82.1	83.3	0.66	0.51	270	72.7	0.53	0.59
Outside Addis Ababa on temporary markets	%	104	11.8	10.0	-1.26	0.21	270	10.2	-1.45	0.15
Outside Addis Ababa not on temporary markets	%	103	6.0	6.4	0.35	0.72	270	17.2	1.08	0.28
% of teff consumers that mix teff with										
Sorghum	%	101	22.1	25.5	1.40	0.16	269	25.2	1.52	0.13
Rice	%	101	8.0	21.2	6.61	**0.00**	269	20.1	6.10	**0.00**
Wheat	%	101	1.1	0.1	-1.83	0.07	269	0.3	-2.01	**0.04**
Maize	%	102	8.5	12.1	2.17	**0.03**	269	11.1	1.98	**0.04**
Other cereals	%	102	1.6	1.4	-0.96	0.34	269	1.4	0.21	0.83

Source: Authors' calculations.
Notes: * In full sample means, weighted by turnover of the retailer and therefore indicating shares for Addis Ababa. ** Significant values at the 5% level are highlighted in bold.

5.2. Mixing with Other Cereals

Teff is often and increasingly mixed with other cereals for the preparation of *enjera*. The type of mixing seems driven by preferences (often linked to the origin of consumers), prices of other cereals, as well as by changing conversion rates from flour to *enjera* when mixed.[11] As seen in Table 5.1, mixing of teff with other cereals is on the rise: While 22 percent of urban customers mixed teff with sorghum ten years prior to the survey, this had increased to 26 percent at the time of the survey. Increases in the proportion of customers mixing teff with rice and with maize are seen as well: from 8 percent to 21 percent in the case of rice and from 8 percent to 12 percent in the case of maize. This mixing seems to explain the strong correlation of teff with other cereal prices as customers seemingly readily substitute into other cereals depending on relative price changes (Rashid 2011).

Table 5.2 shows to what extent poor consumers—as subjectively defined by the retail shop owner—consume different types of teff compared to the rich. While the rich consume almost exclusively *magna* and white teff, the poor almost only eat red and mixed teff. The influence of income on mixing is further shown by starkly different mixing patterns of rich versus poor customers. First, poor consumers mix more readily with other cereals than richer consumers: 55 percent of poor consumers mix teff with other cereals, while only 14 percent of rich consumers do. Second, when richer and middle-income consumers mix, they mostly do so with rice—that has a price similar to white teff—as it improves the whiteness and the flexibility of *enjera*. Poorer consumers mix teff mostly with the cheaper sorghum and maize.

Table 5.2—Mixing

	Unit	Consumers			*Enjera* sellers	
		Poorest	Middle income	Richest	With fixed shops	Without fixed shop
Number of observations	Number	275	274	251	79	86
Type of teff bought*						
Red	%	23	7	6	2	2
Mix	%	62	32	4	42	75
White	%	12	50	31	47	21
Magna	%	3	11	58	9	2
Total	%	100	100	100	100	100
Share of customers that mix teff with other cereals*	%	55	39	14	76	74
Typical composition of flour bought*						
Teff	%	76	84	93	77	77
Sorghum	%	14	4	0	11	15
Rice	%	1	8	4	10	6
Maize	%	6	2	0	3	2
Wheat	%	0	0	0	0	0
Other	%	3	2	2	0	0
Total	%	100	100	100	100	100

Source: Authors' calculations.
Note: * weighted by turnover of the retailer and therefore indicating shares for Addis Ababa.

5.3. Foodservice Industry

The foodservice sector is defined for this study as those businesses, institutions, and companies responsible for any meal prepared outside the home. In the foodservice industry, the *enjera* sellers are especially important, as reported by urban retailers and wholesalers. While they represented 15 percent and 8 percent—using un-weighted averages—of sales 10 years earlier, they now make up 13 percent and 9 percent of total sales of retailers and wholesalers respectively, indicating a slight shift in their procurement to wholesale markets (Table 5.3). It is estimated that about 20 percent of the teff sold in Addis Ababa is currently being marketed as prepared *enjera* by *enjera* sellers and that share has changed little over time. Direct procurement from retailers by restaurants (4.5 percent), institutions (such as schools, universities, jails, army, etc.) (0.4 percent), and supermarkets (0.6 percent) is relatively less important. Table 5.3 further shows how the mills have become increasingly important over time and how the share of customers who buy directly on wholesale markets declined in the last ten years, further confirming the increasing role of mills as one-stop retail shops.

[11] While the authors are not aware of any research on this, this is seemingly the common perception as 60 percent of the retailers "agreed" or "strongly agreed" with the statement that "One can get more *enjera* out of a quintal if teff is mixed with other cereals; the conversion rate is higher if teff is mixed with other cereals".

Four different categories of *enjera* sellers can be distinguished, i.e. formal large *enjera* wholesale companies (that usually sell branded products), informal *enjera* wholesalers (that sell to schools and restaurants, for example), *enjera* retailers with fixed shops (*baltena* shops—local shops that sell different kind of traditional flour products, based on milled spices, pulses, cereals, and others), and *enjera* retailers without fixed shops (microsellers or *gulits*). The *enjera* retailers are most important of all *enjera* sellers, representing almost 90 percent of all *enjera* sellers that buy cereals from retail shops. *Enjera* sellers have different procurement patterns than direct consumers as they come more often to teff retail shops, negotiate lower prices, get more often credit, and do more regular mixing of the teff with other cereals (Table 5.2).[12] The share of the large *enjera* wholesale companies selling branded products is still rather small.

Table 5.3—Share of customers of urban wholesalers and retailers

	Panel - unweighted			Paired T-test**		Full sample		Unpaired T-test**	
	Numb. of obs.	10 years prior to survey (%)	At survey (%)	10 years ago vs now t-value	Pr(|T|>|t|)	Numb. of obs.	At survey (weighted) (%)	10 years ago vs now t-value	Pr(|T|>|t|)
Type of customers for wholesalers (share)									
Wholesalers	33	11.7	9.3	-0.92	0.36	75	6.9	-1.24	0.22
Mills	33	51.5	59.6	1.61	0.11	75	69.0	2.39	**0.02**
Cereal shops	33	8.5	8.6	0.05	0.96	75	8.2	-0.09	0.92
Cooperatives	33	1.4	2.6	1.38	0.17	75	1.4	0.03	0.97
Consumers	33	13.0	5.9	-2.56	**0.01**	75	4.1	-3.25	**0.00**
Enjera wholesalers	33	2.0	2.4	0.54	0.59	75	1.2	-0.78	0.44
Enjera wholesale companies	33	0.7	1.1	0.44	0.66	75	0.6	-0.15	0.88
Enjera retailers with fixed shops	33	4.9	4.7	-0.33	0.74	75	4.7	-0.05	0.96
Enjera retailers without shops	33	0.9	0.7	-0.30	0.76	75	1.7	0.51	0.61
Institutions	32	3.3	2.8	-0.53	0.60	75	2.3	-0.42	0.67
Restaurants	33	1.8	2.2	0.35	0.72	75	1.0	-0.90	0.37
Supermarkets	33	0.2	0.2	-	-	75	0.1	-0.59	0.55
Others	33	0.0	0.0	-	-	75	0.3	0.66	0.50
Total	33	100.0	100.0			75	100.0		
Type of customers for retailers (share)*									
Consumers	103	80.4	82.5	1.46	0.14	277	81.2	2.58	**0.01**
Enjera wholesalers	103	0.8	1.2	0.79	0.43	277	2.2	0.45	0.65
Enjera wholesale companies	103	0.3	0.0	-1.15	0.25	277	0.1	-1.41	0.16
Enjera retailers with fixed shops	103	4.7	4.8	0.05	0.96	277	4.4	-1.71	0.09
Enjera retailers without shops	103	8.7	7.0	-2.28	**0.02**	277	5.3	-2.10	**0.04**
Institutions	103	0.7	0.4	-1.04	0.30	277	0.4	-1.13	0.26
Restaurants	103	1.9	2.1	0.29	0.77	277	4.5	-0.87	0.37
Supermarkets	103	0.0	0.0	-	-	277	0.6	0.86	0.39
Others	103	0.0	0.2	1.00	0.32	277	0.7	0.27	0.79
Total	103	100.0	100.0			277	100.0		

Source: Authors' calculations.
Notes: * in full sample means, weighed by turnover of the retailer and therefore indicating shares for Addis Ababa. ** Significant values at the 5% level are highlighted in bold.

In these urban settings and downstream in the value chain, we thus note an increasing willingness to pay for convenience as seen in the emergence of one-stop retail shops as well in the presence of a sizable foodservice sector. We also see a diversification of products being offered, with innovative mixes of teff and other cereals being tried out. In the section below, we will further look at changes in marketing margins between the different layers in the value chain.

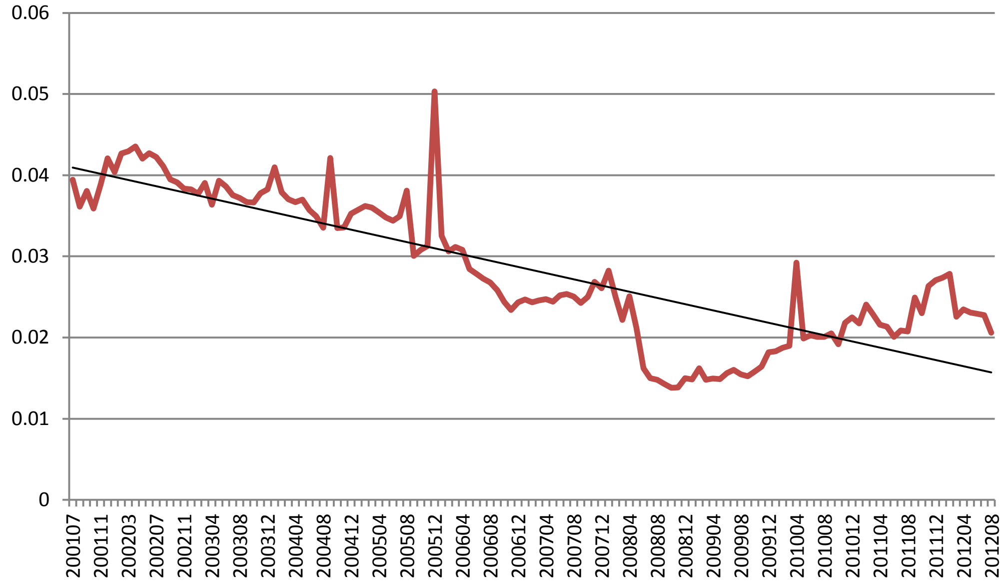
6. MARKETING MARGINS

Price series for teff have been collected over the last decade by the Central Statistical Agency (CSA) at the retail, producer, and milling level and by the Ethiopian Grain Trading Enterprise (EGTE) at the wholesale level. By comparing

[12] The table shows that the *enjera* sellers do a mixing similar to what the poorest do. It is unclear how the *enjera* sellers market their product, e.g. as unmixed teff *enjeras* or as a mixed product. Further research would be needed.

these prices, we can analyze the evolution of urban–rural marketing, urban distribution, and processing margins over time. The increasing competition between mills, as mentioned by retailers, seem to have led to a significant reduction of the share of milling margins in final retail prices over the last ten years (Figure 6.1). These margins have dropped on average to half the level of ten years ago.

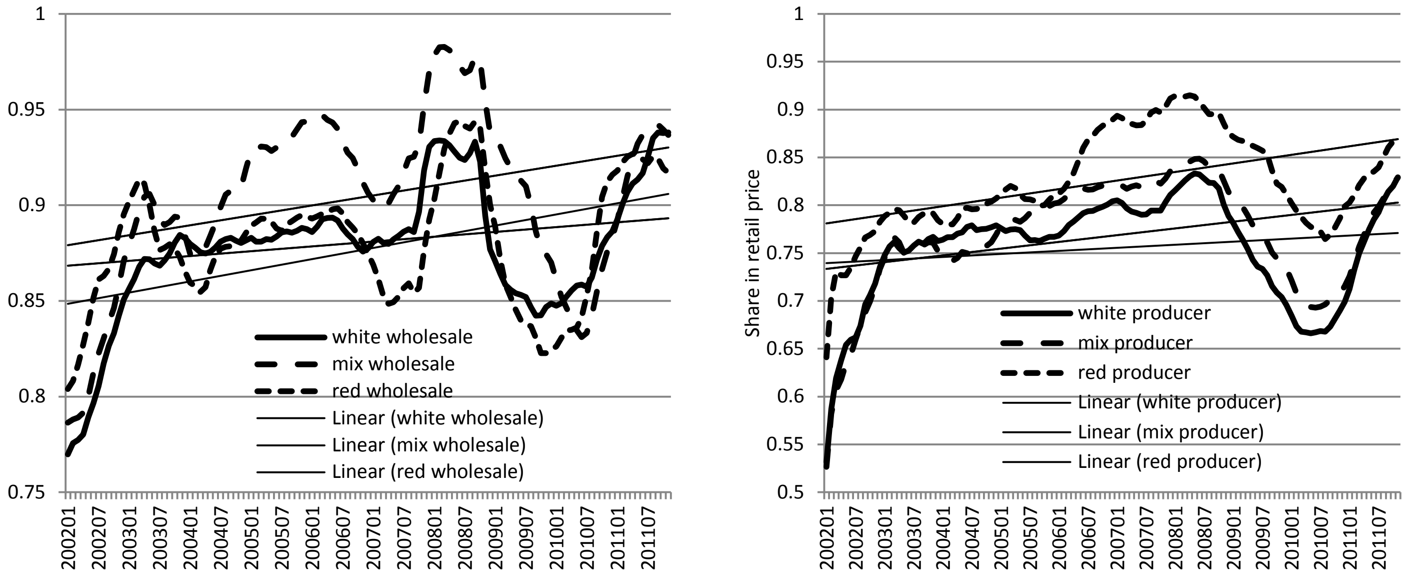
Figure 6.1—The ratio of milling charges over (white) teff retail prices in Addis Ababa



Source: Authors' calculations.

When we compare wholesale to retail prices in Addis Ababa, we also see a decrease of the share of urban retailers in the final retail price over time (Figure 6.2). The share of urban retailers in final retail prices (using linear trend lines) declined from between13 and 15 percent in 2001 to between 7 and 11 percent in 2011, depending on the type of teff. For the share of the producer price in the final price, we focus again on those five major production zones that were part of the producer survey. Using data from the trend line, the share of the producer in the final retail prices increased from a level of between 74 and 78 percent in 2001 to between 76 and 86 percent in 2011. Despite having the highest prices, white teff shows also the lowest producer-to-retail ratio, indicating significantly higher marketing costs than other types of teff. It is not immediately clear what is driving this and further research seems needed. Moreover, we see large variability of these margins over time with a significant decrease in shares of wholesale and producer in final retail prices in 2009 and 2010. Overall, we note that, despite large variability, the shares of urban–rural marketing, urban distribution, and milling in final retail prices have declined significantly over a ten-year period.

Figure 6.2—Share of producer and wholesale in final retail prices of teff in Addis Ababa (12-month moving average)



Source: Authors' calculations.

7. DRIVERS FOR CHANGE

We thus note important changes in the teff value chain over the years. A number of drivers can be linked to this agricultural and food market transformation (e.g. Reardon and Timmer 2007; Minot and Roy 2007; Tsakok 2011).

First, the public sector has played a more active role in the better delivery of modern agricultural inputs. The government has invested especially heavily in improving the spatial reach of agricultural extension in the country—Ethiopia has now one of the lowest farmers to extension agent ratios in the world (Davis et al. 2010). The wide access to extension agents is illustrated in Table 7.1. Almost three-quarters of the surveyed farmers was visited by an extension agent in the two years prior to the survey and a large share of farmers have been exposed to individual and community meetings, visits of demonstration plots, and visits to the government's office of agriculture to discuss teff related issues over the twelve-month period prior to the survey. This leads to a high percentage of farmers being aware of recommended fertilizer use (50 percent) and improved technologies in teff (Table 7.1). Fertilizer delivery also has improved and there are now less complaints about lack of fertilizer, especially so in the more accessible zones, compared to ten years earlier. The government has also invested in research and development. However, investments toward the development of better teff varieties have been limited. For example, Flaherty, Kelemework, and Kelemu (2010) show that investments in agricultural research and development declined by about 30 percent between 2002 and 2008 and they find that agricultural research staffing in Ethiopia is among the least qualified in Africa as measured in terms of post-graduate degrees.

Table 7.1—Agricultural extension use

		Unit	Mean/ Percent	Median	Standard deviation
Contact extension agents:					
Received a visit of an agricultural extension agent in the last 2 years		share (%)	74.4		
Type of organization that provided the extension service:	- NGO	share (%)	4.7		
	- Government	share (%)	95.3		
	- Private	share (%)	0.0		
	- Other	share (%)	0.0		
In last 12 months:					
Number of times that farmer talked individually with extension agent on teff issues		number	2.3	2.00	4.0
Number of times that farmer participated in a community meeting to discuss teff issues		number	2.2	1.00	3.1
Farmer visited a demonstration plot of teff		share (%)	35.3		
Farmer visited a government office of agriculture and discussed teff issues		share (%)	27.1		
Farmer awareness of technologies:					
Farmer knows the recommended fertilizer use on teff plots		share (%)	50.4		
Farmers is aware of:	- broadcasting at lower seed rates	share (%)	91.5		
	- row planting of teff	share (%)	77.9		
	- transplanting of teff	share (%)	39.3		
	- zero tillage of teff soils	share (%)	10.4		

Source: Authors' calculations.

Second, there have been important changes in the last decade in the provision of road and communication infrastructure. Improved infrastructure has led to significant declines in transport costs and better connectivity of rural to urban areas (Schmidt and Kedir 2009). The increasing spread of mobile phone has presumably also led to important efficiency gains, as has been seen in a number of other countries (e.g. Aker and Fafchamps 2011; Jensen 2007). While mobile phone connection only became available in Addis Ababa in the beginning of the 2000s, cell phone coverage is now widespread in rural areas. Consequently, the phone has been adopted by a large number of value chain agents with important implications for the way business is done in teff value chains.

Table 7.2 shows the extent to which telephones are now used in the teff value chain. While it is quickly increasing, mobile phone penetration with farmers in Ethiopia is still low as only 27 percent of the farming households in our survey area reported to own a phone. It is estimated that in 12 percent of the teff transactions by farmers, a phone was used to contact traders beforehand and in 71 percent of these cases, a price was agreed on with the trader by phone. On the other hand, phone use is much more widespread with wholesalers and retailers. Almost all of the traders and retailers report owning a phone and using it actively in their business. 97 percent of the urban traders report having used a mobile phone in their last marketing transaction. This compares to 56 percent of urban retailers. Table 7.2 illustrates that mobile phones are intensively used by these traders to obtain information about prices, to complete trade deals, and to follow up on payments.

Table 7.2—Use of phones

	Unit	Farmers	Rural traders	Urban traders	Urban retailers
Owners of a phone	share (%)	27	100	100	98
Year since they own a phone	year	-	2006	2007	2008
Used mobile phone in the last marketing transaction	share (%)	12	-	97	56
If yes, agreed on a price with the trader by phone in the last transaction	share (%)	71	-	52	32
Before using a mobile phone, they used a fixed phone	share (%)	-	-	43	28
Use of mobile phone:					
- Use it to inform himself or transmit teff prices	share (%)	-	99	100	73
- Agree on prices (plus quantity/quality) with teff suppliers by phone	share (%)	-	52	85	40
If yes, % of suppliers	share (%)	-	38	74	64
- Request a show-up (without price agreements) with suppliers by phone	share (%)	-	35	36	10
If yes, % of suppliers	share (%)	-	35	67	57
- Follow up on payments with teff suppliers by phone	share (%)	-	34	88	54
If yes, % of suppliers	share (%)	-	40	74	78
- Agree on prices (plus quantity/quality) with teff clients per phone	share (%)	-	86	68	34
If yes, % of clients	share (%)	-	80	54	30
- Follow up on payments with teff clients by phone	share (%)	-	87	95	40
If yes, % of clients	share (%)	-	81	62	48

Source: Authors' calculations.

Third, urbanization is increasing rapidly in Ethiopia. Based on data from the national census in 2007, it is estimated that the population of Addis Ababa was 3.4 million people at that point. Schmidt and Kedir (2009) show that urban centers grew at up to 3.7 percent per year on average over the last decade. Using these growth rates, Addis Ababa would have added about 1.2 million people over the period 2003–2012 (from 2.9 in 2003 to 4.1 million in 2012). As teff is an important staple crop for these urban populations, this has led to a significant increase in the flow of trucks coming to Addis Ababa. Berhane et al. (2011) have further found that teff has high income elasticities, and national household surveys show that incomes are increasing in Ethiopia. Real per adult equivalent consumption in 2004/05 (at 1995/96 constant prices) was 1,542 Birr, an increase over five and ten years earlier of 16 and 17 percent, respectively (MoFED 2008). Analysis of recent national household data show that poverty declined between 2004/05 and 2010/11 from 38.7 percent to 29.6 percent, indicating further welfare improvements over the period considered (MoFED 2012).

The urbanization and economically superior characteristics of teff have led to rapidly increasing demand in Addis Ababa, leading to economies of scale such as in the use of larger trucks (Minten, Stifel, and Tamru 2012). Assuming that the average urban consumption level of teff is as high as estimated in the national household survey (HICES) of 2004/05, this implies a flow of approximately 250,000 ton of teff into Addis Ababa in 2012, for an approximate value of 165 million USD—using the 2012 mixed teff wholesale prices of approximately 1,200 Birr/quintal. Because of population growth in urban areas, we estimate an increase in the quantity traded of about 45 percent over the last decade. Unfortunately, no good data are available on this trend. If we assume that average income grew by 30 percent over the last decade, this would have added another 32 percent to urban teff demand. Both factors combined have thus led to important changes for marketed teff surplus to Addis Ababa, possibly almost a doubling over the last decade.

Fourth, economic and income growth is often linked with higher opportunity costs of time, especially of women. As the different steps involved in the purchase of teff and the preparation of *enjera* require significant effort and time, this higher opportunity cost leads to increasing demand for prepared products in such settings (Kennedy and Reardon 1994; Reardon and Timmer 2007; Minot and Roy 2007) and gives an impetus toward the further take-off of ready-to-eat products delivered by the foodservice industry.

8. CONCLUSIONS

We study the transformation of the teff value chain in Ethiopia in the last decade. Teff is the most important crop in Ethiopia in terms of area and in value of production, and is the second most important cash crop after coffee. We rely on primary surveys fielded in five of Ethiopia's major teff production zones that together account for 42 percent of all commercial surplus in the country. We follow the commercialization of teff from these zones to Addis Ababa, the capital of Ethiopia and its largest city. As such, this study looks at the most important domestic staple value chain in the country.

Important changes have happened in the teff value chain in the last decade both at the production level and on the consumption side. Modern inputs are increasingly adopted in teff production, quality and convenience demands are on the rise among teff consumers, and the teff marketing system is becoming more efficient. These changes resulted from an interplay of on the one hand, the increasing availability of improved varieties and chemical fertilizer and an improved extension system in rural areas, and on the other hand, the increasing downstream demand for commercial teff driven by growing incomes, urbanization, and high income elasticities for teff. The changes upstream have especially happened in those areas that are reasonably well connected to the city, illustrating the importance of market access and demand as drivers for rural and agricultural transformation (Wiggins 2000).

While changes are happening, the transformation of the teff production and marketing systems is still in an early stage of agricultural development (e.g. Reardon and Timmer 2007). At the production level, the number of farmers that use improved varieties is still limited, the quantities of chemical fertilizers that are being used are still below the recommended levels, and mechanization, which is quickly happening in other emerging economies (e.g. Yang et al. 2013; Binswanger 1986), are still completely absent. We also observe very little vertical integration and coordination mechanisms between teff production and marketing. Midstream and downstream, we see little evidence of up-scaling of trade, of modern retail, and of branding, which are typically seen as agricultural market development gets underway (Reardon et al. 2012).

Despite the progress, there are therefore still a number of constraints that need to be addressed to facilitate further transformation in the upstream production portion of the teff value chain in Ethiopia. First, while the *quncho* variety has quickly taken off, there is still major room for improved variety development. For example, a major problem in teff cultivation is the problem of lodging of the crop, but lodging resistant varieties have not yet been developed. There has also been little attention in current breeding programs to taste preferences and downstream requirements (as, for example, shown in complaints on the drying out disadvantages of the improved white teff variety *quncho*), as well as disease and pest resistant varieties. Further, teff breeding has until now focused on conventional cross-breeding and selection techniques. More sophisticated techniques that allow for a faster selection process are currently available[13] and should best be employed to enhance availability of a larger portfolio of improved teff varieties to farmers.

Second, besides improved seed development, little is currently known on the potential of other technologies to improve teff productivity. For example, randomized control trials at the farm level are now underway to evaluate the potential of row planting and transplanting toward improved teff productivity.[14] On-station trials have also shown high responses to fertilizers that contain zinc and copper (Tareke 2011), as well as a good effect of minimal tillage methods (Habtegebriel, Singh, and Haile 2007), but no research beyond experimental settings has been conducted.

Third, despite the large importance of teff in the local food sector of Ethiopia, investments in research toward the development of improved agronomic practices have not been at appropriate levels. [15,16] The neglect of teff in research and development illustrates the importance of demand analysis and priority setting for the future. Given consumption patterns in Ethiopia as well as high economic growth, it was and is expected that there is a rapidly increasing demand for teff and,

---

[13] Including a technique of doubling the chromosome number of gametes at the first generation after crossing (known as *gynogenesis based doubled haploid production*) (Tareke 2011).

[14] By reducing the high seeding rates common currently in teff production, by improving weeding practices, and, thus, by enhancing the nutrient uptake of teff plants, these technologies show great promise. However, they are currently under-evaluated. On-station research indicates that the shift from broadcasting to row planting can reduce seeding rates by 90 percent. Lower planting densities result in increased tillering, much stronger stems, and increased grain yields (Tareke 2010).

[15] This is illustrated by the fact that teff is not one of the targeted value chains in the largest current investment program in the high-potential areas in the country, the Agricultural Growth Program (AGP) of the government.

[16] This is explained by a number of reasons. Attention to teff by Ethiopian agricultural researchers was discouraged locally during the Derg period in the 1970s and 1980s (Tareke 2011). Internationally, teff does not fit well within the agricultural research priorities of the international agricultural research institutes of the CGIAR (Consultative Group for International Agricultural Research). The CGIAR institutes typically work closely with the NARS (National Agricultural Research System) in the development of better varieties and technologies and have seen significant successes over time (Spielman and Pandya-Lorch 2009). However, CGIAR research focuses on crops grown in a large number of countries. Consequently, to date teff has been the subject of almost no research by the CGIAR.

thus, there are likely high pay-offs to public investments in research and development to improve teff production in Ethiopia.[17]

Fourth, while large investments in road improvements have been made in the last decade—Ethiopia started from a low base—the country still has one of the lowest road densities in the world (von Braun and Olofinbiyi 2007). Similarly, while access to information is now widely available for traders and brokers through the rapid development of the mobile phone network in the country over the past ten years, penetration and use of mobile phones by Ethiopian farmers is still one of the lowest in Africa. Further investments in this area would thus be welcome. We also show that urban demand has been a major factor driving rural change. While urbanization has been increasing in Ethiopia, the proportion of the Ethiopian population that resides in urban centers is still one of the lowest in Africa, possibly linked to rural land tenure rules that make rural–urban migration cumbersome.

Fifth, quality demands for teff are on the rise in the marketing system. However, uncertainty on quality rewards for sellers as well as on the exact quality demanded by buyers exists at all levels. This is shown by the mistrust by farmers of traders, the difficulty of finding quality teff in urban areas unless retailers go to teff production zones themselves and link directly with producers, and the mixing of teff with other cereals that consumers are often not aware of. Improved branding practices or vertical coordination could possibly take care of such coordination problems. It is thus expected that such practices will increase over time, especially when consumers are willing to pay for assured quality teff and teff products, as branded products usually are significantly more expensive (Reardon et al. 2012; Minten, Reardon, and Sutradhar 2010). Further stimulation of expansion of a private modern retail sector—that is currently very little involved in cereal trade (Woldu et al. 2013)—might possibly also lead to better coordination toward better quality assurance for teff consumers.

REFERENCES

Aker, J.C., and M. Fafchamps. 2011. *Mobile Phones and Farmers' Welfare in Niger*. Berkeley: University of California Press.

Berhane, G., Z. Paulos, and K. Tafere. 2011. *Foodgrain Consumption and Calorie Intake Patterns in Ethiopia*. ESSP II Working Paper 23. Addis Ababa, Ethiopia: International Food Policy Research Institute / Ethiopia Strategy Support Program II.

Bezemer, D., and D. Headey. 2008. "Agriculture, development, and urban bias." *World Development* 36 (8): 1342–1364.

Binswanger, H.P. 1986. "Agricultural Mechanization: A Comparative Historical Perspective." *The World Bank Research Observer* 1 (1): 27–56.

Collier, P., and S. Dercon. 2009. "African Agriculture in 50 years: Smallholders in a Rapidly Changing World?" Expert Paper for the FAO Conference on "How to Feed the World in 2050?", Rome, 12–13 October.

Cragg, J. G. 1971. "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods." *Econometrica* 39 (5): 829–844.

CSA (Central Statistical Agency). 2012. *Agricultural Sample Survey 2011/2012: Report on area and production of major crops.* Addis Ababa: Central Statistical Agency.

Davis, K., B. Swanson, D. Amudavi, D. Mekonnen, A. Flohrs, J. Riese, C. Lamb, and E. Zerfu. 2010. *In-depth assessment of the public agricultural extension system of Ethiopia and recommendations for impact*. IFPRI discussion paper 1041. Washington, DC: International Food Policy Research Institute.

Demont, M., P. Rutsaert, M. Ndour, and W. Verbeke. 2013. "Reversing urban bias in African rice markets." *World Development*, forthcoming.

Fafchamps, M., and B. Minten. 2001. "Property rights in a flea market economy." *Economic Development and Cultural Change* 49 (2): 229–268.

[17] This can be illustrated by the rate of return to the investments to *quncho* development. Flaherty, Kelemework, and Kelemu (2010) estimate that Ethiopia invested in 2008 70 million USD in agricultural R&D. Assuming, generously, that 10 million USD would have been spent annually on teff research and that the *quncho* development was achieved after breeding investments for 5 years, this leads to a cumulative investment of 50 million USD. The results in Table 4.4 show that productivity of *quncho* is about 10 percent higher than other varieties. Assuming that half of the producers would adopt *quncho* and prices would not change, that would lead to a sustained yearly benefit of 80 million USD. If we spread these benefits over a 20-year period, the rate of return for that investment would amount to 160 percent. Admittedly, no costs for extension efforts are included in this. Even if we would quadruple investments to 200 million USD to account for this, the rate of return would still be high at 40 percent.

Fafchamps, M., and R. Vargas Hill. 2008. “Price Transmission and Trader Entry in Domestic Commodity Markets.” *Economic Development and Cultural Change* (56): 729–766.

Flaherty, K., F. Kelemework, and K. Kelemu. 2010. *Ethiopia: Recent developments in agricultural research*. Washington, DC; Addis Ababa, Ethiopia: International Food Policy Research Institute (IFPRI); Ethiopian Institute of Agricultural Research.

Fufa, B., B. Behute, R. Simons, and T. Berhe. 2011. “Strengthening the tef value chain in Ethiopia.” Mimeo, Agricultural Transformation Agency (ATA), Addis Ababa.

Gabre-Madhin, E.Z. 2001. *Market Institutions, Transaction Costs, and Social Capital in the Ethiopian Grain Market.* IFPRI Research Report 124. Washington, DC: International Food Policy Research Institute.

Gulati, A. et al. 2007. “Growth in high-value agriculture in Asia and the emergence of vertical links with farmers.” In *Global Supply Chains, Standards and the Poor*. Edited by J.F.M. Swinnen. Oxford: CABI publishing.

Habtegebrial, K., B. R. Singh, and M. Haile. 2007. “Impact of tillage and nitrogen fertilizer on yields, nitrogen use efficiency of teff (*Eragrostis tef* (Zucc.) Trotter) and soil properties.” *Soil and Tillage Research* 94: 55–63.

Haggblade, S., and P. Hazell. 2010. *Successes in African Agriculture: Lessons for the Future.* Baltimore: Johns Hopkins University Press.

Henson, S., and T. Reardon. 2005. “Private agri-food standards: implications for food policy and the agri-food system.” *Food Policy* 30: 241–253.

Jensen, R. 2007. “The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector.” *Quarterly Journal of Economics* 127 (3): 879–924.

Jerven, M. 2013. *Poor Numbers: How we are misled by African development statistics and what to do about it.* Ithaca, NY: Cornell University Press.

Kenea, Y., G. Ayele, and W. Negatu. 2001. “Farming Research on Teff: Small Holders Production Practices.” In *Narrowing the Rift: Teff Research and Development.* Edited by H. Tefera, G. Belay, and M. Sorrels, 9–23. Addis Ababa, Ethiopia: Ethiopian Agricultural Research Organization (EARO).

Kennedy, E., and T. Reardon. 1994. “Shift to non-traditional grains in the diets of East and West Africa: Role of women’s opportunity cost of time.” *Food Policy* 19 (1): 45–56.

Kherallah, M., C. Delgado, E. Gabre-Madhin, N. Minot, and M. Johnson. 2002. *Reforming agricultural markets in Africa*. Baltimore: John Hopkins University Press and International Food Policy Research Institute.

Maertens, M., and J.F.M. Swinnen. 2009. “Trade, standards, and poverty: evidence from Senegal.” *World Development* 37: 161–178.

Mason, N.M., T.S. Jayne, C. Donovan, and A. Chapoto. 2011. “Are staple foods becoming more expensive for urban consumers in eastern and southern Africa? Trends in food prices, marketing margins and wage rates in Kenya, Malawi, Mozambique, and Zambia.” In *The food and financial crises in sub-Saharan Africa: origins, impacts and policy implications*. Edited by D.R. Lee, and M. Ndulo, 154–188. Wallingford: CABI.

McCullough, E.B., P.L. Pingali, and K.G. Stamoulis. 2008. *The Transformation of Agri-Food Systems: Globalization, Supply Chains and Smallholder Farmers.* Rome: Food and Agriculture Organization of the United Nations.

Mergenthaler, M., K. Weinberger, and M. Qaim. 2009. “The food system transformation in developing countries: a disaggregate demand analysis for fruits and vegetables in Vietnam.” *Food Policy* 34: 426–436.

Minot, N., and D. Roy. 2007. “Impact of high-value agriculture and modern marketing channels on poverty: An analytical framework.” Mimeo, International Food Policy Research Institute, Washington, DC.

Minten, B., K.A.S. Murshid, and T. Reardon. 2012. “Food quality changes and implications: Evidence from the rice value chain of Bangladesh.” *World Development* 42: 100–113.

Minten, B., L. Randrianarison, and J. Swinnen. 2009. “Global retail chains and poor farmers: Evidence from Madagascar.” *World Development* 37(11): 1728–1741.

Minten, B., T. Reardon, T., and R. Sutradhar. 2010. “Food prices and modern retail: The case of Delhi.” *World Development* 38 (12): 1775–1787.

Minten, B., D.C. Stifel, and S. Tamru. 2012. *Structural transformation in Ethiopia: Evidence from cereal markets*. ESSP II Working Paper 39. Addis Ababa, Ethiopia: International Food Policy Research Institute / Ethiopia Strategy Support Program II.

MoFED (Ministry of Finance and Ecomomic Development). 2008. *Dynamics of Growth and Poverty in Ethiopia (1995/96–2004/05).* Addis Ababa, Ethiopia: Ministry of Finance and Economic Development, Federal Democratic Republic of Ethiopia.

———. 2012. *Ethiopia's Progress towards Eradicating Poverty: An Interim Report on Poverty Analysis Study (2010/2011).* Addis Ababa, Ethiopia: Ministry of Finance and Economic Development, Federal Democratic Republic of Ethiopia.

Morris, M., V.A. Kelly, R.J. Kopicki, R.J., and D. Byerlee. 2007. *Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines.* Directions in Development Paper 39037. Washington, DC: World Bank.

Nang'ole, E.M., D. Mithöfer, and S. Franzel. 2011. *Review of guidelines and manuals for value chain analysis for agricultural and forest products.* ICRAF Occasional Paper 17. Nairobi: World Agroforestry Centre.

Nweke, F. 2009. "Resisting Viruses and Bugs: Cassava in Sub-saharan Africa." In *Millions fed: Proven successes in agricultural development*. Edited by D. Spielman, and R. Pandya-Lorch, 41–46. Washington, DC: International Food Policy Research Institute (IFPRI).

Pingali, P. 2007. "Westernization of Asian diets and the transformation of food systems: implications for research and policy." *Food Policy* 32: 281–298.

Poulton, C., J. Kydd, and A. Dorward. 2006. "Overcoming Market Constraints on Pro-Poor Agricultural Growth in Sub-Saharan Africa." *Development Policy Review* 24 (3): 243–277.

Rakotoarisoa, M., M. Iafrata, and M. Paschali. 2011. *Why has Africa become net food importer? Explaining Africa's agricultural and food trade deficit*. Rome: Food and Agriculture Organization of the United Nations.

Rashid, S. 2011. *Intercommodity price transmission and food price policies: An analysis of Ethiopian cereal markets*. IFPRI Discussion Paper 1079. Washington, DC: International Food Policy Research Institute (IFPRI).

Reardon, T., and C.P. Timmer. 2007. "Transformation of Markets for Agricultural Output in Developing Countries since 1950: How Has Thinking Changed?" In *Handbook of Agricultural Economics*. Vol.3, edited by R. E. Evenson and P. Pingali, 2808–2855. Amsterdam: Elsevier Press.

Reardon, T., C. Barrett, J. Berdegué, and J.F.M. Swinnen. 2009. "Agrifood Industry Transformation and Small Farmers in Developing Countries." *World Development* 37 (11): 1717–1727.

Reardon, T., K. Chen, B. Minten, and L. Adriano. 2012. *The Quiet Revolution in Staple Food Value Chains. Enter the Dragon, the Elephant, and the Tiger.* Mandaluyong City, Philippines: Asian Development Bank (ADB); International Food Policy Research Institute (IFPRI).

Reardon, T., C.P. Timmer, C.B. Barrett, and J. Berdegue. 2003. "The rise of supermarkets in Africa, Asia, and Latin America." *American Journal of Agricultural Economics* 85: 1140–1146.

Ricker-Gilbert, J., T.S. Jayne, and E. Chirwa. 2011. Subsidies and Crowding Out: A Double-Hurdle Model of Fertilizer Demand in Malawi. *American Journal of Agricultural Economics* 93 (1): 26–42.

Schmidt, E., and M. Kedir. 2009. *Urbanization and Spatial Connectivity in Ethiopia: Urban Growth Analysis Using GIS*. ESSP II Working Paper 3. Addis Ababa, Ethiopia: International Food Policy Research Institute / Ethiopia Strategy Support Program II.

Smale, M., and T.S. Jayne. 2009. "Breeding an 'Amaizing' crop: Improved maize in Kenya, Malawi, Zambia and Zimba-bwe." In *Millions fed: Proven successes in agricultural development*. Edited by D. Spielman, and R. Pandya-Lorch. R, 33–40. Washington, DC: International Food Policy Research Institute (IFPRI).

Smale, M., D. Byerlee, and T. Jayne. 2011. *Maize revolutions in Sub-Saharan Africa*. World Bank Policy Research Paper 5659. Washington, DC: World Bank.

Spielman, D., and R. Pandya-Lorch. 2009. *Millions fed: Proven successes in agricultural development*. Washington, DC: International Food Policy Research Institute.

Tareke, B. 2010. "Implementation of modern improvement techniques to boost the productivity of teff in Ethiopia." Mimeo, research proposal for submission to USAID/Ethiopia.

———. 2011. “Teff breeding concept note.” Mimeo.

Timmer, C.P. 2009. “Do supermarkets change the food policy agenda?” *World Development* 37: 1812–1819.

Tsakok, I. 2011. *Success in agricultural transformation*. Cambridge: Cambridge University.

United Nations (UN) Population Division. 2010. *World Urbanization Prospects: The 2009 Revision*. New York: UN Population Division.

Von Braun, J., and T. Olofinbiyi. 2007. *Famine and food security in Ethiopia.* Case study #7-4 of the program: “Food policy for developing countries: The role of government in the global food system” 2007, edited by P. Pinstrup-Andersen, and F. Cheng. Ithaca, NY: Cornell University.

Webber, M., and P. Labaste. 2009. *Building competitiveness in Africa’s agriculture: a guide to value chain concepts and applications*. Washington DC: World Bank.

Wiggins, S. 2000. “Interpreting changes from the 1970s to the 1990s in African agriculture through village studies.” *World Development* 28 (4): 631–662.

Woldu, T., G. Abebe, I. Lamoot, and B. Minten. 2013. *Urban Food Retail in Africa: The Case of Addis Ababa, Ethiopia*. ESSP Working Paper 50. Addis Ababa, Ethiopia: International Food Policy Research Institute / Ethiopia Strategy Support Program II.

World Bank. 2005. *The Dynamics of Vertical Coordination in Agrifood Chains in Eastern Europe and Central Asia: Implications for Policy and World Bank Operations*. Washington, DC: World Bank.

———. 2013. *Agri-business in Africa: Removing barriers to regional trade to food staples*. Washington, DC: World Bank.

Yang, J., Z. Huang, X. Zhang, and T. Reardon. 2013. “The Rapid Rise of Cross-Regional Agricultural Mechanization Services in China.” *American Journal of Agricultural Economics* 95 (5), forthcoming.

Yanggen, D., V. Kelly, T. Reardon, A. Naseem, M. Lundberg, M. Maredia, J. Stepanek, and M. Wanzala. 1998. *Incentives for fertilizer use in Sub-Saharan Africa: A review of empirical evidence on fertilizer response and profitability.* International Development Working Paper 70. East Lansing: Department of Agricultural Economics, Michigan State University.

Yu, B., and A. Nin-Pratt. 2011. *Agricultural productivity and policies in Sub-Saharan Africa*. IFPRI Discussion Paper 1150. Washington, DC: International Food Policy Research Institute (IFPRI).

About ESSP II

The Ethiopia Strategy Support Program II is an initiative to strengthen evidence-based policymaking in Ethiopia in the areas of rural and agricultural development. Facilitated by the International Food Policy Research Institute (IFPRI), ESSP II works closely with the government of Ethiopia, the Ethiopian Development Research Institute (EDRI), and other development partners to provide information relevant for the design and implementation of Ethiopia's agricultural and rural development strategies. For more information, see http://www.ifpri.org/book-757/ourwork/program/ethiopia-strategy-support-program or http://essp.ifpri.info/ or http://www.edri-eth.org/.

About these working papers

The ESSP Working Papers contain preliminary material and research results from IFPRI and/or its partners in Ethiopia. The papers are not subject to a formal peer review. They are circulated in order to stimulate discussion and critical comment. The opinions are those of the authors and do not necessarily reflect those of their home institutions or supporting organizations.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

2033 K Street, NW | Washington, DC 20006-1002 USA | T: +1.202.862.5600 | F: +1.202.457.4439 | Skype: ifprihomeoffice | ifpri@cgiar.org | www.ifpri.org

IFPRI–ESSP II ADDIS ABABA

P.O. Box 5689, Addis Ababa, Ethiopia | T: +251.11.617.2000 | F: +251.11.646.2318 | mahlet.mekuria@cgiar.org | http://essp.ifpri.info

ETHIOPIAN DEVELOPMENT RESEARCH INSTITUTE

P.O. Box 2479, Addis Ababa, Ethiopia | T: +251.11.550.6066 ; +251.11.553.8633 | F: +251.11.550.5588 | info@edri-eth.org | www.edri-eth.org