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Seed, Fertilizer, and Agricultural Extension in Ethiopia

David J. Spielman, Dawit Kelemwork, and Dawit Alemu

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Table of Contents

Acknowledgment.....	2
Abstract.....	2
1. Introduction.....	3
2. Ethiopia's input systems and markets in historical perspective.....	4
3. Seed systems and markets.....	9
3.1. Improved seed adoption.....	9
3.2. Seed demand and supply.....	12
3.3. Seed industry structure.....	12
4. Fertilizer markets.....	19
4.1 Fertilizer uptake.....	19
4.2. Fertilizer prices and profitability.....	21
4.3. Fertilizer market structure.....	23
5. Agricultural extension services.....	25
6. Conclusions and policy implications.....	28
References.....	30

List of Tables

Table 2.1. Policy regimes and development programs in agricultural input systems and markets, 1957–1995.....	6
Table 2.2. Yields in on-farm field trials vs. farmers' yields, 1993–2008 (metric tons/hectare)	7
Table 2.3. Policy regimes and development programs in agricultural input systems and markets, 1995-present	8
Table 3.1. Seed supply shortfalls in Ethiopia, 2005–08	12
Table 4.1. Fertilizer value cost ratios, 1992–2008 ^a	22
Table 5.1. Development Agents (DAs) and Farmer Training Centers (FTCs), 2008	26
Table 5.2. Agricultural Technical and Vocational Education and Training (ATVET) colleges graduates, 2003–04 to 2007–08	27

List of Figures

Figure 2.1. Total and per capita grain production and grain yields, 1991–92 to 2007–08	5
Figure 3.1. Area under improved seed application and quantity of improved seed distributed, for cereals only, 1993–94 to 2007–08.....	11
Figure 3.2. Area under improved seed application, main cereal crops, 1995–96 to 2007–08	11
Figure 3.3. A schematic of the Ethiopian seed system	13
Figure 3.4. Hybrid maize seed distribution by type of supplier, 1993–2008	14
Figure 3.5. Basic seed demand and supply for maize hybrid multiplication, 2006–2008.....	15
Figure 3.6. Raw seed production, Ethiopian Seed Enterprise, 2000–2008	16
Figure 3.7. Hybrid maize seed-to-grain price ratios and real seed prices, 1991–92 to 2007–08.....	17
Figure 4.1. Fertilizer imports, 1996–2008	20
Figure 4.2. Fertilizer use intensity, 1996–2008	20
Figure 4.3. Fertilizer value cost ratios, 1992–2008	21
Figure 4.4. Fertilizer import shares by type of importer, 1996–2008 ^a	23

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Abstract

Over the past four decades, decision-makers in Ethiopia have pursued a range of policies and investments to boost agricultural production and productivity, particularly with respect to the food staple crops that are critical to reducing poverty in the country. A central aim of this process has been to increase the availability of improved seed, chemical fertilizers, and extension services for small-scale, resource-poor farmers. While there is some evidence to suggest that the process has led to improvements in both agricultural output and yields, decision-makers still recognize that there is an urgent need for more substantial improvement. This paper attempts to synthesize the lessons learned from Ethiopia's past experiences with providing smallholders with access to seed, fertilizer, and extension services, identify challenges facing the country's continuing efforts to strengthen its input systems and markets, and recommend policy solutions for the future. The paper does so by specifically focusing on three policy "episodes" in Ethiopia's recent history to shed light on the potentially complementary, but often conflicting, roles played by the public and private sectors in the provision of seed, fertilizer, and extension services.

Keywords: Agricultural development, agricultural extension, fertilizer, seed markets, cultivar improvement, Sub-Saharan Africa, Ethiopia

1. Introduction

Over the past two decades, decisionmakers in Ethiopia have pursued a range of policies and investments to boost agricultural production and productivity, particularly with respect to the food staple crops that are critical to reducing poverty in the country. A central aim of this process has been to increase the availability of improved seed, chemical fertilizers, and extension services for small-scale, resource-poor farmers, particularly those cultivating food staple crops. While there is some evidence to suggest that the process has led to improvements in both output and yields during this period, decisionmakers still recognize that there is extensive room for improvement. And given the persistent food security issues facing Ethiopia year on year, there is a sense of urgency underlying the need for improvement.

This paper begins with a brief overview of efforts to promote improved seed, chemical fertilizers, extension services, and other modern agricultural inputs and services in Ethiopia. Following a brief review of sequential programs aiming to promote agricultural development and intensification, we focus this discussion of history to three policy “episodes” that have occurred over the past two decades.

We then examine the systems and markets for seed, fertilizer, and extension. We do so by exploring both the theoretical and practical roles of the public and private sectors as they relate to seed, fertilizer, extension systems, and markets. We conclude by offering several policy solutions that aim to encourage investment, improve incentives, and strengthen institutions necessary to improve smallholder access to improved seed, chemical fertilizers, and extension services in Ethiopia.

2. Ethiopia's input systems and markets in historical perspective

Ethiopia presents one of the most important global challenges in agricultural development. It is among the poorest countries in the world, and its agricultural sector accounts for about 44 percent of national GDP, 85 percent of employment, and 90 percent of the poor. Rural poverty is further compounded by extreme land shortages in the highlands (where per capita land area has fallen from 0.5 ha in the 1960s to only 0.2 ha by 2008), low productivity of food production (with cereal yields averaging around 1.5 ton/ha), recurrent droughts and variable rainfall, and, as a consequence, high variability in agricultural production (World Bank 2005). As a result, Ethiopia experiences widespread structural food deficits that lead to chronic dependence on food aid.

Accordingly, the Government of Ethiopia (GoE) has consistently emphasized agricultural productivity growth and food security in its long-term development strategies. Key components of these strategies date back to the mid-1960s with the introduction of policies and programs specifically aimed at increasing access to modern inputs and extension services for the country's largely smallholder-based agricultural sector (Table 2.1).

The first such programs were organized as Comprehensive Integrated Package Projects (CIPPs) and promoted by the Imperial regime during the period 1968–1973. On the ground implementation focused on the promotion of modern inputs, credit, extension services, and the formation of cooperative societies, and were highlighted by area development programs—the Chilalo Agricultural Development Unit (CADU 1967), the Wolaita Agricultural Unit (WADU 1970), and the Ada District Development Project (ADDP 1972). While these programs helped to develop Ethiopia's expertise in agricultural intensification, their scale was too small to boost output or productivity. Thus, by the end of the Imperial era, Ethiopia's extension services reached only about 16 percent of the farming population, while input and credit provision catered largely to the feudal class rather than the smallholder population engaged in food production (Rahmato 2004).

The first Minimum Package Program (1971–1979) attempted to expand access to modern inputs such as improved seed and fertilizer, while simultaneously reducing the level and cost of services provided to smallholders. A minimum package area comprised about 10,000 farm households residing along a main all-weather road for 50–75 km and away from the road for 5–10 km on both sides.

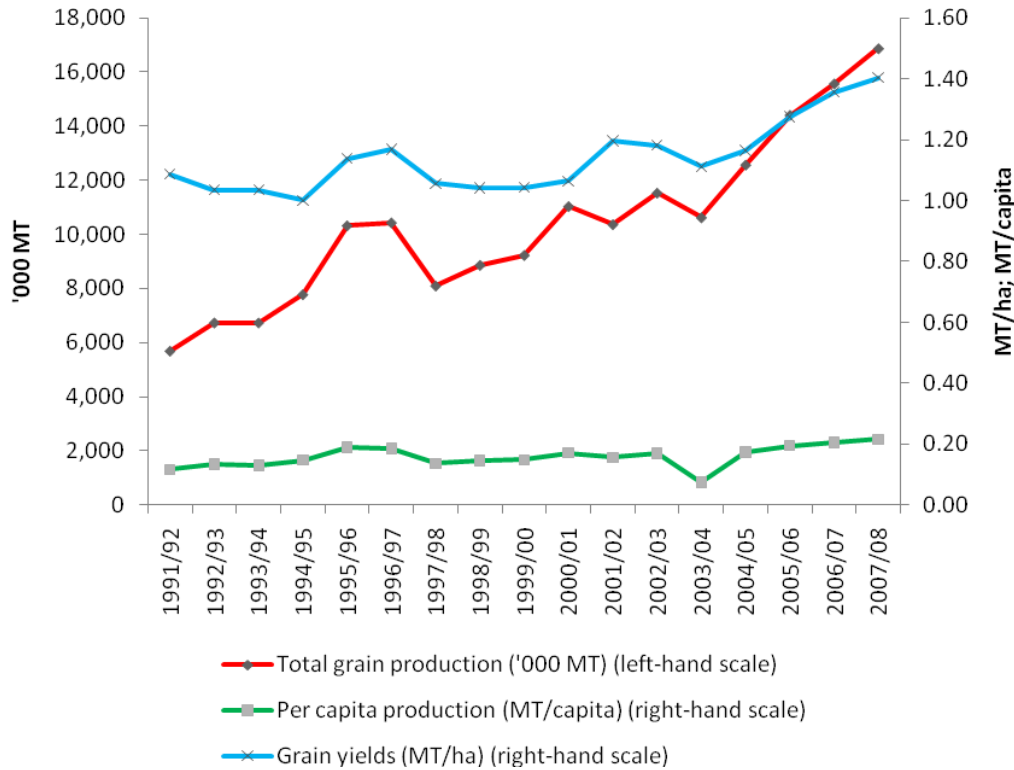
Although the program was designed during the Imperial era, its implementation continued into the military *Derg* regime that followed (1974–1991). During this latter regime, economic reforms undertaken by the *Derg* led to significant changes in Ethiopia's rural landscape. The feudal system was summarily dismantled; agricultural production was organized around peasant cooperatives, state-owned farms, and collectives; and the formal research and extension systems were expanded throughout the entire country. But by the end of the *Derg* regime, the extension services had been reduced to instruments of political control over the peasantry, while input and credit provision was largely focused on covering the inefficiencies of large state farms and peasant collectives (Wubneh 2007).

Since the end of the *Derg* in 1991, the GoE has introduced new policies to intensify cereal production, accelerate agricultural growth, and achieve food security under a national economic strategy known as Agriculture Development Led Industrialization (ADLI) (FDRE 2006a, 2002, 1993). During the 1990s, ADLI set in motion a series of reforms that sought to generate a more supportive macroeconomic framework, liberalize markets for agricultural products, and promote the intensification of food staple production through the use of modern inputs, especially seed and fertilizer packages (FDRE 2006a, 2002). The

intensification campaign focused on cereals in the moisture-reliable highlands where 60 percent of the rural population lives and where the strategy had the best chance of success.

By and large, the GoE's macroeconomic reforms have been successful, resulting in more than a decade of sustained economic growth. Similarly, the GoE's cereal intensification efforts have experienced similar successes, although growth has been more episodic than continuous, with fairly stagnant per capita production of grain (Table 2.1).

Figure 2.1. Total and per capita grain production and grain yields, 1991–92 to 2007–08



Note: The term “grain” refers to all cereals, legumes, and pulses cultivated in Ethiopia.
 Source: CSA, various years.

The first episode of success ran from about 1994–95 to 2000–01, and hinges on the achievements of the National Agricultural Extension Intervention Program (NAEIP). The NAEIP was a scale-up of the Participatory Demonstration and Training Extension System (PADETES), an integrated program of extension, seed, fertilizer, and credit that was piloted by Sasakawa Global 2000 (SG2000), an international nongovernmental organization. The NAEIP reached about 40 percent of the roughly 10 million farm households in Ethiopia over a 10-year period. The extensive data from millions of demonstrations carried out through PADETES (3.6 million in 1999 alone) indicated that the adoption of seed-fertilizer technologies could more than double cereal yields (Table 2.2) and would be profitable to farmers in moisture-reliable areas (Howard et al. 2003).

Table 2.1. Policy regimes and development programs in agricultural input systems and markets, 1957–1995

Period	Intervention/Event	Focus/Objectives	Remarks
1957-1967	First and Second Five Year Development Plans	Develop large-scale commercial farms and coffee exports	Subsistence farming was neglected
1968-1973	Third Five Year Development Plan (Comprehensive Integrated Package Projects)	Transport infrastructure development; dissemination of high-input technologies, credit, and extension; formation of cooperative societies.	Implementation revolved around three comprehensive extension programs that focused on high-potential areas only.
1971-1979	Minimum Package Program I (MPP-I)	Expand geographic coverage of the comprehensive extension programs; provide fertilizer, credit, and extension to "minimum package areas."	Fertilizer procurement managed by Agricultural and Industrial Development Bank (AIDB), distribution managed by Ministry of Agriculture (MoA).
1978	Agricultural Marketing Corporation (AMC)	Improve management of agricultural input importation, storage, and transport by handing over control of these tasks to the AMC.	MoA maintains role of distributing fertilizer to farmers, disbursing credit, and estimating fertilizer demand through approx 18,000 peasant associations.
1980-1985	Minimum Package Program II (MPP-II)	Expand input supply and extension service coverage three-fold.	Actual provision of inputs and extension was limited due to: lacking financial support for MPP-II; increasing inefficiency in MoA and AMC; fertilizer overstocking due to inaccurate demand estimates; and poor institutional coordination of input deliveries.
1984	Agricultural Input Supply Corporation (AISCO)	Improve the importation and distribution of fertilizer and marketing of other agricultural inputs.	As a successor to AMC, AISCO was limited by lengthy bureaucratic process needed to secure foreign exchange, high freight costs, lack of proper port facilities, high inland transport costs, inaccurate demand estimates, and organizational inefficiency.
1986-1995	Peasant Agricultural Development Program (PADEP)	Provide inputs, credit, and extension services to smallholders organized into approximately 2,900 farmer service cooperatives (SC) using a Training and Visit (T&V) extension approach.	As a successor to MPP-II, PADEP aimed to cover 8 development zones across the country, but only received financing sufficient for 3 zones, all located in high potential areas.

Source: Stepanek 1999; Demeke 1995; Gebremedhin et al. 2006; Abate 2008; and authors.

Table 2.2. Yields in on-farm field trials vs. farmers' yields, 1993–2008 (metric tons/hectare)

Crop	SG2000 1993–1999)		NAEIP (1995–1999)		Current farm yields (2000–08)
	Improved	Traditional	Improved	Traditional	
Maize	4.60	1.57	4.73	1.57	1.98
Wheat	2.31	0.95	2.93	1.17	1.47
Sorghum	2.08	0.92	2.79	1.12	1.4
Teff	1.62	0.64	1.43	0.85	0.93
Barley	–	–	2.15	1.00	1.19

a NAEIP is the National Agricultural Extension Intervention Program. SG2000 is the Sasakawa Global 2000 program.
Source: World Bank 2006b.

This episode was succeeded by a period of volatility (2001–02 to 2002–03) that demonstrated just how susceptible Ethiopia's agricultural economy is to weather and price shocks. First, maize prices collapsed in 2001, partly as a consequence of a glut that resulted from intensification of maize production in the 1990s. A drought soon followed, contributing to further reductions in cereal production (DSA 2006).

The next episode might be described as a period of rapid agricultural growth. Following a recovery from the drought, agricultural GDP growth averaged 12 percent per annum between 2003–04 and 2007–08. But this growth period was paradoxically accompanied by a surge in food price inflation which escalated from 2 percent in 2003–04 to 78 percent in 2007–08 (Ulimwengu et al. 2009, Mishra 2008) and raises a number of questions including some pertaining to the quality of agricultural production statistics (IFPRI 2009; Minot 2009; Taffesse 2008).

These episodes raise the question of to what extent the policies governing Ethiopia's input markets and extension services have helped or hindered Ethiopia's agricultural intensification efforts over the past 15 years (Table 2.3). While the use of improved seed and chemical fertilizer have increased across these episodes—by about 50 and 30 percent respectively, between 1995 and 2008—the gains have been inconsistent and volatile. Part of this may be attributable to the shifting roles of the public and private sectors, and the occasional policy changes that have influenced their respective roles in different ways. Ethiopia's experiences over the past 15 years, and the issues raised by these experiences, are summarized below for each of the major components of the country's agricultural input system and market—seed, fertilizer, and extension.

Table 2.3. Policy regimes and development programs in agricultural input systems and markets, 1995–present

Period	Intervention/Event	Focus/Objectives	Remarks
1991-1995	Partial liberalization of the fertilizer market	Open the importation, wholesaling, and retailing of fertilizers to private companies.	Undertaken by the Transitional Government of Ethiopia (TGE). Fertilizer prices remained pan-territorial and subsidized.
1993–1999	Participatory Demonstration and Training Extension System (PADETES)	Promote improved seed-fertilizer-credit packages (primarily for maize and wheat) through a “training and visit” approach piloted by Sasakawa Global 2000.	PADETES demonstrated on a pilot basis that yields could be doubled with the application of modern inputs in Ethiopia.
1995–present	National Agricultural Extension Intervention Program (NAEIP)	Scale up the PADETES approach to the national level as a means of boosting cereal yields and output.	Efforts to scale up the PADETES approach were less successful than the piloting demonstrated by Sasakawa Global 2000.
1997-98	Fertilizer price liberalization	Eliminate subsidies and deregulate the price of fertilizer at the wholesale and retail levels.	Liberal prices have not resulted in competitive market due to the government’s continued control over marketing and credit.
2000-07	Shifting industry structure	Private companies withdraw from the fertilizer market in 2000, succeeded by “holding” companies; cooperative unions enter the market in 2005, followed by the withdrawal of “holding” companies” in 2007.	The Agricultural Input Supply Enterprise (AISE) and cooperative unions emerge as the only actors engaged in fertilizer importation, and are also the largest players in the wholesale and retail markets, in conjunction with the regional input supply and extension systems.

Source: Stepanek 1999; Demeke 1995; Gebremedhin et al. 2006; Abate 2008; and authors.

3. Seed systems and markets

From a conceptual perspective, seed systems and markets are subject to at least three unique constraints—three market failures—that complicate early stages of seed market development. These constraints are contestable property rights relating to the improvement of cultivated varieties (cultivars); absent institutions in the market for improved cultivars; and information asymmetries in the exchange of seed between buyers and sellers (Gisselquist and Van Der Meer 2001; Hassan et al. 2001; Morris 1998; Tripp and Louwaars 1997).

The first constraint emerges from the public goods nature of research embodied in improved cultivars and the inherent market failure that accompanies cultivar improvement. Consider a scenario where a farmer saves and replants seed of an improved cultivar across seasons and, in doing so, avoids paying the private innovator who improved the cultivar for his or her investment in research and development (R&D). In this scenario, the social returns from enhanced yields or increased output exceed the returns to the private innovator. This suggests that the public sector must play a continuous role in cultivar improvement, by investing in agricultural R&D.

The second constraint is associated with mechanisms designed to increase the private innovator's capacity to recoup his or her investment in R&D and overcome the market failure described above. Biological mechanisms such as hybridization (common in maize and increasingly in rice, millet, and sorghum) imply that farmers must purchase seed each season to reap the yield benefits of hybrids—the vigor conferred by *heterosis*. Institutional mechanisms such as intellectual property rights (plant variety protection certificates, patents, and trade secrecy laws) similarly allow the innovator to recoup investment costs through litigation when a farmer plants improved cultivars without paying some fee to the innovator for use of the seed. The inability to leverage the biological properties of hybrids, enforce IPRs, or prevent farmers from saving seed can discourage private investment in cultivar improvements that have potentially significant social impacts, thus signaling another difficulty in correcting this market failure.

A third constraint emerges where the characteristics of improved seeds are known only by the innovator, implying that farmers are unable to make accurate *ex ante* assessments of quality, giving unscrupulous sellers an advantage over their customers. Remedies to this include strong regulation of the seed certification process or truth in labeling laws. Importantly, the absence of such regulations—or worse yet, the wholesale deregulation of the seed sector as part of a wider market liberalization program—can inhibit smallholder adoption of improved cultivars (Tripp and Louwaars 1997).

In short, seed is a tricky good to manage due to inherent market failures that are difficult to overcome. We examine these issues in the context of Ethiopia's seed system and market, focusing on the (a) adoption of improved seed, (b) the demand and supply for improved seed, and (c) the seed industry structure.

3.1. Improved seed adoption

Official estimates from the Central Statistics Agency (CSA) show that while the total quantity of improved seed supplied nationally has been increasing since 1996–97, farmer use of improved seed covered an average of only 4.7 percent of cropped area in 2007–08 (Figure 3.1).

Various surveys similarly report low adoption rates, for example, just 3 percent according to the nationally-representative Ethiopia Rural Smallholder Survey (ERSS) conducted in 2005.¹

To be sure, most farmers still rely primarily on farmer-to-farmer exchanges or saved seed (Belay 2004). However, surveys such as these are often unable to provide real insights into the improved seed adoption due to problems in their design. The question that should be asked is what type of variety is a farmer cultivating and when did he or she purchase the seed. For improved open-pollinated varieties such as wheat and teff, farmers do not necessarily need to purchase seed each season as they would hybrid maize. Rather, they might purchase seed every 4-5 years to replace their stocks of saved seed with seed that has a higher level of purity, and thus better performance when cultivated (Doss et al. 2003).²

To be sure, a large portion of wheat cultivated in Ethiopia is improved wheat. Lantican et al. (2005) reported that in 2002, 71 percent of all wheat area in the country was sown with improved varieties. Kotu et al. (2000), Beyene (1998), and Zegeye (2001) report improved wheat adoption in selected *woredas* ranging from 42 to 80 percent during various years in the 1990s. Yet as an indication of just how common long-term seed recycling is among Ethiopian smallholders, Lantican et al. (2005) find that only 43 percent of the area under improved wheat varieties was sown with varieties released since 1995.

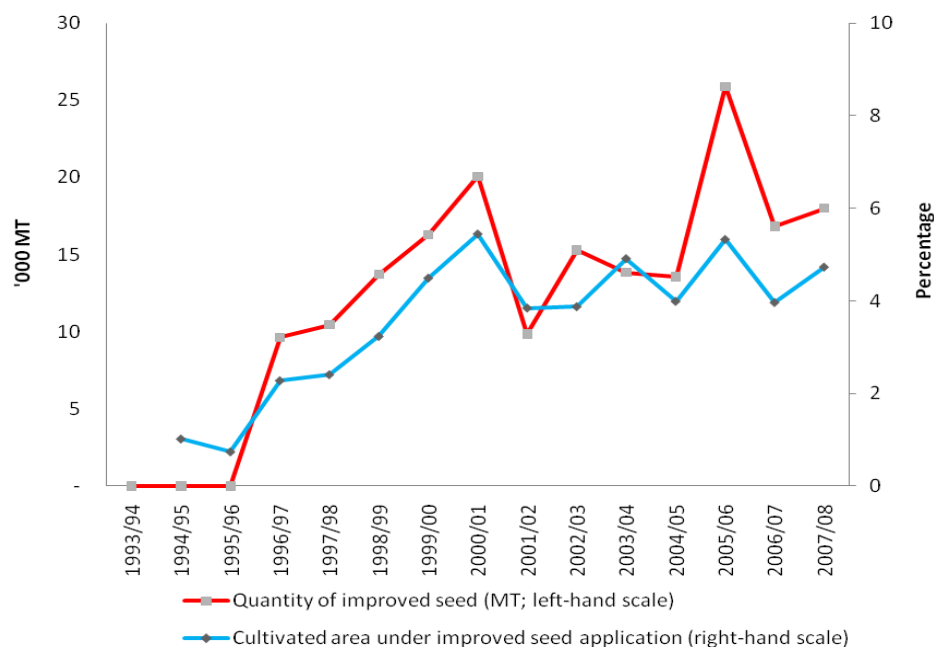
With respect to maize, CSA reports that area under improved varieties and hybrids has grown from 5 percent in 1998 to 20 percent in 2008. Lantican et al. (2005) report that as of 2001, the majority of the improved maize was accounted for by hybrids. Degu et al. (2000) and Zegeye (2001a, b, c) report improved maize adoption in selected *woredas* ranging from 6 to 47 percent during various years in the 1990s. With respect to teff, barley, and sorghum, the other main cereal crops cultivated in Ethiopia, adoption rates are relatively lower than both wheat and maize (Figure).

In short, the conventionally-cited figures—3 percent adoption of improved varieties and 4-5 percent of cropped area under improved varieties—obscure the extensive uptake of improved wheat and, to a lesser extent, improved maize, in Ethiopia. Moreover, these figures obscure the high rates of seed recycling and low rates of seed replacement, suggesting challenges for the promotion and adoption of new cultivars among smallholders.

¹ The Ethiopia Rural Smallholder Survey (ERSS) was conducted by the International Food Policy Research Institute (IFPRI), Ethiopian Development Research Institute (EDRI), and the Central Statistics Agency (CSA). Data were collected mid-2005 from 7,186 households randomly drawn from 293 enumeration areas (EAs, roughly mapping to a kebele) based on a stratified two-stage cluster sample design. The sample is considered representative at the national level as well as at the regional level for four regions: Amhara, Oromia, Tigray, and the Southern Nations, Nationalities, and Peoples (SNNP) regional state. The ERSS survey was based on the CSA's Annual Agricultural Sample Survey (AASS) which used a sampling frame of 25 agricultural households selected from each EA and covered all of rural Ethiopia except Gambella Region and the non-sedentary population of three zones of Afar Region and six zones of Somali Region.

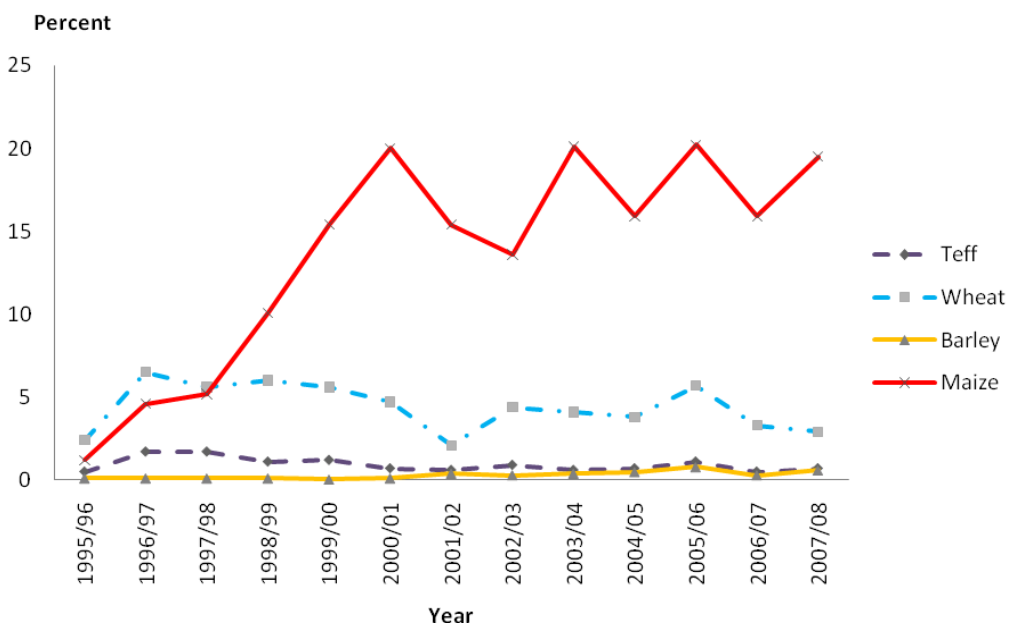
² Interestingly, a study by Bishaw (2004) indicates that the purity and germination rates for farmer saved wheat seed, seed purchased in local markets, and seed purchased or traded from neighbors is comparable to seed supplied by the government (R. Tripp, personal communication. December 18, 2009).

Figure 3.1. Area under improved seed application and quantity of improved seed distributed, for cereals only, 1993–94 to 2007–08



Source: CSA, various years.

Figure 3.2. Area under improved seed application, main cereal crops, 1995–96 to 2007–08



Source: CSA, various years.

3.2. Seed demand and supply

Estimates of market demand for improved seed in Ethiopia are based entirely on official projections that are developed at the local (*kebele*) level and then transmitted through official channels to zonal and regional levels, after which they are aggregated nationally to produce estimates of the type and quantity (but not preferences for specific varieties or traits) of seed that needs to be supplied in the coming season (Alemu et al. 2007).

The responsibility of responding to these demand estimates lies primarily with the state-owned Ethiopian Seed Enterprise (ESE). On the supply side, production and distribution of improved seed has been stagnant since about 2000. At about this same time, the supply of improved seed channeled through the regional extension and input supply system began to fall short of official estimates of demand (with a 72 percent shortfall in 2008 for the five major cereals). Limited production capacity at ESE for certified seed, combined with insufficient provision of breeder and pre-basic seed from the research system, contribute much to these shortfalls.

Assuming that demand estimates are not wholly inaccurate, demand has consistently fallen short of supply, as shown in Table 3.1.

Table 3.1. Seed supply shortfalls in Ethiopia, 2005–08

Crop	Supply as a percent of official demand			
	2005	2006	2007	2008
Wheat	20	38	23	24
Maize	53	28	60	48
Teff	5	12	22	19
Barley	16	18	10	7
Sorghum	Na	7	16	48

Source: MoARD, various years.

And yet, shortcomings in seed quality and timeliness of delivery have been longstanding issues in Ethiopia. Poor cleaning, broken seeds, low germination rates, and the presence of mixed seeds have been reported in ESE-supplied seed (DSA 2006). In addition, reports are common of seed being distributed after the optimal planting time or of varieties being distributed that are not appropriate to changes in farmers' expectations of seasonal weather conditions at the local level (Sahlu and Kahsay 2002; DSA 2006; EEA/EEPRI 2006).

3.3. Seed industry structure

Low adoption rates and shortfalls in the supply of improved cultivars can be partly attributed to bottlenecks emerging from the structure of the seed industry and the regulatory agencies that oversee it. We discuss the structure of the seed industry here in the context of hybrid maize because experience from other industrialized and developing countries has shown hybrid maize to be one of the most lucrative seed businesses available to private innovators and investors primarily due to the ability of innovators to recoup their investments in breeding due to the biological properties associated with hybridization that make saving seed by farmers to be a relatively undesirable practice.

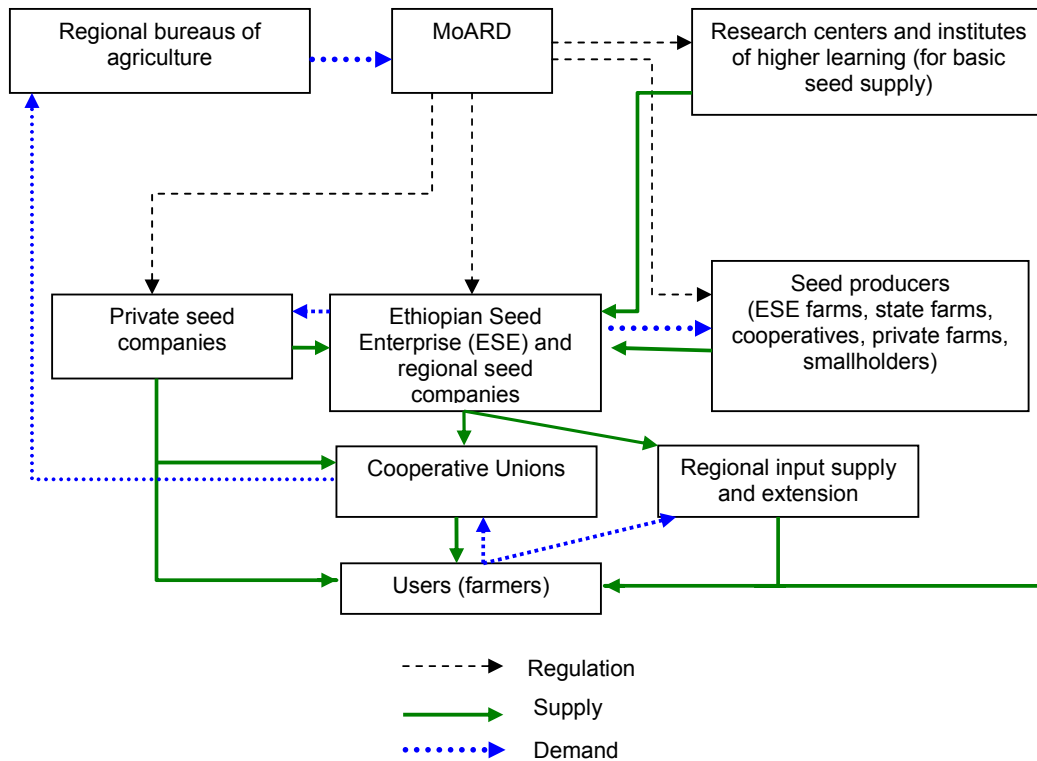
The seed industry in Ethiopia involves a range of both public and private sectors (Figure 3.3; also see Bishaw, Sahlu, and Simane 2008). The national research system—headed by the Ethiopian Institute of Agricultural Research (EIAR) and comprised of a range of federal

research centers, regional research centers, and agricultural universities and faculties—is charged with developing improved varieties and breeder and pre-basic seed needed by other players in the industry. Regulatory functions such as varietal release reviews and seed certification are performed by various departments of the MoARD.

Basic and certified seed production is carried out by the ESE, which relies on its own farms alongside private companies, private subcontractors, state farms, and cooperatives, to bulk up seed that is supplied to the regional extension and input supply systems. More recently, state-owned regional seed enterprises have also emerged in Oromia and SNNPR (in 2008) and in Amhara (in 2009).

Improved certified seed is supplied to Ethiopian smallholders primarily through regional, state-run extension, and input supply systems that operate with a degree of guidance from the federal Ministry of Agriculture and Rural Development (MoARD). This regional system is made up of regional bureaus of agriculture and rural development (BoARDs), their *woreda* (district) offices, and extension agents (termed “development agents” in Ethiopia) working at the *kebele* (peasant association) level. These organizations collaborate closely with farmers’ cooperatives and regional credit and savings institutions in both supplying inputs and disbursing credit.

Figure 3.3. A schematic of the Ethiopian seed system



Source: Authors.

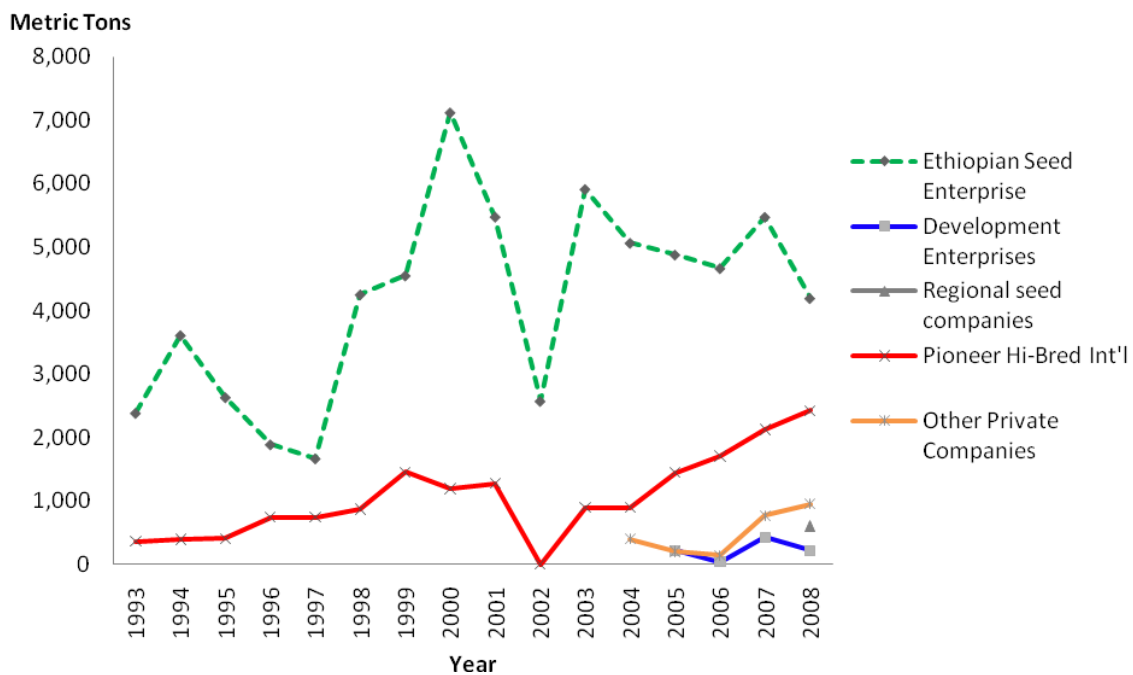
Following market reforms in the 1990s, seed production and distribution were opened to the private sector. In 2004, eight firms were active in seed production, with most of them involved specifically in hybrid maize seed, though primarily as ESE subcontractors (Langyintuo et al.2008; Alemu et al. 2007). By 2008, the number of firms had increased to 11, although most were again operating primarily as ESE subcontractors. In some cases,

these subcontractors also multiply seed for cooperatives, cooperative unions, and regional seed companies, although very few actually sell seed directly to farmers (with the exception of Pioneer Hi-Bred International and a few others).

Despite the lucrative potential of the hybrid maize seed market—a potential that private seed companies have realized in other Sub-Saharan African countries—approximately 60 percent of maize seed was still controlled by the public sector (primarily the ESE and state-owned development enterprises), with an additional 10 percent serving as sub-contractors to the public sector, and 30 percent (Pioneer and a few small private companies) operating independently from the public sector’s seed production system.

An even smaller level of private sector activity is seen in the distribution and retail side of the seed market. The public sector, including the regional extension and input supply systems, accounts for 80 percent of total sales of improved seeds, mostly paid for with credit disbursed against public guarantees (World Bank 2006c). Even Pioneer relies on the public sector to distribute about half of its seed; initially, through the regional input and extension systems and, more recently, through cooperative unions. Most other seed firms simply produce as subcontractors to ESE, which then distributes seed through the regional extension and input supply systems, cooperative unions, and through its own branch offices, satellite stores, and sales points.

Figure 3.4. Hybrid maize seed distribution by type of supplier, 1993–2008



Source: MoARD, various years.

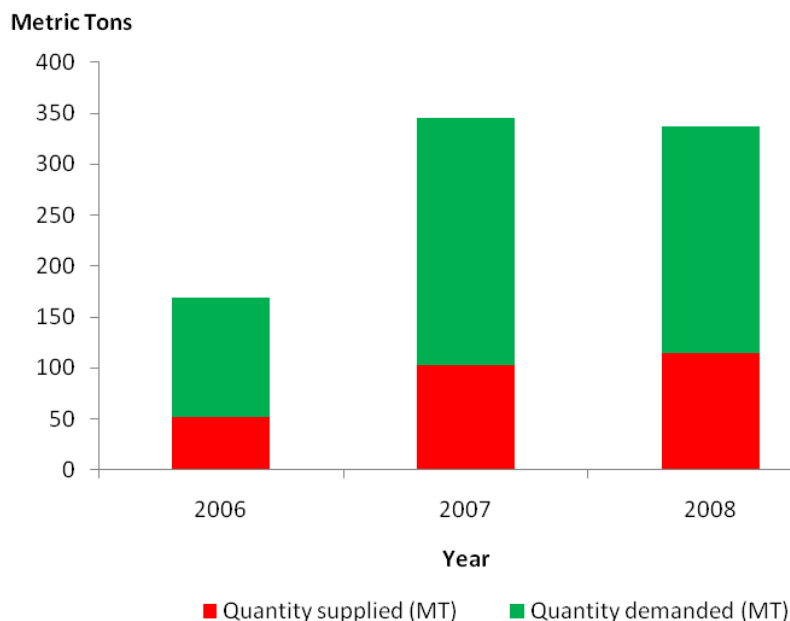
Why is the seed business so difficult to break into in Ethiopia? We examine here the key barriers to entry.

First and foremost, the market failures that characterize seed markets (described earlier) constrain the potential for profitability. Hybrid maize stands out as the exception to this rule because the gains conferred by hybridization can be secured by the farmer year on year

only by purchasing new hybrid seed, while saving hybrid maize seed can result in yield losses by as much as 50 percent, depending on the hybrid type.

Second, the seed business depends on the availability of a good supply of high quality pre-basic and basic seed for the production of certified seed that can then be distributed to farmers. The main sources for pre-basic and basic seed in Ethiopia are the federal and regional research centers and universities (with basic seed also being produced by ESE), and bottlenecks at these institutions create significant shortfalls in the availability of these key inputs (Figure 3.5). In some instances, these shortfalls have been exacerbated by research centers that are engaged not only in producing pre-basic and basic seed, but also in producing certified seed for farmers in areas surrounding the centers. Although the MoARD has taken action to rectify these problematic allocations of scarce seed system resources—for instance, by involving ESE, private firms, and regional seed enterprises in the business of basic seed production—the pressure on the entire seed industry is not easily resolved (MoARD 2008; A. Beshir, personal communication September 30, 2009).

Figure 3.5. Basic seed demand and supply for maize hybrid multiplication, 2006–2008

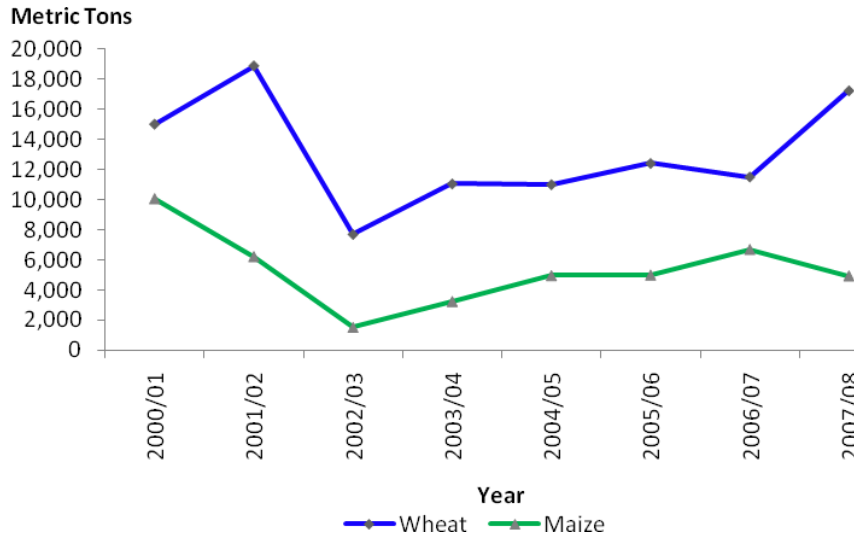


Third, the seed business is risky because seed production is closely correlated to the same weather risks faced by farmers. Hence, seed production in Ethiopia drops during drought periods just as crop production does. Having said this, seed production on irrigated land can mitigate this risk to some extent, and much of ESE’s maize seed production operations and subcontracted production currently take place on irrigated land in the Awash River basin. However, the shortage of irrigated land in Ethiopia makes reliable seed production a real challenge for both the public and private sectors (MoARD 2008).

Fourth, the seed business is often dependent on smallholders themselves as contract growers for ESE’s seed multiplication activities, at least for open-pollinated crops such as lentils, chickpeas, haricot bean, and linseed (but not hybrids due to the technical complexity of hybrid seed production). In 2004/05, ESE produced nearly 8,000 tons of seed through approximately 6,700 contract growers (Beshir 2005). ESE pays a 15 percent premium over grain prices for quality seed grown by smallholders. However, changing grain prices—

particularly low prices at harvesting time and higher prices in planting time—tempt farmers to default on their seed supply contracts to ESE and hold the seed over for sale as grain to local traders and farmers at planting time. This frustrates ESE’s attempt to bulk up seed for certain crops.

Figure 3.6. Raw seed production, Ethiopian Seed Enterprise, 2000–2008



Source: ESE, various years.

Fifth is the issue of price. ESE, the largest seed supplier in Ethiopia, prices its seed at a 5 percent profit margin. But for the industry to be viable, seed prices have to be high enough for private seed firms to recoup their investments in seed production without making seed unaffordable for both farmers who regularly use improved seed and for new adopters. Thus, the optimal seed price is based on the demand derived for the grain that is produced from that seed. A useful benchmark is the seed-to-grain price ratio which, in an emerging maize seed market such as Ethiopia’s, might approach 5:1, eventually increasing to 10:1 as the market matures (Morris 1998). Moreover, seed-to-grain price ratios have fluctuated tremendously: upwards with the collapse of maize prices in 2001–02, down with the drought in 2002–03, and down again to a ratio of 3.42:1 in 2007–08 (Figure 3.7). The volatility in these ratios suggests similarly volatile returns to investing in the maize seed business in Ethiopia, exacerbated by falling real prices for maize seed in the country.

Related to this is the issue of retail pricing to farmers. In each region, cooperative unions are currently charged with distribution of seed sourced from ESE and other seed providers. Regional bureaus of agriculture and rural development set the price at cost plus transportation and a set profit margin, with some inter-regional variations in pricing policies. For example, Oromia region’s Bureau of Agriculture and Rural Development set a profit margin in 2008–09 at 2.5 percent for the cooperative union and 2.5 percent for the primary cooperative. This puts the retail price of hybrid maize seed in Oromia at approximately ETB 11,000 per metric ton, which by comparison, is just 43 percent of Pioneer’s hybrid maize seed, which was sold at ETB 19,200 per metric ton.

Figure 3.7. Hybrid maize seed-to-grain price ratios and real seed prices, 1991–92 to 2007–08



Source: ESE, various years; MoARD, various years.

Yet even Pioneer is marketing their products at relatively low prices by regional standards. This raises the issue of whether Pioneer or another competitor can develop and market a profitable product in Ethiopia. Anecdotal evidence from several sources indicate that the implicit rationing of hybrid maize seed has given rise to a black market in which repackaged (and potentially adulterated) seed sells for two to four times the retail price. This suggests that the market can bear a higher price, whether for hybrids suitable for the highlands such as the ever-popular BH 660 produced by ESE and its subcontractors, or the hybrids suitable for mid-altitudes produced from Pioneer.

Efforts to use smallholders as private agents themselves in the multiplication of seed have met with limited success.³ Though the technical requirements of maize hybrid multiplication (for example, the need for relatively large field size and means of controlling cross pollination) might limit its applicability to small farmers in Ethiopia, there is potential for smallholders to play a larger role in multiplying open-pollinated crops (such as improved wheat varieties). Both the GoE and non-governmental organizations have invested in various projects aimed at strengthening farmers' skills in seed multiplication, with the goal of increasing the supply of seed for improved Varieties, both within communities and to the formal seed system. The outcomes to date have been mixed, partly due to poor incentives offered to farmers, insufficient capacity on both sides, and the constant threat of food insecurity that causes farmers to use their seed stocks for food.

Finally, there is the issue of competitiveness. The public sector remains the main seed supplier in Ethiopia partly because it enjoys an implicit subsidy on both the production end (where high administrative costs do not figure into calculations of ESE's financial viability) and on the marketing end (where regional, state-run extension, and input supply systems handle distribution and retailing). To compete effectively with the public sector, private

³ For a review of Ethiopia's informal seed system and the role of farmer-based seed multiplication programs, see Thijssen et al. 2008.

companies would have to build their own distribution and marketing networks, develop unique product lines that rival ESE products such as BH 660, establish their brand identities and reputations, provide agronomic services to support their customers, and price their products competitively. At present, only Pioneer markets its own product lines through a network of 15 dealers and through direct sales to state farms, commercial farms, cooperative unions, nongovernmental organizations, and from warehouse purchases (M. Admassu, personal communication June 16, 2009).

Necessarily, as the maize seed industry in Ethiopia matures and companies begin releasing their own cultivars (rather than multiplying cultivars already released by EIAR), they would also have to contend with significant indirect costs. These costs include the costs associated with navigating the regulatory system, accessing financing from the formal banking sector, and meeting the banks' high collateral requirements. Thus, it is not surprising that Pioneer sells much of its output through official channels (formerly, through the regional extension and input supply systems, and more recently through the cooperative unions). Nor is it surprising that other, smaller private seed companies prefer to operate as ESE subcontractors and/or suppliers to cooperative unions rather than competitors.

In summary, the most lucrative of seed businesses—hybrid maize—has seen very little investment activity in Ethiopia, with far less investment flowing to seed businesses for other crops where the challenges are even greater. Since the introduction of the National Seed Industry Policy in 1992, the GoE has pursued several policies favorable to private sector development such as the basic introduction of a legal framework for seed system operations (Proclamation 206/2000), the inclusion of commercial seed production as a sector under the Investment Code, and the enactment of legislation on breeders' rights and plant variety protection in 2006 (Proclamation 481/2006) (see Bishaw, Sahlu, and Simane 2008).

However, there is little likelihood that these policies will have the desired impact.⁴ Opening commercial seed production to investors, for example, is a policy improvement that goes only so far in the absence of regulations allowing investors to access credit without non-agricultural collateral. Further, plant breeders' rights are only as effective as the sector they are meant to protect and only as strong as the judicial system's capacity to enforce these rights. Moreover, there is limited empirical evidence from other developing countries to suggest that breeders' rights actually stimulate private sector investment (see for example, Gerpacio 2003; Pray, Ramaswami, and Kelley 2001; Alston and Venner 2000; Pray 1992; and Butler and Marion 1985). Finally, it is important to recognize that varietal improvement of many crops in Ethiopia, particularly open-pollinated crops such as wheat, will continue to depend on public breeding and seed production efforts, making the need for organizational reforms in the research system and seed sector as urgent as reforms in the policies governing the seed market itself.

⁴ For example, the administrative procedures necessary to implement the 2006 legislation on breeders' rights and plant variety protection have yet to be implemented.

4. Fertilizer markets

Chemical fertilizer, a more obvious private good than seed, also possesses several features that complicate early stages of market development (Morris et al. 2007; Crawford et al. 2003). On the demand side, the cost of creating fertilizer markets is high where final consumers are widely dispersed geographically, or where their small landholdings and limited cash resources mean that they purchase only small quantities of fertilizer that are more costly for retailers to sell (Harrigan 2008; Jayne et al. 2003). Furthermore, in rainfed areas, fertilizer consumption is highly seasonal (a two to three month market window), and year-to-year fluctuations in rainfall patterns contribute to high inter-year variability in demand for fertilizer, with corresponding risks to dealers of high carryover stocks from year to year. On the supply side, the considerable economies of size in international procurement and shipping imply that fertilizer importers require a high degree of liquidity to procure for the supply chain.

These characteristics suggest that while fertilizer may be a tradable private good, development of fertilizer markets may require some degree of public intervention in financing and market infrastructure development until markets mature. We examine these issues in the context of Ethiopia's fertilizer market, focusing on the (a) uptake of fertilizer, (b) fertilizer prices and profitability, and (c) the fertilizer industry structure.

4.1 Fertilizer uptake

The uptake and use of chemical fertilizer in Ethiopia (primarily DAP and urea) can be assessed in several ways—in terms of total fertilizer imported, percentage of farmers using fertilizer and improved seed-fertilizer packages, percentage of cultivated land under fertilizer application, and household-level estimates of fertilizer application per hectare. We examine these indicators below.

When measured in terms of quantity imported, fertilizer use in Ethiopia has increased from 250,000 tons in 1995 to 400,000 tons of product in 2008 (Figure 4.1). This growth of total fertilizer consumption was more rapid than the average for Sub-Saharan Africa over the same period (Crawford et al. 2006; Jayne et al. 2003).

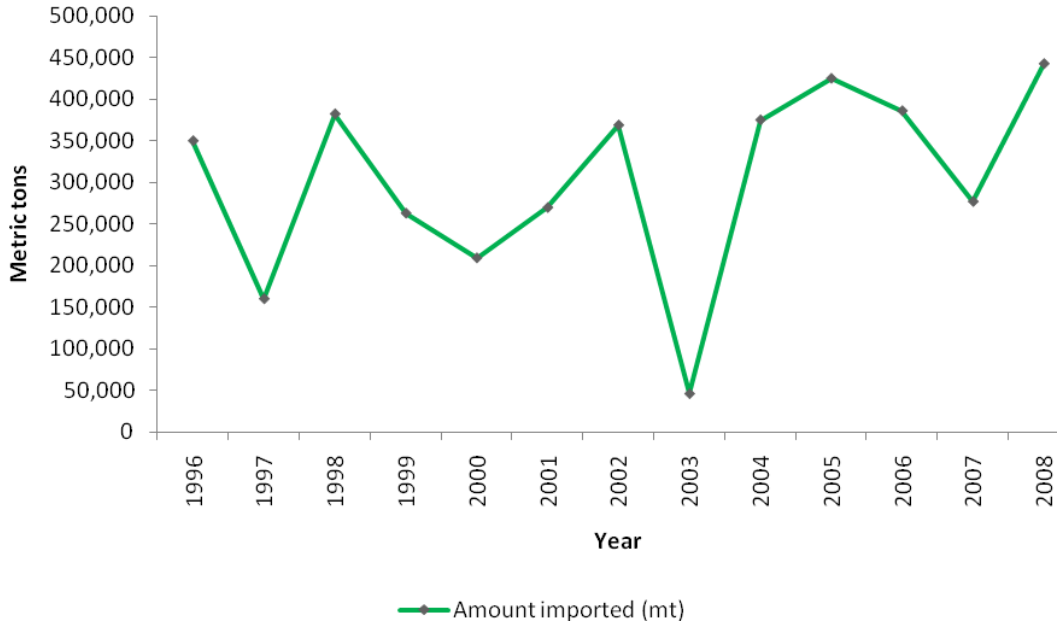
Data on fertilizer use suggest that a significant portion of smallholders use fertilizer: 39 percent according to CSA and 32 percent according to the 2005 ERSS survey. Teff, wheat, and maize cultivation account for the majority of fertilizer use.

However, data on application rates tell a slightly different, and often confusing, story about the intensity of fertilizer use in Ethiopia (Figure 4.2). Fertilizer use intensity, when measured in terms of kg/ha of arable and permanent cropland, is currently estimated at 17 kg/ha of nutrients (about 29 kg/ha of commercial product), which is similar to application rates elsewhere in the region but considerably below comparable smallholder highland farms in neighboring Kenya (applied to 70 percent of maize fields at an average dose for all fields of 45 kg/ha) (Ariga et al. 2008). When measured in terms of kg/ha of land under grain production, the figure increases to 21 kg/ha of nutrients (about 37 kg/ha of commercial product). And when measured in terms of kg/ha of land under grain cultivation where fertilizer is applied (which accounts for 89 percent of all land cultivated in Ethiopia), the figure increases to 48 kg/ha of nutrients (about 83 kg/ha of commercial product), which begins to approach application rates in Asia.

There is also some evidence suggesting that these high fertilizer use intensity figures may be overstating the case. A study conducted by EEA/EEPRI (2006) notes that up to a third of farmers covered by PADETES have dis-adopted the seed-fertilizer technology packages

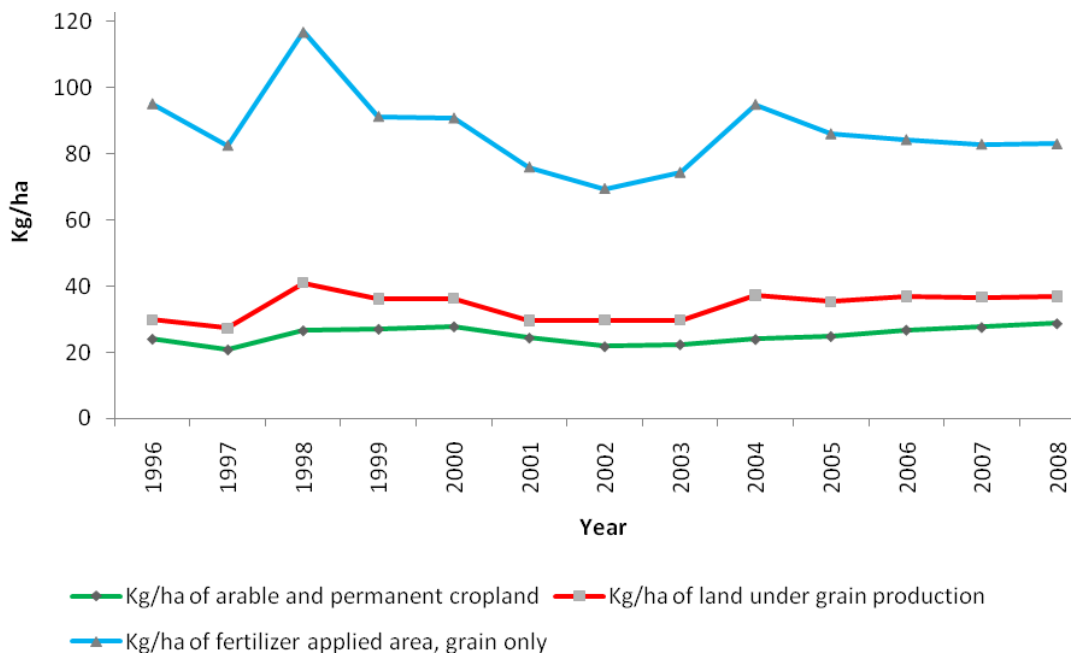
over time, likely due to the high cost of inputs, insufficient credit and credit rationing, a lack of varieties with traits appropriate to farmers' needs, and other factors.

Figure 4.1. Fertilizer imports, 1996–2008



Source: MoARD, various years.

Figure 4.2. Fertilizer use intensity, 1996–2008

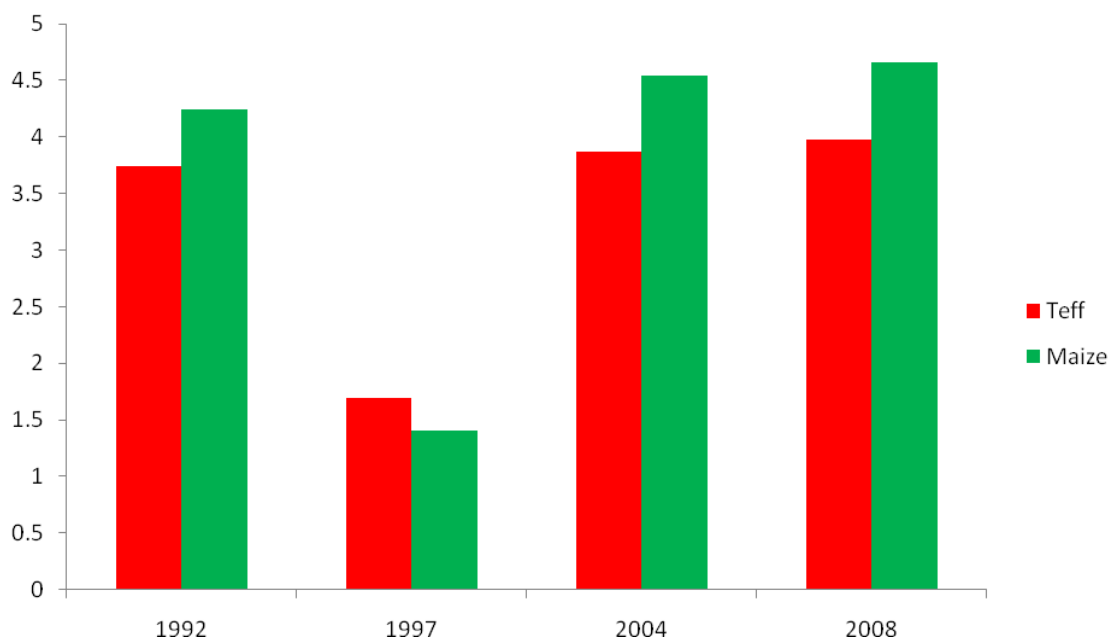


Sources: MoARD, various years; CSA, various years.

4.2. Fertilizer prices and profitability

We explore here the issue of fertilizer demand and supply in terms of the returns to fertilizer use, a subject of extensive discussion in Ethiopia. Estimates of the value cost ratio (VCR)⁵ for four years between 1992 and 2008 are shown in Figure 4.3. Assuming that fertilizer use is profitable where the VCR is greater than two, then the return to fertilizer use has been generally positive in recent years with a VCR around the threshold of 2. And this holds true even when disaggregated by regional markets, except Arsi/Bale for Teff and Welega/Keffa for maize (Table 4.1).

Figure 4.3. Fertilizer value cost ratios, 1992–2008



Sources: For 1992 and 1997, Demeke (1997); for 2004 and 2008, authors' calculations.

These figures suggest that fertilizer prices in Ethiopia are competitive. While the margin between domestic and international prices is higher in Ethiopia than in Asian and Latin American countries, it is still comparable to the margin in other Sub-Saharan African countries, including South Africa. And while the price build-up from port to farm gate is estimated at 26 percent (Rashid, personal communication 2009), comparisons with other African countries indicate that marketing margins in Ethiopia are somewhat lower.⁶

In addition, fertilizer prices represent only one dimension of market performance. As with seed, the ability to provide the right type of input of good quality to farmers in a timely manner is equally important. The distribution system in Ethiopia is inflexible, providing only two types of fertilizer (DAP and urea), both in 50 kg bags. Moreover, numerous farmers in recent years (as many as half in some regions) have consistently reported late delivery of fertilizer.

⁵ Value cost ratio is calculated as $VCR = (\Delta y \cdot p) / C_f$, where Δy denotes incremental yield gains resulting from fertilizer use, p denotes output price per kg, and C_f denotes the cost of fertilizer per recommended rate.

⁶ The price build-up for fertilizer estimated here is specifically for fertilizer imported through Djibouti, transported to Adama, distributed to cooperative unions, distributed onward to primary cooperatives, and eventually sold to farmers.

Table 4.1. Fertilizer value cost ratios, 1992–2008^a

Crop, zone	1992				1997				2004				2008			
	C _f	Δy	P	VCR	C _f	Δy	P	VCR	C _f	Δy	P	VCR	C _f	Δy	P	VCR
	ETB/ dose	Kg/ ha	ETB/ kg	ETB/ dose	Kg/ ha	ETB/ kg	ETB/ dose	Kg/ ha	ETB/ kg	ETB/ dose	Kg/ ha	ETB/ kg	ETB/ dose	Kg/ ha	ETB/ kg	ETB/ dose
Teff																
Shewa	212	641	1.22	3.69	516	641	1.35	1.67	601	641	1.80	1.92	1465	641	4.36	1.91
Gojam	197	592	1.22	3.66	480	592	1.35	1.66	587	592	2.10	2.12	1387	592	4.67	1.99
Arsi/Bale	160	473	1.22	3.6	391	473	1.35	1.63	459	473	1.80	1.85	1224	473	4.36	1.69
Across the Country	192	590	1.22	3.74	468	590	1.35	1.69	565	590	1.93	2.02	1374	590	4.44	1.91
Maize																
Shewa	194	1325	0.65	4.44	472	1325	0.53	1.48	548	1325	0.95	2.30	1346	1325	2.32	2.28
Gojam	296	1932	0.65	4.24	720	1932	0.53	1.41	874	1932	1.22	2.69	2084	1932	2.61	2.42
Welega/Kefa	314	1855	0.65	3.84	765	1855	0.53	1.28	974	1855	0.95	1.81	2347	1855	2.32	1.83
Gamu Gofa/Sidamo	191	1212	0.65	4.13	463	1212	0.53	1.38	543	1212	0.77	1.73	na	1212	2.30	na
Across the Country	216	1410	0.65	4.24	526	1410	0.53	1.41	633	1410	0.95	2.12	1556	1410	2.41	2.18

^a Value cost ratio is calculated as $VCR = (\Delta y \cdot p) / p_f$, where Δy denotes incremental yield gains resulting from fertilizer use, p denotes output price per kg, and C_f denotes the cost per recommended dose of fertilizer for a hectare of land. Fertilizer recommendation (dose) and response rate were taken from fertilizer trials conducted from 1989 and 1991 by the Ministry of Agriculture and National Fertilizer and Inputs Unit (NFIU).

Source: For 1992 and 1997, Demeke (1997); for 2004 and 2008, authors' calculations.

A study of Ethiopian smallholders by Bongor et al. (2004) found that half of farmers surveyed for the study reported that fertilizer arrived after planting, while 32 percent reported underweight bags, 25 percent complained of poor quality, and almost 40 percent reported that their planting was delayed by fertilizer problems. Studies by DSA (2006) and EEA/EEPRI (2006) found that while fertilizer quality problems had been reduced in recent years, delays in delivery were still common, with 25 percent or more of farmers complaining of late delivery. Also, unlike neighboring countries, Ethiopia does not offer fertilizer in smaller packages that could be used by smallholders, or in different formulations needed for different types of agroclimates, soils, and crops.

In addition, input distribution tied to credit limits the space available for the emergence of private sector retailers. Thus, those farmers with sufficient resources for cash purchase of fertilizer, often on more favorable terms than on credit, are unable to do so since there are very few private traders. Similarly, the guaranteed loan program with below-market interest rates creates an uneven playing field in the rural finance sector by undermining efforts to set up alternative institutions such as microfinance institutions, branches of commercial banks, or independent financial cooperatives.

Loan recovery, using extension agents, and a degree of coercion by local administrative officials, were generally successful until the collapse of maize prices in 2001 and the subsequent drought. In Oromia Region, for example, credit recoveries had averaged above 80 percent up to 2001, but this figure dropped to 60 percent in 2002, forcing a major rescheduling of loans. This has resulted in high fiscal costs and fiscal risks associated with the loan guarantee program. The write-off to loan guarantees amounted to Ethiopian birr (ETB) 84 million in 2001, but by 2005 liabilities had again accumulated to ETB 183 million (DSA 2006). Also in 2005, Oromia region was obliged to pay approximately ETB 84 million to the Commercial Bank of Ethiopia to honor its guarantees for the previous three-year time

period. The guarantee thus becomes a subsidy that is not accounted for in government budgeting.

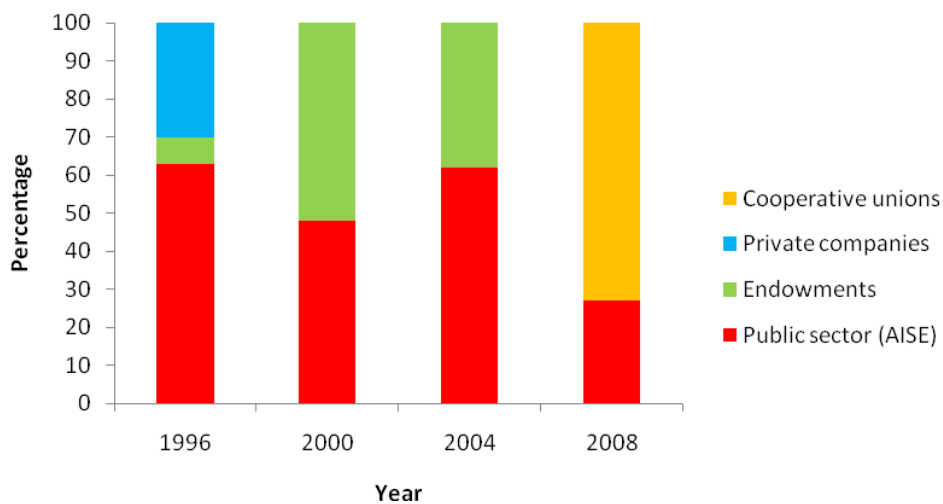
Beyond fiscal costs, there are also considerable but non-quantifiable implicit costs in the system, many of which are borne by the government through its regional extension and input supply systems. These include the costs resulting from the “central planning” system of demand estimation similar to that described earlier for seed. The indirect costs also include the storage costs and quality deterioration incurred because closing stocks have comprised 50 percent or more of total consumption in most years except in 2004 and 2005. Finally, the implicit costs include those resulting from damage done to extension-farmer relationships when harsh measures have been employed to ensure loan repayment.

4.3. Fertilizer market structure

Fertilizer use intensity, demand, and supply discussed above are closely tied to the changing structure of Ethiopia’s fertilizer market. The GoE liberalized the fertilizer sector soon after the end of the *Derg* regime. The first reforms occurred in the early 1990s with the privatization and abolishment of the monopoly on fertilizer importation and distribution held by the state-owned Agricultural Inputs Supply Corporation (AISCO, then renamed the Agricultural Inputs Supply Enterprise (AISE)). Policy changes that fully liberalized fertilizer pricing and the removal of subsidies followed in 1997–98. The private sector’s initial response to market liberalization was rapid. By 1996, several private firms were importing fertilizer, and 67 private wholesalers and 2,300 retailers had taken over a significant share of the domestic market.

Unfortunately, there is little empirical data or analysis against which to assess the private sector’s performance during this initial round of reforms. This is due to the fact that the independent private sector rapidly exited the fertilizer market within a few years of its entry. In the case of imports, the share of private firms operating in the market went from 33 percent in 1995 to 0 in 1999. These firms were first replaced by “private” holding companies with strong ties to government (Jayne et al. 2003). Since 2007, fertilizer imports have been controlled by AISE and cooperative unions (Figure 4.4).

Figure 4.4. Fertilizer import shares by type of importer, 1996–2008^a



^a The term “Endowments” denotes the holding companies described in the paper and by Jayne et al. (2003). AISE denotes Agricultural Inputs Supply Enterprise. Source: MoARD, various years.

The market share trends are similar in the case of wholesalers. While the AISE had a market share of less than 50 percent during the mid and late 1990s, it had regained the majority share by 2001 when private sector wholesalers, except for the holding companies, had disappeared from the scene. And in the retail market, the decline was even more dramatic. While private retailers held a majority share of the market in the early 1990s, the public sector and cooperative unions have become almost the sole distributors of fertilizer since 2000 (DSA 2006). As of 2004, the public sector accounted for over 70 percent of distribution, with private dealers accounting for only 7 percent of sales nationwide (EEA/EEPRI 2006). Public sector supply channels have also changed; whereas extension agents initially managed distribution, the responsibility was shifted to *woreda* input supply offices and cooperatives in more recent years.

The decline in private sector participation in fertilizer markets reflects several factors, including difficulties in the import process itself. Importing fertilizer requires that the importer obtain a license that is allocated by the GoE through a tendering process and requires that fertilizer be imported in lots of 25,000 tons. The importer almost always requires financing given that a single shipment of fertilizer alone requires over \$US 5-10 million over several months. A private sector buyer is currently required to deposit 100 percent of the value of the fertilizer to be imported at the time a line of credit is opened. What remains to be understood clearly is whether these same requirements apply to the AISE, holding companies, or cooperative unions. In so far as these actors in the fertilizer market enjoy privileged collateral requirements, this would suggest an uneven playing field and a clear determinant of the private sector's total exit from the fertilizer market.

5. Agricultural extension services

In effect, agricultural extension services are what tie improved seed, chemical fertilizers, and credit together for the Ethiopian smallholder. Extension services were first introduced in 1953 by the Imperial Ethiopian College of Agricultural and Mechanical Arts (also known as Alemaya University and recently renamed Haramaya University) in the style of a U.S. land grant university. Extension services were later provided to a larger number of farmers in the 1960s under the Comprehensive Integrated Package Projects, described earlier. In the 1980s, the extension system jumped on the bandwagon and transformed itself into a Training and Visit (T&V) style system that was favored by the international donor community at the time (Abate 2008).

The PADETES program described earlier worked with this T&V approach to specifically promote improved seed and chemical fertilizer and succeeded in convincing the GoE to expand its coverage under the NAEIP in 1995. The PADETES/NAEIP programs are credited with expanding the reach of Ethiopia's extension services to some 9 million farmers by 2007–08 (Adugna 2008).

Over the last five years, the federal and regional extension programs have increased the number of public extension staff almost three-fold—from approximately 15,000 development agents during the PADETES/NAEIP period to almost 47,500 in 2008 (Table 5.1). This rapid expansion has been accompanied by the establishment of Farmer Training Centers (FTCs), each of which is meant to house three DAs with a range of technical skills, and provide a broad range of demand-responsive extension and short-term training services.

Agricultural extension services in Ethiopia have traditionally been financed and provided almost entirely by the public sector. Thus, these programs represent a significant public investment, amounting to over \$50 million dollars annually, or almost 2 percent of agricultural GDP in recent years—a figure that exceeds expenditure in most other developing countries and regions (see Roseboom 2004).

But real progress on the ground has been mixed with respect to DA deployment and FTC start-ups (Table 5.1). DA recruitment and training has largely succeeded in meeting its numeric targets, while FTCs have lagged behind. Meanwhile, the expected impact of DAs and FTCs remains unclear due in part to the near absence of any rigorous impact evaluation.

Having said this, four previous studies that evaluate the contribution of agricultural extension in Ethiopia are worth noting. First is the EEA/EEPRI (2006) evaluation of PADETES, which is referred to throughout this paper. Second is Bongor et al. (2004), also referred to herein. Third is a recent impact evaluation of Ethiopia's Productive Safety Net Program (PSNP) by Gilligan, Hoddinott, and Taffesse (2008), which reports a positive impact on a range of food security and poverty indicators from income earned from public works activities undertaken by food-insecure households through the PSNP *when combined with* the "Other Food Security Program" (OFSP) that provides access to improved seed, extension services, and natural resource management schemes. Fourth is a study based on panel data from the Ethiopian Rural Household Survey by Dercon et al. (2009) that reports a significant effect of extension workers visits on poverty headcounts and consumption growth between 1994 and 2004.

Table 5.1. Development Agents (DAs) and Farmer Training Centers (FTCs), 2008

Region	Farmer Training Centers			Development Agents								Total DAs
	FTCs required (number of <i>kebeles</i>)	FTCs established as of 2008	Fully functional FTCs	Crop development		Livestock		Natural resource management		Other		
				M	F	M	F	M	F	M	F	
Tigray	602	588	55	544	65	526	52	574	29	235	42	2,067
Oromia	6,420	2,549	1,147	5,885		6,021		6,080		1,668		19,654
Amhara	3,150	1,725	318	2,407	464	2,438	493	2,597	318	90	1,389	10,196
SNNP	3,681	1,610	857	13,448 ^a								13,448
Afar	558	-	-	240		241		209		58		748
Somali	-	2	-	422	26	376	32	334	40	35	4	1,269
Harari	17	5	3	15	-	15	3	15	2	2	-	52
Dire Dawa	25	7	-	22	2	14	4	18	4	19	5	88
Total	14,453	6,486	2,380	3,410	557	3,369	584	3,538	393	381	1,440	47,522

^a Data for SNNP are based on figures from 2006–07.
Source: MoARD 2009.

Nonetheless, the entire body of evidence on agricultural extension suggests that the impact on productivity and poverty has been a mixed experience to date. Although many farmers seem to have adopted the packages promoted by the extension system, up to a third of the farmers who have tried a package had discontinued its use (Bonger, Ayele, and Kumsa 2004; EEA/EEPRI 2006). Indeed, Bonger et al. (2006) also find that poor extension services were ranked as the top reason for non-adoption.

Part of the problem is that the success of the extension services has been traditionally measured in terms of numeric targets for physical input use, often at the cost of emphasizing the efficiency and profitability of input use. In fact, most extension agents view their role primarily as distributing fertilizer and credit, a role that hampers the provision of technical advice (EEA/EEPRI 2006).

The hierarchical “culture” underlying the extension system does little to encourage and exploit the inherent resourcefulness of those who work closely with farmers and rural communities (Gebremedhin et al. 2006; Davis et al. 2007). And although extension has been decentralized to the administrative control of regional governments and *woreda* administrations, continued imposition of targets from above and weak local capacity have not yet permitted the emergence of a dynamic demand-driven system.

On the positive side, several reforms have been introduced to address these deficiencies. First, in an effort to get beyond a focus on cereals, new packages have been developed to support other crop and livestock enterprises, improve post-harvest technology adoption, and encourage natural resource management. Second, in recognition of the diversity of smallholder farming systems in Ethiopia, classifications have been developed to divide the country into several distinct agro-ecological zones to aid in the development of more appropriate zone-specific packages (Ibrahim 2004). Third, input distribution is being shifted away from extension services to cooperatives, thus freeing extension agents to provide more technical advice. Finally, there are moves being made to strengthen and diversify the curriculum provided by the 25 Agricultural Technical and Vocational Education and Training (ATVET) colleges that are responsible for preparing DAs for deployment throughout the country (Table 5.2).

Table 5.2. Agricultural Technical and Vocational Education and Training (ATVET) colleges graduates, 2003–04 to 2007–08

Year	Number of ATVET graduates
2003–04	9,368
2004–05	13,899
2005–06	11,095
2006–07	15,099
2007–08	9,404
Total	59,364

Source: MoARD 2009.

6. Conclusions and policy implications

In spite of nearly two decades of policies that placed high priority on boosting agricultural production and productivity, Ethiopia has yet to see payoffs in terms of higher and more stable cereal yields, lower consumer prices for food staples, and reduced dependence on food aid. Yet there is little doubt that intensification and commercialization of agriculture is needed in Ethiopia given its precarious food situation and acute land scarcity. The challenge is finding ways to strengthen smallholder access to inputs, technology, and information, and improving the incentives for their use and adoption, all within highly heterogeneous agro ecologies characterized by high risks.

State-led policies to promote improved seed and fertilizer through regional, state-run input supply and extension systems initially generated some positive impacts in Ethiopia over the last two decades. But experience to date suggests that an increasing role of the state will not provide the intended growth stimulus to the agricultural sector. The current approach reduces the quality of input services to smallholders, incurs many hidden costs to the government, and generates significant risks to both smallholders and the government.

This is not to say that the public provision of information, input, credit, and administration is unnecessary. Rather, public sector involvement in Ethiopia's agricultural sector will remain critical where smallholders have poor access to markets, weak purchasing power, and asymmetrical access to market information. Moreover, public leadership in encouraging private investment in market-based systems remains necessary in Ethiopia, where modern market institutions are still under development.

Nonetheless, more consideration should be given to long-term policies designed to build a dynamic private sector to promote fertilizer, seed, credit, and market information systems. A greater degree of flexibility in how inputs and services are provided, and a greater degree of choice for smallholders, can open up new market and technological opportunities in the agricultural sector.

Thus, the development of an efficient input marketing and rural financial system will be a difficult, time-consuming, and expensive undertaking that will require significant support for institution-building activities, capacity strengthening and training, and financial sector infrastructure development. Several measures would facilitate the transition.

First, policies to open the market (and pricing) for hybrid maize seed—taking a page from successful experiences in the region—should be explored more actively. This transition would have to be gradual. ESE's capacity to produce seed during a transition into privatization could drop dramatically, while private seed multipliers aiming to fill the gap would struggle to expand into upstream breeding activities, scale up multiplication, and build their distribution and retailing networks. But if reforms were accompanied by new procurement procedures that encouraged regional extension and input supply systems to purchase seed more extensively from the private sector, and if commercial lending was made more readily available to encourage private seed companies to expand their production and distribution, then smallholders could benefit from a larger choice and better quality of maize seed. There are positive signs suggesting that both the government and other stakeholders are pursuing such reforms with support from the donor community; however, close monitoring of the reform's progress remains vital to success.

Second, policies to liberalize the fertilizer market should be pursued. This includes liberalizing collateral requirements for fertilizer imports and reducing the credit guarantee to 50 percent and gradually lowering it further until an eventual phase-out; opening the credit

guarantee to other certified financial institutions; and liberalizing interest rates. In the short-term, risk-averse commercial banks might shy away from financing fertilizer imports and distribution. However, with the long run development of a liberalized and competitive financial sector, these short-term issues would likely give way to greater investment in fertilizer importation and distribution.

Third, deep reforms in the extension system should be explored sooner than later. Such reforms would need to extricate the system away from single-minded, top-down, package approaches to cereal intensification, to more dynamic, responsive, and competitive service provision. These approaches will require greater flexibility within the current system that can only be done by investing time, effort, and resources in changing the cultures and practices of the extension system, and are likely to yield results over a much longer-term period. However, without such changes, the extension and education system in Ethiopia will become increasingly irrelevant to the needs of intensive, commercial smallholder production systems. Again, the signs suggest that the government is pursuing reforms in this area, although close monitoring of progress is vital to success.

Fourth, innovative programs should be continually explored. Given the risks posed by production and price variability in Ethiopia, price risk mitigation based on a combination of market and non-market management tools should also be a major policy priority for the country. Non-market-based options will only work in the short-term if combined with long-term improvements in physical infrastructure, information and communications technology, contract enforcement, and strengthening of the markets for credit and insurance. Innovative programs include investments to scale up the weather insurance schemes currently being piloted, develop a comprehensive market information system to support the new commodity exchange, and liberalization of the telecommunications sector to improve rural access to information and communications technologies.

Finally, significantly more resources should be invested in regular and methodical assessments of the impact of the extension and input supply system. This near absence of independent impact assessment makes it difficult to evaluate where the disincentives, bottlenecks, and structural issues are in the system, and how they can be remedied.

These findings reinforce other studies conducted in the region of the need for complete, rather than half-hearted, liberalization of input supply markets to support smallholders' efforts to intensify cereal production. Moreover, these recommendations detail the intricacies of the liberalization process, and the need to be deeply aware of the peculiarities—both the inherent market failures and the potential profit opportunities—that describe input markets and extension services. Finally, the findings recognize both the necessity of continued public engagement in input markets and extension services, while carving out new space for private investment in providing goods and services for smallholders in a potentially efficient manner.

In conclusion, while Ethiopia has an admirable record of supporting agriculture, the continued state-led policies to boost agricultural production and productivity have now outlived their usefulness. A rethinking of approaches is needed, one that reallocates the roles of the public and private sectors in the promotion and regulation of the agricultural input sector. This rethinking requires a nuanced understanding of the complex issues involved, evidence-based analysis and policy recommendations, and continuous debate on the pros and cons of alternatives and options. Lessons learned from this process can do much to inform Ethiopia's long-term development strategy.

References

- Abate, H. 2008. *Key Messages from a Study on Ethiopia's Extension Systems*. Addis Ababa: Food and Agriculture Organization (FAO) of the United Nations Subregional Office for Eastern Africa.
- Admassu, M. 2009. Personal communication. June 16.
- Adugna, T. 2008. PASDEP progress report. Presentation on the Rural Economic Development and Food Security (RED/FS) in Ethiopia. Addis Ababa, November 10.
- Adugna, T., and M. Demeke. 2000. Institutional reforms and sustainable input supply and distribution in Ethiopia. In *Institutions for Rural Development*, ed. W. Negatu, L. Dadi, A. HaileGabriel, and S. Bellele S. Proceedings of the Fourth Annual Conference of the Agricultural Economics Society of Ethiopia (AESE), November 23–24, 2000, in Addis Ababa, Ethiopia. Addis Ababa: AESE.
- Ahmed, R. Liberalization of agricultural input markets in Bangladesh: Process, impact, and lessons. *Agricultural Economics* 12: 115–128.
- Alemu, D., W. Mwangi, M. Nigussie, and D. J. Spielman. 2007. *An Analysis of Maize Seed Production and Distribution Systems in Ethiopia's Rift Valley*. Ethiopian Institute of Agricultural Research (EIAR) Research Report 72. Addis Ababa: EIAR.
- Alston, J.M., and R.J. Venner. 2000. The effects of the U.S. plant variety protection act on wheat genetic improvement. Environment and Production Technology Division Discussion Paper 62. Washington, D.C.: International Food Policy Research Institute.
- Ariga, J., T.S. Jayne, and J. Nyoro. 2006. *Factors driving the growth in fertilizer consumption in Kenya, 1990–2005: Sustaining the momentum in Kenya and lessons for broader replicability in Sub-Saharan Africa*. Tegemeo Institute of Agricultural Policy and Development, Egerton University, Kenya.
- Ariga, J., T.S. Jayne, B. Kibaara, and J.K. Nyoro. 2008. Trends and Patterns in Fertilizer Use by Smallholder Farmers in Kenya, 1997–2007. Draft paper. Tegemeo Institute of Agricultural Policy and Development, Egerton University.
- Barrett, C.B. 2008 Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy* 33: 299–317.
- Belay, S. 2004. *The Seed Regulations and Standards of Ethiopia: The Way Forward*. Eastern and Central Africa Program for Agricultural Policy Analysis (ECAPAPA) Report. Entebbe, Uganda: ECAPAPA.
- Beshir, A. 2009. Personal communication. September 30.
- Beshir, A. 2005. Farmer-based seed production an alternative for seed security: The Ethiopian experience. *Seed Info* 29: 8–10.
- Beyene, H., H. Verkuil, and W. Mwangi. 1998. *Farmers' Seed Sources and Management of Bread Wheat in the Wolmera Wereda, Ethiopia*. Mexico, D.F/Addis Ababa: CIMMYT/IAR.

- Bishaw, Z., Y. Sahlu, and B. Simane. 2008. The status of the Ethiopian seed industry. In *Farmers, seeds and varieties: Supporting informal seed supply in Ethiopia*. Ed. M. H. Thijssen, Z. Bishaw, A. Beshir, and W.S. de Boef. Wageningen: Wageningen International.
- Bonger, T., G. Ayele, and T. Kumsa. 2004. *Agricultural Extension, Adoption and Diffusion in Ethiopia*. Ethiopian Development Research Institute (EDRI) Research Report 1. Addis Ababa: EDRI.
- Butler, L., and B. Marion. 1985. The impacts of patent protection on the U.S. seed industry and public plant breeding. North Central Region Research Publication 304, North Central Project 117, Monograph 16. Madison, Wis., U.S.A: Research Division, College of Agricultural and Life Sciences, University of Wisconsin.
- Byerlee, D. 1988. Agricultural extension and the development of farmers' management skills. In *Training and Visit Extension in Practice*. Overseas Development Institute (ODI) occasional paper no. 8. Ed. J. Howell, J. London: ODI.
- Byerlee, D., C.K. Eicher. 1997. *Africa's Emerging Maize Revolution*. Boulder, CO: Lynne Rienner.
- Byerlee, D., T.S. Jayne, and R.J. Myers. 2006. Managing food price risks and instability in a liberalizing environment: Overview and policy options. *Food Policy* 31, 275–287.
- Crawford, E. W., T.S. Jayne, and V.A. Kelly. 2006. *Alternative Approaches to Promoting Fertilizer Use in Africa*. Agriculture and Rural Development Discussion Paper 22. Washington, D.C.: World Bank.
- Crawford, E., V. Kelly, T.S. Jayne, and J. Howard. 2003. Input use and market development in Sub-Saharan Africa: an overview. *Food Policy* 28: 277–292.
- CSA (Central Statistics Agency), Federal Democratic Republic of Ethiopia, various years. Statistical Abstracts and Statistical Bulletins. Addis Ababa: CSA.
- Cummings, R., S. Rashid, and A. Gulati. 2006. Grain price stabilization experience in Asia: What have we learned? *Food Policy* 31: 302–312.
- Davis, K.E., J. Ekboir, W. Mekasha, C.M.O. Ochieng, D.J. Spielman, and E. Zerfu. 2007. *Strengthening Agricultural Education and Training in Sub-Saharan Africa from an Innovation Systems Perspective: Case Studies of Ethiopia and Mozambique*. IFPRI Discussion Paper 736. Washington, D.C.: International Food Policy Research Institute.
- Degu, G., W. Mwangi, H. Verkuil, and A. Wondimu. 2000. *An Assessment of the Adoption of Seed and Fertilizer Packages and the Role of Credit in Smallholder Maize Production in Sidama and North Omo Zones, Ethiopia*. Addis Ababa: EARO/CIMMYT.
- Demeke, M., V. Kelly, T.S. Jayne, A. Said, J.C. LeVallé, and H. Chen. 1998. *Agricultural Market Performance and Determinants of Fertilizer Use in Ethiopia*. Grain Market Research Project Working Paper 10. Addis Ababa: Ministry of Economic Development and Cooperation, Federal Democratic Republic of Ethiopia.
- Dercon, S., and L. Christiaensen. 2005. Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. Mimeo. Washington, D.C.: World Bank.

- Dercon, S., D.O. Gilligan, J. Hoddinott, and T. Woldehanna. 2009. The Impact of agricultural extension and roads on poverty and consumption growth in fifteen Ethiopian villages. *American Journal of Agricultural Economics* 91(4): 1007–1021.
- DSA (Development Studies Associates). 2006. *Study on Improving the Efficiency of Input Markets*. Addis Ababa: Ministry of Agriculture and Rural Development, Federal Democratic Republic of Ethiopia.
- Dorward, A., S. Fan, J. Kydd, H. Lofgren, J. Morrison, C. Poulton, N. Rao, L. Smith, H. Tchale, S. Thorat, I. Urey, and P. Wobst. 2004. *Institutions and Economic Policies for Pro-poor Agricultural Growth*. Development Strategy and Governance Division Discussion Paper 15. Washington, D.C.: International Food Policy Research Institute.
- Doss, C.R., W. Mwangi, H. Verkuil, and H. De Groote. 2003. *Adoption of Maize and Wheat Technologies in Eastern Africa: A Synthesis of the Findings of 22 Case Studies*. Economics Working Paper 03–06. Mexico, D.F.: CIMMYT.
- EEA/EEPRI (Ethiopian Economic Association/Ethiopian Economic Policy Research Institute), 2006. *Evaluation of the Ethiopian Agricultural Extension with Particular Emphasis on the Participatory Demonstration and Training Extension System (PADETES)*. Addis Ababa: EEA/EEPRI.
- Feder, G., A. Willett, and W. Zijp. 2000. *Agricultural Extension — Generic Challenges and Some Ingredients for Solutions*. Washington, D.C.: World Bank.
- FAOSTAT (FAO Statistical Database), 2005. Agriculture, Fishery, Forestry and Nutrition 2005. CD-ROM. Rome: Food and Agriculture Organization.
- FDRE (Federal Democratic Republic of Ethiopia). 2006a. *Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty*. Addis Ababa: Ministry of Finance and Economic Development, FDRE.
- FDRE (Federal Democratic Republic of Ethiopia). 2006b. Proclamation No. 481/2006, Plant Breeders' Right Proclamation. *Federal Negarit Gazeta*, February 27, 3339–3352.
- FDRE (Federal Democratic Republic of Ethiopia). 2002. Ethiopia: Sustainable Development and Poverty Reduction Program. Addis Ababa: Ministry of Finance and Economic Development, FDRE.
- FDRE (Federal Democratic Republic of Ethiopia). 1993. *An Economic Development Strategy for Ethiopia* (A Comprehensive Guidance and A Development Strategy for the Future). Addis Ababa: Ministry of Planning and Economic Development, FDRE.
- Freeman, H.A., and W. Kaguongo. 2003. Fertilizer market liberalization and private retail trade in Kenya. *Food Policy* 28: 505–518.
- Freeman, H.A., and J.M. Omiti. 2003. Fertilizer use in semi-arid areas of Kenya: analysis of smallholder farmers' adoption behavior under liberalized markets. *Nutrient Cycling in Agroecosystems* 66: 23–31.
- Gebremedhin, B., D. Hoekstra, and A. Tegegne. 2006. *Commercialization of Ethiopian Agriculture: Extension Service from Input Supplier to Knowledge Broker and Facilitator. Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project working paper no. 1*. Nairobi, Kenya: International Livestock Research Institute.

- Gerpacio, R.V. 2003. The roles of public sector versus private sector in R&D and technology generation: the case of maize in Asia. *Agricultural Economics* 29 (3): 319–330.
- Gilligan, D.O., J. Hoddinott, and A.S. Taffesse. 2008. *The Impact of Ethiopia's Productive Safety Net Programme and its Linkages*. IFPRI Paper 839. Washington, D.C.: International Food Policy Research Institute.
- Gisselquist, D., and C. Van Der Meer. 2001. *Regulations for Seed and Fertilizer Markets: A Good Practice Guide for Policy Makers*. Rural Development Working Paper 22817. Washington, D.C.: World Bank.
- Harrigan, J. 2008. Food insecurity, poverty, and the Malawian Starter Pack: Fresh start or false start? *Food Policy* 33: 237–249.
- Hassan, R.M., M. Mekuria, and W.Mwangi. 2001. *Maize Breeding Research in Eastern and Southern Africa: Current Status and Impacts of Past Investments Made by the Public and Private Sectors 1966–97*. Mexico, D.F.: CIMMYT.
- Heisey, P.W., G.W. Norton. 2007. Fertilizers and other farm chemicals. In *Handbook of Agricultural Economics Vol. 3: Agricultural Development: Farmers, Farm Production and Farm Markets*, ed. R.E. Evenson, and P.L. Pingali. Amsterdam: Elsevier/North Holland.
- Howard, J., E. Crawford, V. Kelly, M. Demeke, and J.J. Jeje. 2003. Promoting high-input maize technologies in Africa: The Sasakawa-Global 2000 experience in Ethiopia and Mozambique. *Food Policy* 28: 335–348.
- Ibrahim, M. 2004. Extension experiences in Ethiopia. Paper presented at the “Ministry of Agriculture and Rural Development Planning Workshop,” Addis Ababa, Ethiopia.
- IFPRI (International Food Policy Research Institute). 2009. *A Study in Support of the Mars-Food Action of the European Union. The Cereal Availability in Ethiopia, 2007/08. Final Technical Report of the Project submitted to the European Commission Joint Research Centre*. Institute for the Protection and the Security of the Citizen, Fermi, Italy.
- InterAcademy Council. 2004. *Realizing the Promise and Potential of African Agriculture: Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa*. Amsterdam: InterAcademy Council.
- Jayne, T.S., J. Govereh, J. Nyoro, A. Mwanaumo, and A. Chapoto. 2002. False promise or false premise: food market reform in eastern and southern Africa. *World Development* 30 (11): 1967–1986.
- Jayne, T.S., J. Govereh, M. Wanzala, and M. Demeke. 2003. Fertilizer market development: A comparative analysis of Ethiopia, Kenya, and Zambia. *Food Policy* 28: 293–316.
- Kormawa, P., A. Munyemanab, and B. Soule. 2003. Fertilizer market reforms and factors influencing fertilizer use by small-scale farmers in Bénin. *Agriculture, Ecosystems and Environment* 100: 129–136
- Kotu, B.H., H. Verkuijl, W. Mwangi, and D. Tanner. 2000. *Adoption of Improved Wheat Technologies in Adaba and Dodola Woredas of the Bale Highlands*. Ethiopia. Addis Ababa: EARO/CIMMYT.

- Kydd, J., and A. Dorward. 2004. Implications of market and coordination failures for rural development in least developed countries. *Journal of International Development* 16: 951–970.
- Langyintuo, A.S., W. Mwangi, A.O. Diallo, J. MacRobert, J. Dixon, and M. Bänziger. 2008. *An Analysis of the Bottlenecks Affecting the Production and Deployment of Maize Seed in Eastern and Southern Africa*. Harare, Zimbabwe: CIMMYT.
- Lantican, M.A., H. J. Dubin, and M.L. Morris. 2005. *Impacts of International Wheat Breeding Research in the Developing World, 1988–2002*. Mexico, D.F.: CIMMYT.
- Lemma, T., P. Anandajayasekeram, and W. Kisamba-Mugerwa. 2006. Review of agricultural impact, Ethiopia. Unpublished World Bank study. Addis Ababa: World Bank.
- Minot, N. 2009. *Market Dynamics and Cereal Availability in Ethiopia: Producers, Traders, and the Policies*. Agricultural Household Survey. Understanding Changes in Farm-level Crop Marketing Policy Brief 1. Addis Ababa: EDRI/IFPRI.
- Minot, N., M. Kherallah, and P. Berry. 2000. *Fertilizer market liberalization in Benin and Malawi: A household-level view*. Mimeo.
- Mishra, D. 2008. Ongoing policy debate on the causes and remedies of Ethiopia's high inflation. Presented at the Africa Chief Economist Seminar Series, World Bank, December 29, Washington, D.C.
- MoARD (Ministry of Agriculture and Rural Development), 2009. *Official documents and records from the Agricultural Extension Directorate*. Addis Ababa: MoARD.
- MoARD (Ministry of Agriculture and Rural Development). 2008. *A Plan to fulfill Maize Seed Demand in the Next five Years, 2008-09 to 2013-14*. [In Amharic]. Addis Ababa: MoARD.
- MoARD (Ministry of Agriculture and Rural Development). Various years. *Official documents and records from the Agricultural Inputs Marketing Department and Crop Development Department*. Addis Ababa: MoARD.
- Morris, M.L., ed. 1998. *Maize Seed Industries in Developing Countries*. Boulder, CO: Lynne Rienner Publishers.
- Morris, M., V.A. Kelly, R.J. Kopicki, and D. Byerlee. 2007. *Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines*. Washington, D.C.: World Bank.
- Negatu, W. 2000. Factors influencing agricultural research and development: A conceptual framework and evidence from Ethiopia. In *Institutions for Rural Development*, ed. L. Dadi, A. Haile Gabriel, and S. Bellete. Proceedings of the Fourth Annual Conference of the Agricultural Economics Society of Ethiopia (AESE). November 23–24, 2000, in Addis Ababa, Ethiopia. Addis Ababa: AESE.
- Omamo, S.W., and L.O. Mose, L.O. 2001. Fertilizer trade under market liberalization: Preliminary evidence from Kenya. *Food Policy* 26: 1–10.
- Pray, C.E., B. Ramaswami, and T. Kelley. 2001. The impact of economic reforms on R&D by the Indian seed industry. *Food Policy* 26 (6): 587-598.

- Rahmato, D. 2004. The agricultural policies of the imperial regime: what lessons can we draw? Paper presented on the occasion of the 50th anniversary of the establishment of Alemaya University, October 23–24, 2004, in Alemaya, Ethiopia.
- Rashid, S. 2009. Personal communication.
- Rashid, S., M. Assefa, and G. Ayele. 2009 (forthcoming). Distortions to agricultural incentives in Ethiopia. In *Distortions to Agricultural Incentives in Africa*, ed. K. Anderson, and W. Masters. Washington, D.C.: World Bank.
- Rashid, S., and M. Assefa. 2006. Sources, extents, and policies to manage food price risks in Ethiopia: How does it fare with other developing countries? Paper presented at the “Ethiopian Strategy Support Program 2006 Policy Conference,” June 6–8, 2006, in Addis Ababa, Ethiopia.
- Roseboom, J. 2004. Agricultural research and extension funding levels required to meet the Anti-Hunger Programme objectives. Manuscript prepared for the Food and Agricultural Organization (FAO), Rijswijk, The Netherlands.
- Sahlu, Y., and M. Kahsay, M. 2002. Maize seed production and distribution in Ethiopia. In *Proceedings of the Second National Maize Workshop*, Addis Ababa, Ethiopia, November 12–16, 2001:160–165.
- Stepanek, J.C. 1999. Lessons from Ethiopia’s High-Input Technology Promotion Program: How the Organization of the Fertilizer Subsector Affects Maize Productivity. PhD dissertation, Michigan State University, Department of Agricultural Economics.
- Swanson, B.E., and N.M. Samy. 2002. Developing an extension partnership among public, private, and nongovernmental organizations. *Journal of International Agricultural and Extension Education* 9(1): 5–10.
- Taffesse, A.S. 2008. *Decomposition of growth in cereal production in Ethiopia*. Mimeo. Addis Ababa.
- Thijssen, M.H., Z. Bishaw, A. Beshir, and W.S. de Boef, ed. 2008. *Farmers, seeds and varieties: Supporting informal seed supply in Ethiopia*. Wageningen: Wageningen International.
- Tripp, R. 2009. Personal communication. December 18.
- Tripp, R., and N. Louwaars. 1997. Seed regulation: Choices on the road to reform. *Food Policy* 22: 433–446.
- Ulimwengu, J.M., S. Workneh, and Z. Paulos, Z. 2009. *Impact of Soaring Food Price in Ethiopia: Does Location Matter?* IFPRI Discussion Paper 00846. Washington, D.C.: International Food Policy Research Institute.
- World Bank. 2008. World Development Indicators [CD-ROM]. Washington, D.C.: World Bank.
- World Bank. 2007. World Development Report 2008. Washington, D.C.: World Bank.
- World Bank. 2006a. Ethiopia: Policies for Pro-poor Agricultural Growth. Washington, D.C.: World Bank.

- World Bank. 2006b. Promoting fertilizer use in Africa; Lessons learned and good practice. Africa Region paper. Washington, D.C.: World Bank.
- World Bank, 2006c. World Bank support to the Ethiopian seed sector. Unpublished document. Addis Ababa: World Bank
- World Bank, 2005. Ethiopia—well-being and poverty in Ethiopia: The role of agriculture and agency. Report No. 29468–ET. Washington, D.C.: World Bank.
- Wubneh, F.K. 2007. Realizing the dream: Agricultural extension for rural livelihoods development in Ethiopia. Institute of Social Studies (ISS) Graduate School of Development Studies. The Hague, The Netherlands: ISS.
- Yesuf, M., A. Mekonnen, M. Kassie, and J. Pender. 2005. *Cost of Land Degradation in Ethiopia: A Critical Review of Past Studies*. Addis Ababa: Environmental Economics Policy Forum in Ethiopia and IFPRI.
- Zegeye, T. 2001. *The Impact of Technology Development and Transfer: The Case of Maize in Ethiopia*. EARO research report 42. Addis Ababa: EARO.
- Zegeye T., and A. Haileye. 2001. *Adoption of Improved Maize Technologies and Inorganic Fertilizer in North-western Ethiopia*. EARO research report 40. Addis Ababa: EARO.
- Zegeye, T., B. Tadesse, and S. Tesfaye. 2001. *Adoption of High Yield Maize Technologies in Major Maize Growing Regions of Ethiopia*. EARO research report 41. Addis Ababa: EARO.
- Zegeye, T., B. Tadesse, and S. Tesfaye. 2001. *Determinants of High Yielding Maize Technology Adoption: Empirical Evidence*. EARO research report 38. Addis Ababa: EARO.
- Zegeye, T., G. Taye, D. Tanner, H. Verkuijl, A. Agidie, and W. Mwangi. 2001. *Adoption of Improved Bread Wheat Varieties and Inorganic Fertilizer by Small-scale Farmers in Yelmana Densa and Farta Districts of Northwestern Ethiopia*. Addis Ababa: EARO/CIMMYT.