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IFPRI Discussion Paper 00707
June 2007

Policies to Promote Cereal Intensification in Ethiopia: A Review of Evidence and Experience

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PUBLISHED BY

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CONTENTS

TABLES

FIGURES

ACKNOWLEDGMENTS

The authors acknowledge the insights and comments received from Shahidur Rashid, John Mellor, Eleni Gabre-Madhin, Alemayehu Seyoum, Hugo de Groote, and an anonymous reviewer; and assistance and input from Wondimsiamregn Mekasha. Any and all errors are the sole responsibility of the authors.

ABSTRACT

Despite more than a decade of policies placing high priority on cereal intensification, backed by one of the highest rates of public expenditures on agricultural in Africa, Ethiopia has yet to see payoffs in terms of higher and more stable cereal yields, reduced dependency on food aid, improved food security, and lower consumer prices for staples. There is understandable concern about the performance, efficiency and sustainability of the agricultural sector, specifically in terms of the current systems for providing extension services, improved seed, fertilizer, and credit. This paper aims to illuminate possible solutions available to improving the prospects for cereal intensification in Ethiopia. The paper traces the largely state-led policies that have been put in place to stimulate increased cereal productivity and examines the extent to which these policies have had their intended impacts. This review indicates that although Ethiopia has an admirable and sustained record of supporting seed-fertilizer technological intensification in cereals, the related state-led policies have outlived their usefulness, suggesting the need for a rethinking of approaches.

Keywords: Agricultural development, agricultural extension, fertilizer, seed markets, Ethiopia

1. INTRODUCTION

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 40 percent of national GDP, 90 percent of exports, 85 percent of employment, and 90 percent of the poor. Rural poverty is further compounded by extreme land shortages in the highlands—per capita land area has fallen from 0.5 ha in the 1960s to only 0.2 ha by 2005—and by a marginal productivity of labor that is estimated at close to zero (World Bank 2005).

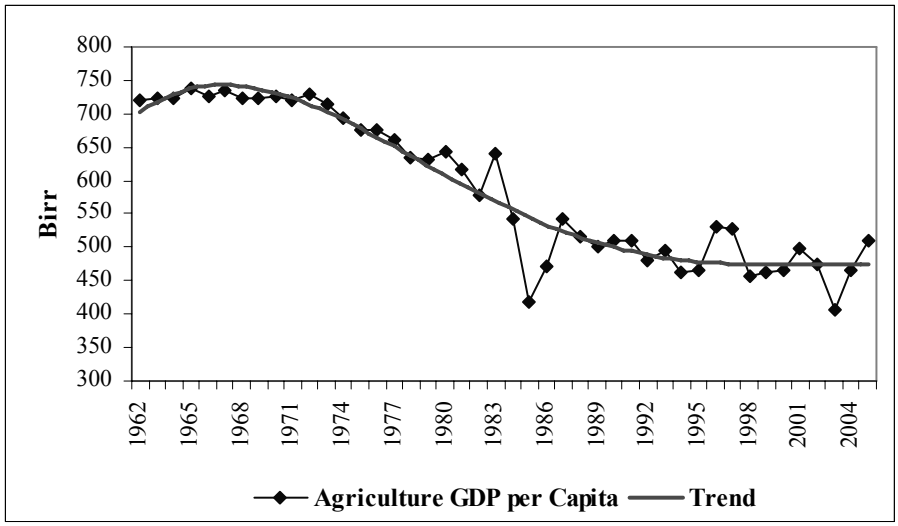
The Government of Ethiopia's (GoE's) economic growth strategy, Agriculture Development Led Industrialization (ADLI, formulated in 1991), accordingly places very high priority on accelerating agricultural growth and achieving food security. Agriculture is also a main focus of the GoE's poverty reduction strategy, which includes the Sustainable Development and Poverty Reduction Program (SDPRP) approved in 2002, the 2004 Food Security Strategy (FSS), and, most recently, the 2006 Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (MoFED 2002, 2006).

During the 1990s, the GoE pursued its ADLI strategy by enacting a series of policies seeking to generate: (i) a more supportive macroeconomic framework; (ii) liberalized markets for agricultural products; and (iii) a strong extension- and credit-led push for intensification of food staples production through the use of modern inputs, especially seed and fertilizer. These early reforms focused on cereals and provided a much needed boost to agricultural production. The most significant growth in agricultural production, which took place in the mid-1990s, was driven almost exclusively by area expansion in response to liberalization.

However, these early gains slowed in the latter part of the 1990s and the first part of this decade, with large annual fluctuations seen in both production and prices. Consequently, from 1996 through 2005, per capita agricultural GDP and per capita grain production were volatile, while their averages showed almost no change over time (Figures 1 and 2). The estimated growth rates of these two measures during this period were 0.48 percent and 1.38 percent, respectively. Yet at the same time, consumer prices for food staples increased in real terms. Thus, to date,

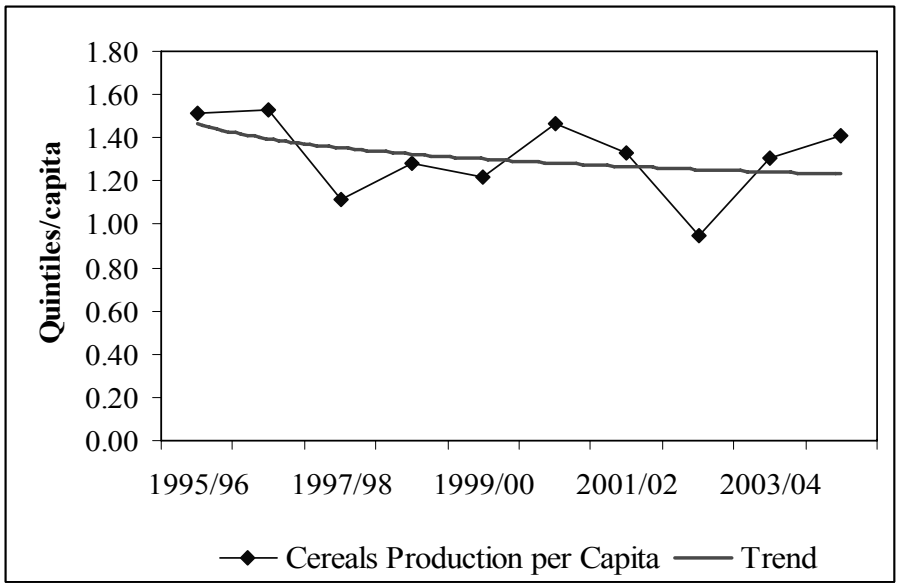
Ethiopia has yet to experience the agricultural growth and improved food security expected to result from the policies implemented by the GoE.[1]

Figure 1. Real agriculture GDP per capita in Ethiopia, 1962-2005



Source: MoFED 2006, 2005.

Figure 2. Per capita cereals production in Ethiopia, 1995/96-2004/05



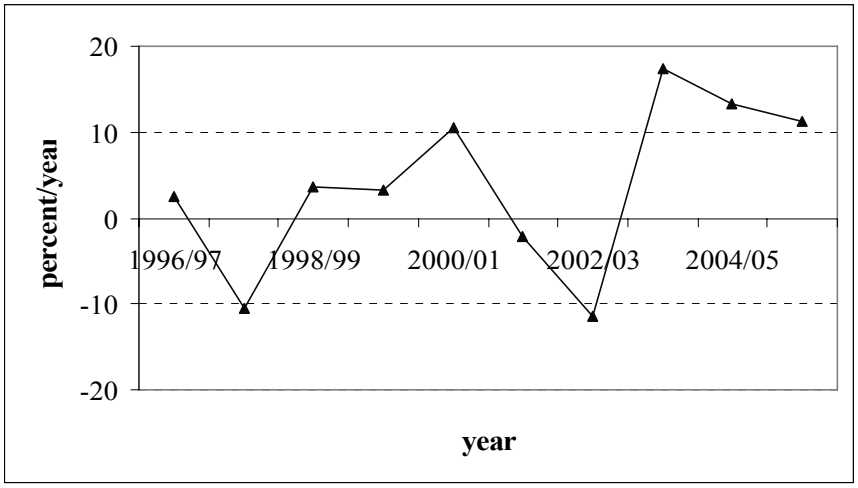
Source: CSA (various years).

[1] Although estimates of growth rates for per capita agricultural GDP and per capita grain production vary by source for the period in question, an analysis of data from the Ministry of Finance and Economic Development (MoFED) and Central Statistics Authority (CSA) indicates negative or stagnant growth. Estimates for the 10-year period 1997-2006 show stagnant or slightly positive growth for both measures, possibly attributable to adequate and timely rainfall during 2004-06.

At present, Ethiopia continues to struggle with two major challenges. First, the country has relatively weak market institutions and infrastructure, particularly with respect to the food staples sector (Alemu, de Groote, and Bacha 2006; Gabre-Madhin 2001). This is often viewed as a key factor in the failure of market liberalization policies to improve agricultural performance in many sub-Saharan Africa countries (Kydd and Dorward 2004; Dorward et al. 2004). Second, recurrent droughts and high variability in production continue to compound the long-term stagnation in productivity. The growth that has occurred to date has been erratic at best, and has largely been driven by upswings in rainfall (Figure 3).

The major results of this dependence on low productivity agriculture and unreliable rainfall are widespread structural food deficits and a chronic dependence on food aid. Ethiopia continues to be the world's largest food aid recipient, with food aid deliveries bridging the gap between food supply and food needs. These deliveries have averaged about 700,000 metric tons annually over the past ten years, and have helped avert the major humanitarian disasters for which Ethiopia had become renown for in previous decades.

Figure 3. Agricultural sector growth rates since 1994



Source: MoFED 2006, 2005.

Despite this aid, however, some 5 to 7 million Ethiopians are chronically food insecure and continue to require support each year. When rainfall is untimely or inadequate, this number increases; for example, during the last major drought (2002/03) the number of Ethiopians requiring support increased to 11 million due to the influx of the transitionally food insecure. Based on this evidence of widespread food insecurity and vulnerability in the agricultural sector,

the GoE placed stronger emphasis on improving household food security by investing heavily in safety nets, programs to build the assets of food insecure households, resettlement, and soil and water conservation, especially water harvesting.

However, the persistence of food insecurity and vulnerability should not imply that the focus on boosting cereal production is unattainable or ill advised. Nor should the recent rapid growth of higher-value export crops such as coffee, livestock, and horticulture products argue against efforts to simultaneously increase productivity in the cereal sector. A recent study by Diao and Pratt (2007) shows that significant poverty reductions in Ethiopia could be achieved by prioritizing investment in improving cereals and other food staples productivity relative to both traditional and non-traditional export crops.

The simulations presented by Diao and Pratt (2007), which were based on a spatially disaggregated, economy-wide model that allows for the analysis of growth and poverty reduction linkages at national and regional levels, suggested the following. First, given an annual growth rate of 3.4 percent, investment in raising food staple yields by 2.1 percent annually (combined with baseline assumptions of a 1.3 percent annual expansion of crop area, 3.4 percent growth in livestock productivity, and 13 percent annual growth in both traditional and nontraditional exportables), would support agricultural sector growth of about 3.5 percent per year and reduction in the poverty rate from the 2000 level of 44.4 percent to about 38 percent in 2015. Second, more rapid growth and poverty reductions could be achieved by simultaneous investment in increasing food staple yields, livestock productivity and export growth, leading to agricultural sector growth in the order of 5 percent or higher, and a decline in the poverty rate to 27.5 percent by 2015.

Yet in spite of more than a decade of policies placing high priority on cereal intensification, backed by one of the highest rates of public expenditures on agricultural in Africa (as a share of the budget), Ethiopia has yet to see payoffs in terms of higher and more stable cereal yields, reduced dependency on food aid, improved food security, and lower consumer prices for staples.

The GoE is understandably concerned about the performance, efficiency and sustainability of the agricultural sector, specifically in terms of the current systems for providing extension services, improved seed, fertilizer, and credit. Accordingly, in 2005 the GoE commissioned a study to review possible options (DSA 2006). The results of the government's study included a number of recommendations for moving forward, but proposed a very slow time frame and failed to address a number of difficult issues that may hamper the transition.

The present paper aims to illuminate possible solutions available to the GoE. The paper traces the largely state-led policies that have been put in place to stimulate increased cereal productivity and examines the extent to which these policies have had their intended impacts. This review indicates that although Ethiopia has an admirable and sustained record of supporting seed-fertilizer technological intensification in cereals, the related state-led policies have outlived their usefulness, suggesting the need for a rethinking of approaches.

2. THE SEED-FERTILIZER TECHNOLOGY PUSH AND ITS IMPACTS

A core goal of the GoE's ADLI strategy was to raise cereal yields through a centralized and aggressive extension-based push focusing on technological packages that combined credit, fertilizers, improved seeds and better management practices. The Participatory Demonstration and Training Extension System (PADETES) was started in 1994/95 to pilot this approach, and was spearheaded by a large-scale demonstration program led by Sasakawa Global 2000 (SG2000). Following the early results and recommendations of SG2000, the extension program scaled up the PADETES package approach to raise productivity and food production.

Some 62 percent of the Ethiopian population is estimated to live in the moisture-reliant highlands (Chamberlin and Pender 2006), so the PADETES-led cereal intensification programs appropriately focused on these areas. In these areas, PADETES focused specifically on wheat, maize, and teff, with the total trials between 1995 and 1997 divided roughly equally among the three crops.[2] 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 1) and would be profitable to farmers in moisture-reliant areas (Howard et al. 2003).

Table 1. Yields in on-farm field trials vs. farmers' yields, 2000-2004 (metric tons/hectare)

Crop	NAEIP (1995-1999)		SG2000 (1993-1999)		Current farm yields
	Improved	Traditional	Improved	Traditional	2000-04
Maize	4.73	1.57	4.60	1.57	1.82
Wheat	2.93	1.17	2.31	0.95	1.31
Sorghum	2.79	1.12	2.08	0.92	1.21
Teff	1.43	0.85	1.62	0.64	0.82
Barley	2.15	1.00			1.05

[a] NAEIP is the National Agricultural Extension Intervention Program. SG2000 is the Sasakawa Global 2000 program.

Source: World Bank 2006b.

Overall, these programs reached about 40 percent of the roughly 10 million farm households in Ethiopia over a 10-year period. The programs also succeeded in boosting input use,

[2] In later years, other crops and non-crop demonstrations were included.

with the use of improved seed and fertilizer increasing by about 50 and 30 percent, respectively, from 1995-2005.

However, the programs' reach has been somewhat limited. Official estimates from the Central Statistical Authority (CSA) show that while the total quantity of improved seed supplied nationally increased during the PADETES period, farmer use of improved seed in 2005 remains at only 3 to 5 percent, suggesting that while some farmers are using improved seed intensely, most still rely primarily on saved seed and farmer-to-farmer exchanges (Figure 4).[3] Similarly, CSA estimates show that area planted with improved seed grew slowly during the PADETES period, and as of 2005, comprised just 4 percent of the total area for wheat, 16 percent for maize, and 1 percent for both pulses and sorghum in 2005 (CSA 2006).[4]

Official estimates on fertilizer use in Ethiopia tell a slightly different story. Fertilizer use increased from 250,000 tons (21 kg/ha) in 1995 to 323,000 tons (32 kg/ha) of product in 2004/05 (Figure 5). This growth of total fertilizer consumption was more rapid (i.e. it has been positive) than the average for Sub-Saharan Africa (SSA) over the same period, and the average use of fertilizer per hectare was almost double the average for Sub-Saharan Africa (Crawford, Jayne, and Kelly 2006).

Notably, however, growth in fertilizer consumption *per hectare* has increased only marginally over the past decade. Despite the huge demonstration programs, only 37 percent of farmers were using inorganic fertilizer, and application rates remained at 16 kg/ha of nutrients (about 33 kg/ha of commercial product) or lower. There is also significant evidence suggesting that the farms have dis-adopted the seed-fertilizer technology packages over time (e.g. EEA/EEPRI 2006).

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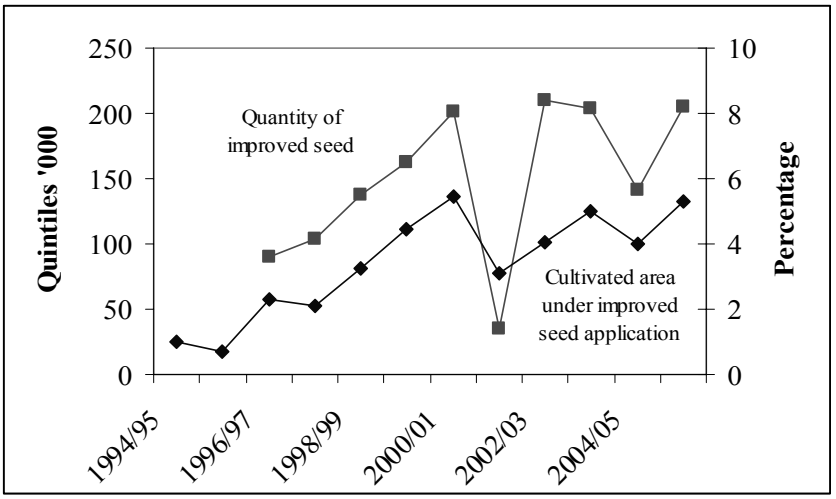
[3] Note, however, that estimation of improved seed use is difficult. In the case of self-pollinated crop varieties such as maize and teff, farmers may be cultivating improved varieties that were distributed several years ago. While yields may benefit from replenishment of seed for the improved variety, the typical rural survey may record the variety as "unimproved" or "non-modern variety." In the case of hybrids such as maize, however, this is obviously not the case.

[4] Other estimates have indicated much higher rates of improved seed use in Ethiopia, possibly by accounting for some of the estimation problems noted in the previous footnote. For instance, the International Maize and Wheat Improvement Center (CIMMYT) reported that in 2002, 71 percent of all wheat area in the country was sown with improved varieties, although only 43 percent of the area was sown with varieties released since 1995 (Lantican, Dubin, and Morris 2005). CIMMYT also reported that 19 percent of all maize area was sown with improved varieties (roughly 18 percent hybrid and 1-2 percent openly-pollinated) during roughly the same period. Adoption studies of improved varieties undertaken at the sub-national level reported median adoption rates for wheat at 55 percent, maize at 30 percent, pulses at 30 percent, and sorghum at 10 percent between 1997 and 2005 (Lemma, Anandajayasekeram, and Kisamba-Mugerwa 2006).

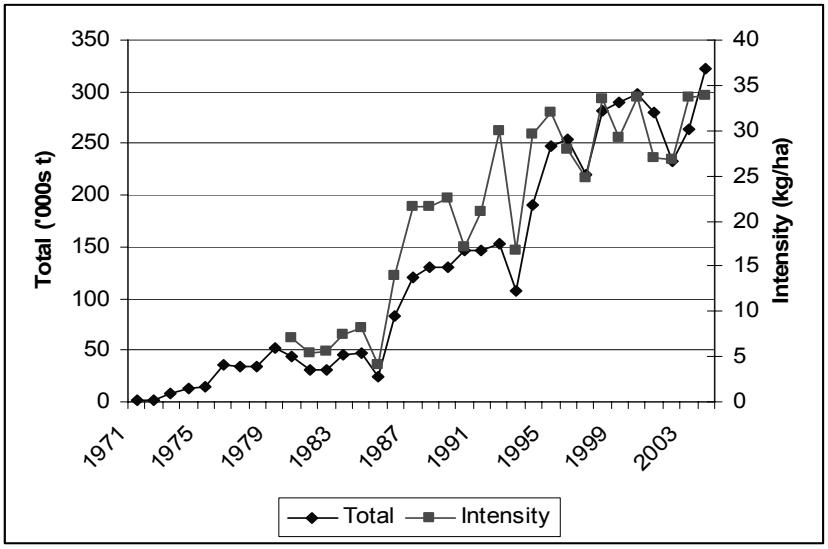
Figure 4. Quantity of improved seed supplied and land cultivated under improved seed application,[a] for cereals only, 1994-2000



[a] Cultivated land under improved seed application is measured on the right-hand scale. Figures are based primarily on ESE data reported to CSA.

Source: CSA, various years; DSA 2006.

Figure 5. Total fertilizer consumption, 1971-2003



Source: MoFED, 2006, 2005.

Although the strong push for intensification has resulted in higher use of improved inputs, the figures for Ethiopia are still low when compared to those in other countries that have successfully intensified cereal production in the past, particularly in Asia (Table 2).[5] Moreover,

[5] See Doss et al. (2003) for a review of technology adoption studies that focus specifically on fertilizer and improved maize and wheat varieties in Ethiopia and other East African countries for the period 1996-99.

the impacts of the intensification push on productivity are not readily discernible in aggregate production data. Almost all of the increased production seen over the past decade may be explained by area expansion, whereas cereal yields have generally stagnated around 1.15 metric tons per hectare.

Table 2. Comparison of modern varieties (MVs) and fertilizer use among different countries and regions, 1997-2002

	Area under wheat MVs (% of area)[a]			Area under maize MVs (% of area)[b]			Fertilizer usage (kg/ha of arable and permanent cropland)[b]		
	1997	2002	2006	1997	1999	2006	1997	1999	2002
Ethiopia	51	65	--	5	15	20	13	16	14
Eastern/Southern Africa	66	87	--	46	72	47	13	13	15
Western/Central Africa	99	--	--	38	--	--	2	3	3
South Asia	92	94	96	48	46	70	99	110	101
China	79	96	95	99	91	--	263	251	257

[a] Denotes the proportion of total wheat cultivation area that is cultivated with improved (semi-dwarf) wheat varieties. Sources: for 1997, Pingali 1999; for all other years, CIMMYT (pers. comm.) 2007.

b Denotes the proportion of total maize cultivation area that is cultivated with improved maize hybrids or improved openly-pollinated varieties. Sources: for maize in Ethiopia, CSA (2006, 2004, 2001), MoARD 2004; all other countries, CIMMYT (pers. comm.) 2007.

c Source: FAOSTAT 2005.

Among the individual cereal crops, wheat is the only crop to show any positive yield growth during the PADETES period, whereas maize yields declined (Table 3a). In the pre-PADETES period (1988/89-1994/95), wheat showed the most rapid area increase, resulting in a substantial 7.5 percent growth in wheat output. During this period, increases in real prices were the largest contributor to growth in value of production. During the post-PADETES period (1995/96-2003/04), however, wheat growth slowed in both value (0.3 percent) and physical terms (0.8 percent) (Table 3b). Overall yields continue to show a modest decline, but at a much lower rate than before. Area expansion also slowed considerably, although it continues to be the main source of growth in output even today. Real prices have remained relatively stable during the post-PADETES period.

In sum, the growth process for cereals in Ethiopia has been qualitatively very different than intended, with area expansion accounting for most of the growth (although yield increases have been seen in some areas with assured rainfall, mainly in wheat). Despite increased fertilizer use there has been little growth in total factor productivity (World Bank 2006a), and without productivity growth, consumers have not benefited through lower food prices.

Table 3a. Main Cereal crop growth estimates pre-PADETES, 1988/89-1994/95 (percent/year)

Crop	Area	Yield	Output	Price	Value
Wheat	7.0	0.5	7.5	5.0	12.6
Maize	4.4	-4.2	0.2	6.5	6.7
Teff	4.7	-3.3	1.5	5.3	6.8
Barley	4.1	-2.6	1.6	6.3	8.1
Sorghum	1.3	-2.6	-1.4	3.6	2.6
Total	4.3	-2.6	1.7	5.2	7.2

Table 3b. Main cereal crop growth estimates post-PADETES, 1995/96-2003/04 (percent/year)

Crop	Area	Yield	Output	Price	Value
Wheat	3.8	0.7	4.5	-0.4	4.3
Maize	1.0	-1.0	0.0	1.1	1.1
Teff	-0.7	-0.5	-1.2	0.8	-0.4
Barley	1.8	0.1	2.0	1.9	4.0
Sorghum	-0.2	-1.5	-1.8	-3.0	-5.1
Total	0.7	-0.5	0.2	0.2	0.4

Source: World Bank 2006a.

A number of factors seem to account for the poor performance of agricultural productivity in the face of significant efforts at intensification and use of modern inputs. One major factor appears to be low technical efficiency in the use of the principle modern input, fertilizer.[6] A recent analysis indicated that farmers are only achieving on average 60 percent of their potential production, given current levels of input use (World Bank 2006a). As a result, fertilizer use may be yielding negative returns to many farmers, thereby resulting in stagnation of further intensification and significant rates of dis-adoption.

This low technical efficiency is largely due to the application of standard packages to very diverse and risky environments, and the state-dominated input supply and credit systems, which negatively impact the timeliness and quality of input supply. Furthermore, this low efficiency is likely related to the rapidly changing and often inconsistent policy signals directing this system. These issues are examined in detail below.

[6] Other likely causes of the yield decline include expansion to more marginal areas as population increases, as well as serious problems with soil erosion and degradation. One study estimated that soil degradation has resulted in an annual average productivity loss of 2-3 percent per year (Yesuf et al. 2005).

3. THE POLICY ENVIRONMENT FOR CEREAL INTENSIFICATION

The policy environment that has pushed the intensification drive in cereals is based on an integrated program of extension, seed, fertilizer and credit. As the poor impacts of these programs on agricultural development and economic growth have been increasingly recognized, considerable effort has been directed at examining these policies more closely. This section traces the evolution of these policies and assesses their effectiveness.

Extension policy

Agricultural extension in Ethiopia is traditionally financed and provided almost entirely by the public sector. The extension services in Ethiopia have followed a rather conventional, top-down approach along these lines. They first evolved in the 1960s and 1970s as part of integrated rural development programs, extending in the 1980s to a locally-adapted Training & Visit (T&V)-like system developed under the Peasant Agricultural Development Projects (PADEPs).[7] In 1995, the PADETES system (see above) was piloted and quickly became the vehicle for the current program, which now claims to reach around four million farmers (EEA/EEPRI 2006).

The PADETES approach has emphasized the development and distribution of packages to farmers; these packages typically include seeds (mainly maize) and the fertilizer inputs needed to grow them, the credit needed to pay for them, and training and demonstration plots intended to facilitate understanding and adoption of the inputs. Through this approach, extension agents encourage the use of packages tied to credit, and the agents themselves are involved in (and largely consumed by) the actual distribution of inputs and the collection of credit repayments. This package-driven extension approach has been implemented on a large scale and has reached virtually all farming communities in Ethiopia.

Unlike many other developing countries, Ethiopia continues to invest heavily in its public sector-led agricultural extension system in order to implement the intensification program. Beginning in 2000, the GoE established 25 college level agriculturally-oriented Technical and Vocational Education Training (TVET) programs with the capacity to train roughly 30,000 students each year for the agricultural extension program. By the end of 2008, the this program will have retrained Ethiopia's existing extension staff of 15,000 Development Agents (DAs), and

[7] The program was "T&V-like" in the sense that it established a bureaucratic structure for the regular transmission of pre-determined technical messages from subject matter specialists to farmers.

will also have trained an additional 50,000 students to become DAs, thus expanding the size of the publicly-financed extension staff significantly.

The formal training offered by the TVET program is the first step of an ambitious scaling-up and intensification of the extension program. Farmer Training Centers (FTCs) have been constructed in 7,400 *kebeles* (peasant associations) using government and community resources, and the total number of FTCs is expected reach 18,000 by 2008. Each FTC will eventually house three DAs, and will theoretically offer three-month basic training courses to farmers, provide a broad range of demand-responsive extension and short-term training services, and support participatory research, innovation adaptation, and demonstrations.

These programs represent a significant public investment in extension in Ethiopia, amounting to over $50 million dollars annually or almost 2 percent of agricultural GDP in recent years.[8] This is four to five times the investment in agricultural research.

Performance of agricultural extension

Despite these expenditures, however, there has been surprisingly little hard evaluation of the impacts of the program. Recent surveys have found mixed results. Although many farmers seem to have adopted the packages promoted by the extension system (backed by the credit programs discussed below), up to a third of the farmers who have tried a package had discontinued its use (Bonger, Ayele, and Kumsa 2004; EEA/EEPRI 2006).

Poor extension services were ranked as the top reason for non-adoption, according to a survey conducted by Bonger, Ayele, and Kumsa (2004). Evidence suggests that extension agents are hampered by tasks other than the provision of technical advice, namely input and credit distribution. In fact, most extension workers view their role primarily as distributing fertilizer and credit, according to an EEA/EEPRI survey (EEA/EEPRI 2006).

Similarly, Bekele and Anandajayasekeram (2006) noted that extension in Ethiopia has been limited by its use of top-down approaches, the distraction of extension workers by their involvement in input supply, the limits of standardized packages, and the emphasis on input targets rather than affordability and profitability.

[8] This does not include the much larger expenditure of the Food Security Program, much of which is aimed at extension activities.

These concerns are echoed in ex ante assessments of the FTC approach, where the major questions are whether sufficient human capital and expertise exist to make these FTCs functional, and whether the fixed curriculum and classroom-based instruction will prove too formal and even less inclusive than the PADETES approach (Spielman, Negash, and Davis 2006).

In short, extension is not living up to its potential. The technological push underpinning the extension strategy has focused excessively on increasing the use of physical inputs to boost production, at the cost of emphasizing the efficiency and profitability of input use.

The GoE has recognized some of these deficiencies and has sought to address some of the weaknesses of the system. To get beyond a focus on cereals, packages have also been developed to support other crop and livestock enterprises, improve post-harvest technology, and encourage natural resource management. To address the diversity of smallholder farming systems in Ethiopia, classifications have been developed to divide the country into several distinct agroecologically-based extension zones, which have been used in the development of more appropriate zone-specific packages (Ibrahim 2004).

Despite these recent changes, however, the extension system remains under pressure from above to meet certain targets. 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. Farming communities do not participate in extension planning, and the extension agents remain largely conveyors of technical messages, rather than active facilitators of community capacity building and providers of relevant information (EEA/EEPRI 2006). And although extension has recently been decentralized to the administrative control of regional and district governments, continued imposition of targets from above and weak local capacity have not yet permitted the emergence of a real demand-driven dynamic.

In sum, evidence suggests that despite the GoE's sizable investment in agricultural extension, its impact has been severely constrained by limited human capital, competing responsibilities placed on extension agents, and entrenched routines and behaviors among extension agents. Underlying this is the issue of whether the extension system is managed in a way that promotes reliable knowledge transfers among researchers, extension agents, farmers, non-governmental organizations, private industry, and other actors in the agricultural sector. New and pluralistic approaches might offer some solutions for increasing the impact of future investments in extension. However, adoption of these approaches will require greater flexibility within the current system.

Seed systems and policy

From an economic point of view, determining the appropriate role of the state and the private sector in the market for seed is a complex issue. Seed systems are, by their nature, subject to a variety of unique market and institutional constraints (Gisselquist and Van Der Meer 2001; Tripp and Louwaars 1997). First, problematic property rights questions arise from fact that improved seeds can, in many cases, be reproduced by the farmer, thus reducing the ability of breeders to appreciate the gains from their innovative activities and investments. Second, information asymmetries result from the inability of farmers to make *ex ante* assessments of seed quality, since the seller retains such knowledge in the absence of certain types of regulation. Third, coordination problems result from difficulties in monitoring and enforcing contracts for seed use. Finally, inelastic supply responses result from the inability of breeders to respond effectively to the changes in seed demand that result from expectations of market prices, household incomes, rainfall, and other determinants of farmers' planting decisions. Nonetheless, over time, many of these failures can be resolved through enactment of plant variety rights and truth in labeling laws, eventually allowing developed seed systems to be largely driven by the private sector.

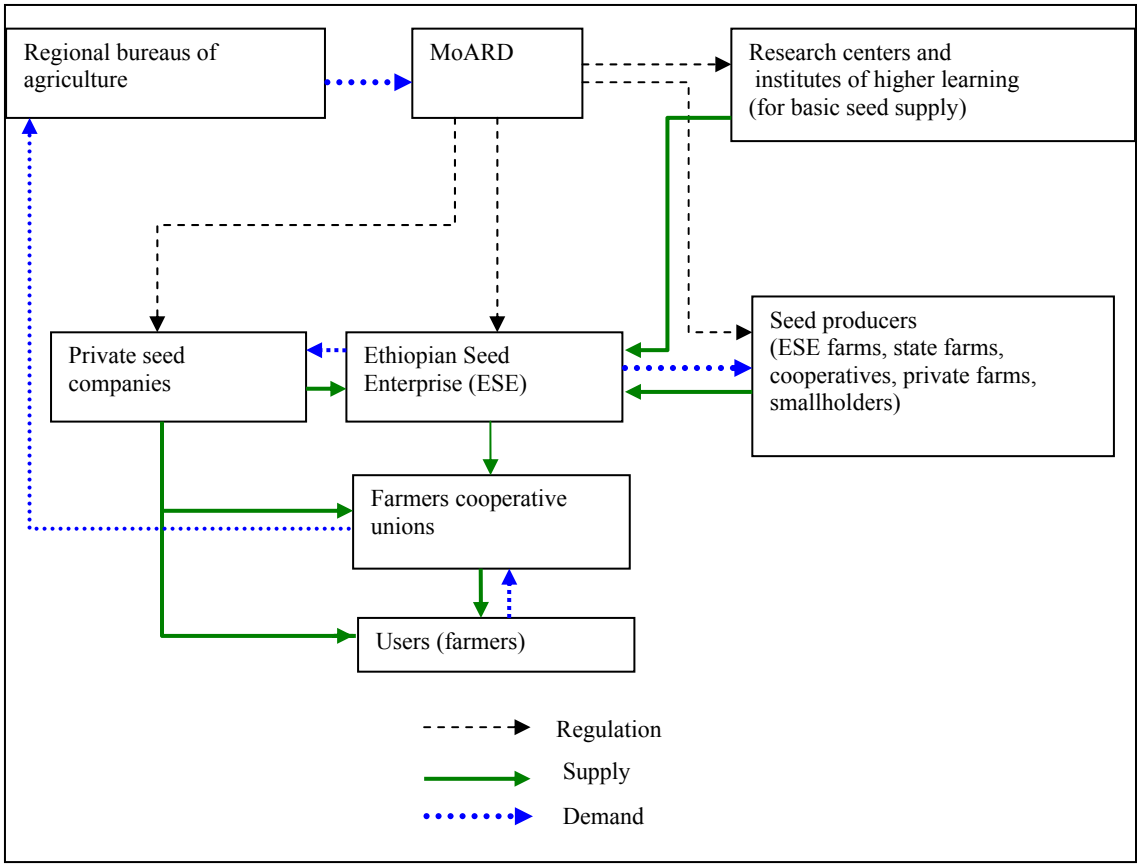
In Ethiopia, the seed system is largely based on informal mechanisms such as farmer selection and farmer-to-farmer exchanges, which account for over 90 percent of the seed trade (Belay 2004). Formal breeding and seed multiplication activities were conducted on an ad-hoc basis until the 1970s. In 1976, the National Seed Council (NSC) was set up to formulate recommendations for seed production in the formal sector and the release of varieties from the national research programs (Belay 2002). Soon after, the Ethiopian Seed Corporation, later renamed the Ethiopian Seed Enterprise (ESE), was established as a fully government-owned parastatal body designed to undertake seed production, processing, and distribution, while regulatory functions were managed under the aegis of the Ministry of Agriculture.

At present, Ethiopia's formal seed market is still driven by the public sector (see Figure 6). The national research system—led by the Ethiopian Institute of Agricultural Research and a number of regional research centers and higher learning institutes—provides improved varieties in the form of basic (foundation) seed or breeding lines. The ESE then multiplies seed in response to official demand projections articulated by regional bureaus of agriculture.

At present, the private sector is a limited force in Ethiopia's seed market. In 2004, although there were 26 firms licensed to produce, 33 to retail, and four to export seed, only eight

firms were active in seed production. This lack of private involvement could be seen even in the hybrid maize seed sector, which has been largely privatized in many other low-income countries.[9] In Ethiopia, as of 2004, approximately 70 percent of maize seed was produced by the ESE, while the remaining 30 percent was produced by Pioneer Hi-Bred International and a handful of smaller firms under contract to ESE (Table 4). For other crops, the ESE is practically the only formal producer of seed.

Figure 6. A schematic of the Ethiopian seed system, c. 2006



Source: Authors.

A fraction of seed distribution is also conducted by private firms, non-governmental organizations, rural development projects, and state farms. In the maize seed sector, for example, Pioneer produces its own branded hybrids based on breeding materials imported from abroad, accounting for approximately 11 percent of the maize seed market in 2004. However, about 47

[9] Since farmers must purchase new hybrid maize seed every year to capture the gains conferred by hybridization, and since private firms can profitably breed and market their own hybrids to meet this demand provided the hybrid lineage remains a trade secret, hybrid maize seed markets are especially attractive to private sector investment in many industrialized and developing countries.

percent of its production was distributed through the regional bureaus of agriculture as part of the package program in 2004, with the remainder being sold to commercial farms, state farms, and (through its own retail centers in major maize-producing areas) directly to farmers. Most other firms simply produce for the ESE, which then supplies the regional bureaus of agriculture.

Performance of the seed system

During the 2004/05 season, the supply of improved varieties channeled through the formal system fell short of GoE-estimated demand by 73 percent. This figure is not inconsistent with past performance and, as shown in Table 5, includes significant variability among the crops (Alemu and Spielman 2006; Alemu et al. 2007). While official figures suggest that ESE production of seed has improved over the last five years, the 2004/05 supply remained short of requirements and was fairly volatile, especially for major cereal crops such as wheat and maize (DSA 2006).

Table 4. Hybrid maize seed production by company, 2004

Company	Percent of total maize seed supply
Ethiopian Seed Enterprise	70.0
Pioneer Hi-Bred International	16.1
Hawas Agro Business	0.2
Awassa Farm Development Enterprise	1.3
Awassa Green Wood	4.7
Hadiya Trading Enterprise	1.5
Bako Agricultural Research Center	4.3
Ano Agro Industry	0.8
Anger Farm	1.1
Total	100

Source: MoARD 2005.

Table 5. Demand and supply for seed during the 2005 agricultural season

Crop	Quantity demanded (qt)	Quantity supplied (qt)	Supply as a percent of demand
Wheat	518,487	106,279	20
Maize	155,215	82,458	53
Barley	70,839	11,628	16
Teff	78,389	4,197	5
Faba bean	77,728	4,761	6
Chickpea	48,187	26,405	55
Haricot bean	33,742	7,027	21
Sesame	21,769	6,046	28
Total (incl. other crops)	1,117,597	304,042	27

Source: MoARD 2006.

However, these shortfalls and volatility represent only part of the story. Shortcomings in seed quality and timeliness of delivery have been an issue in Ethiopia for several reasons. First, the ESE supplies seed with only a limited number of traits capable of addressing the many biotic and abiotic stresses found across these farming systems and agroecologies. Second, concerns have been raised regarding the quality of seed provided by the ESE. Poor cleaning, broken seeds, low germination rates, and the presence of mixed seeds has been commonly reported in ESE-supplied seed (DSA 2006). Third, the official process of procuring, stocking, and distributing seed often fails to meet the time-sensitive needs of farmers. Numerous surveys have found that seed procurement and distribution through official channels is often not conducted in a timely or coordinated manner. Seed is either distributed after the optimal planting time, or the varieties distributed are not appropriate to changes in farmers' expectations of weather (e.g. Sahlu and Kahsay 2002; DSA 2006; EEA/EEPRI 2006).

Efforts to encourage a seed system that is more responsive to farmers' needs face several issues in Ethiopia, including the crowding-out effects of the state's continued dominance of the seed sector and the high barriers to entry set for private investors. Other issues include the following, all of which militate against private entry into the seed sector.

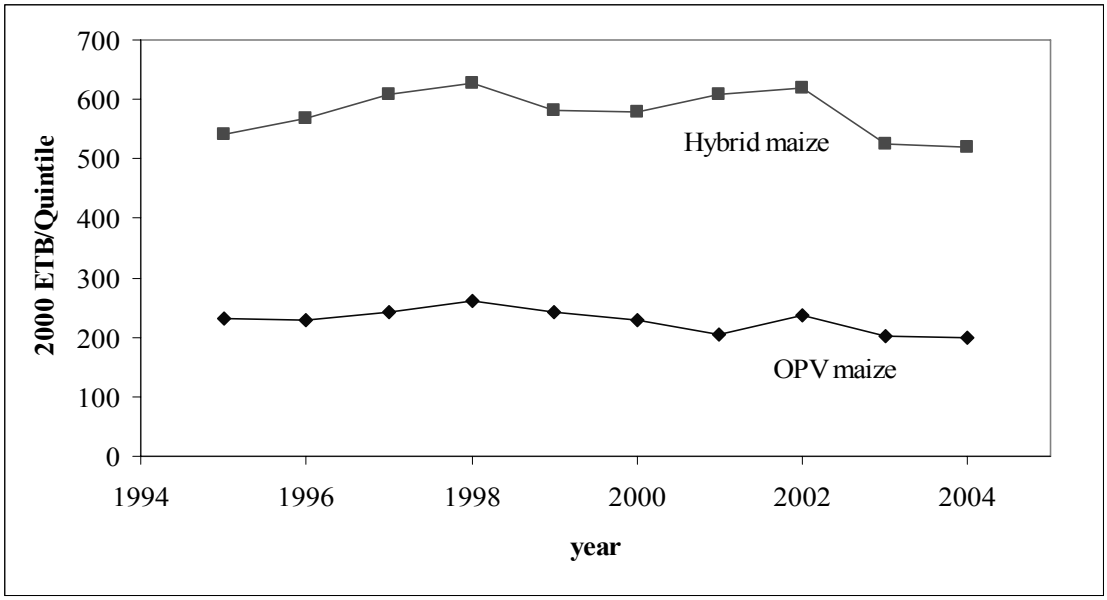
First, while the ESE provides some opportunity for private firms to develop their capacity and infrastructure by outsourcing a portion of its seed multiplication operations, the 15 percent premium offered to contractors over current market prices is often an insufficient incentive for private investment. Private firms and cooperatives subcontracted by the ESE can often realize higher profits by breaking their contracts, storing the seed, and selling it as grain when market prices surpass the ESE premium price.

Second, private sector entry has been thwarted by relatively low (and generally fixed) nominal prices for seed, and the past decade has seen declines in real prices for almost all types of seed. While the ESE sets its prices to generate a profit of 3 to 5 percent, the fact that demand so significantly exceeds supply suggests that the market could easily bear a higher margin (Figure 7).[10] Moreover, there is potentially room to bring these seed prices into closer alignment with

[10] For instance, while the prices of most seed have been stable over the past decade (and declining in real terms), the market nonetheless managed to absorb dramatic (if aberrant) increases in the price for lentil seed (186 percent between 2003/04 and 2004/05) and chickpea seed (29 percent) owing to seed production shortages and growth in export demand for these particular crops.

international or regional benchmarks that price hybrid seed at about a 10:1 ratio over the grain price, versus the 5:1 used in Ethiopia.[11]

Figure 7. Maize seed prices, measured in constant 2000 ETB/quintile, 1995 – 2004



Note: "OPV maize" denotes open-pollinated maize varieties; ETB denotes Ethiopian birr at constant 2000 prices.
Source: ESE 2005.

Third, while evidence strongly suggests that the cost basis for private seed firms is potentially far lower than that of the ESE, primarily due to a significant difference in overheads and administration (Table 6), other indirect costs work against private sector entry into the seed market. These include the costs associated with navigating the regulatory system, accessing financing from the formal banking sector without non-agricultural collateral, and establishing independent distribution and marketing networks. They also include the costs associated with competing against the public sector's extension system, which accounts for 80 percent of total sales of improved seeds, mostly paid for with credit disbursed against public guarantees (World Bank 2006c).[12]

[11] In neighboring Kenya, for instance, the ratio in 2005 stood at approximately 7:1, down from 10:1 in 1992 as a result of grain market liberalization that caused grain prices to increase more rapidly than seed prices.

[12] Cash sales account for just eight percent of the seed-fertilizer technology packages disbursed through the National Extension Implementation Program in 2001/02.

Table 6. A breakdown of hybrid maize production costs, 2004-05

Cost Center	Cost (ETB/qt)	
	Ethiopia Seed Enterprise	Private seed multiplier
Direct labor costs	33	35
Direct material costs	50	48
Administration and overheads	309	43
Total	392	125

Source: ESE 2005; corporate sources.

Fourth, while regulatory improvements such as the inclusion of commercial seed production as a sector under the Investment Code, or the recent enactment of legislation on breeders' rights and plant variety protection in 2006 are important to stimulating private investment, their impact is likely to be fairly limited.[13] 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 strong as the sector they are meant to protect. 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); Butler and Marion (1985). Moreover, plant breeders' rights are often designed to confer protection to those investing in self/openly-pollinated crop varieties because hybrids can be bred and marketed without the need for such protections. Yet in Ethiopia, even the lucrative hybrid maize market remains dominated by the state.

Fifth, efforts to use smallholders as private agents themselves in the multiplication of seed have met with limited success. 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 self/open-pollinated crops (e.g. 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.

[13] Ethiopia applied for membership in the WTO in February 2003 and, as it seeks to meet the inclusion criteria, obtained full observer status in 2004. In an effort to comply with the WTO's agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), the Ethiopian government is working closely with the World Intellectual Property Organization (WIPO) and other agencies to update and strengthen its intellectual property rights regime in the agricultural, industrial, and service sectors.

The outcomes to date have been mixed, partly due to poor incentives offered to farmers by the ESE, insufficient capacity on both sides, and the constant threat of food insecurity that causes farmers to use their seed stocks for food.

Ultimately, the system's greatest weakness continues to be the lack of a private sector-led production and distribution network that could help mediate supply and demand, offer alternatives to farmers, and provide information on the optimal use of appropriate varieties. To date, private sector growth in this area has been severely constrained by the factors noted above, as well as the costs of building these networks while competing with the existing public sector network that provides seed-fertilizer technology packages throughout much of the country.

Fertilizer and credit policies

Unlike seed, fertilizer is a private good that should be well suited to private market development in Ethiopia. However, a number of features of fertilizer have complicated market development in the early stages of adoption. On the *demand side*, fertilizer is a highly specialized input, the efficient use of which generally requires complementary inputs (e.g. improved varieties), as well as higher levels of management. Most final consumers of fertilizer—smallholders—are widely dispersed geographically, and most of them are poor, so creating a market can be costly. Furthermore, in rainfed areas, fertilizer consumption is highly seasonal (a 2-3 month market window), and year-to-year fluctuations in rainfall patterns contribute to high inter-year variability in demand for fertilizer, with corresponding risks of high carryover stocks from year to year.

On the *supply side*, fertilizer is a bulky input, with relatively low value to volume. This means that transportation costs can make up a large share of final selling prices, even despite considerable economies of size in international procurement and shipping. In countries that import fertilizer (such as Ethiopia), the supply chain from fertilizer production to the final user, the farmer, is long in terms of both distance and time, often requiring over six months from initial orders to final purchase. Hence, liquidity along the supply chain is often a constraint. Due to these constraints on both demand and supply, public interventions in fertilizer markets are common in the early stage of market development.

Under the military regime of the Derg (1974-1991), the private sector was excluded from participation in this sector, while fertilizer was subsidized by the state, and special credit programs were put in place to encourage fertilizer use. The Agricultural Inputs Supply

Corporation (AISCO), established in 1984, was the sole importer and distributor of fertilizers to cooperatives and state farms. Although fertilizer consumption rose to 100,000 tons by 1990, the fertilizer market during this period was characterized by widespread operational inefficiencies. Not only did the provision of subsidies drain public sector revenues, but there was also a high rate of default on fertilizer credit.

The period following the fall of the Derg saw the private sector enter the fertilizer market. By 1993, the GoE had issued the National Fertilizer Policy, which supported fertilizer market development. By 1996, the GoE had launched the National Fertilizer Sector Project with financial support from the World Bank and other donors; this project supported fully liberalized pricing, the abolition of subsidies, and the regulation of fertilizer standards. AISCO's monopoly was abolished, and the organizations was transformed into the Agricultural Inputs Supply Enterprise (AISE).

The initial response of the private sector to market liberalization was rapid. By 1996, several private firms were importing fertilizer, and 67 private wholesalers and 2,300 retailers made up a significant share of the domestic market.

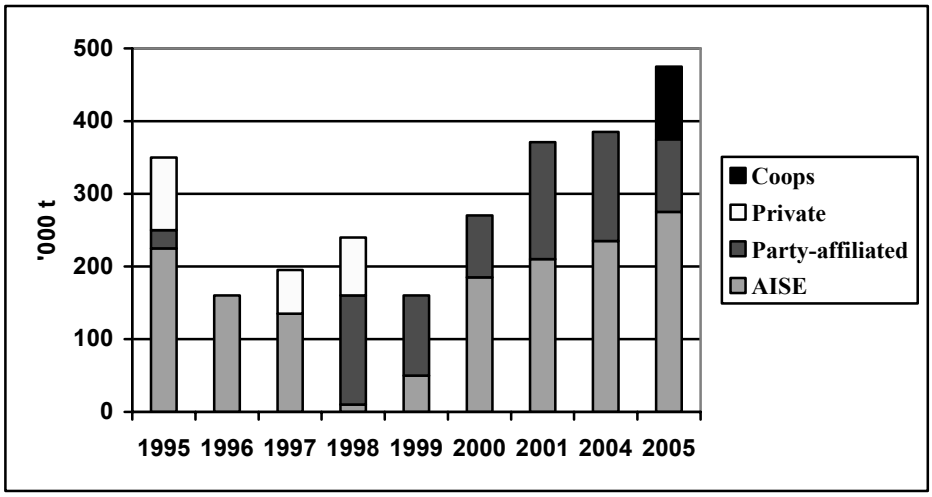
However, since 1999 the private sector that had initially responded to the reforms has largely exited the fertilizer market. In the case of imports, the share of private firms operating in the market went from 33 percent in 1995 to zero in 1999. Since then, the AISE has taken the majority share, followed by "private" companies closely affiliated with or owned by the governing party and, more recently, cooperative unions (Figure 8). In 2004/05, the share of party-affiliated companies declined, and cooperative unions entered the import market with considerable technical assistance from the Ministry of Agriculture.

The market share trends are similar in the case of wholesalers. While 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 party-affiliated companies, had disappeared from the scene.

The decline of the private sector in the retail market was more dramatic. While private sector retailers held a majority share of the market in the early 1990s, the public sector and cooperatives have become almost the sole distributors of fertilizer since early 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 (Figure 9; EEA/EEPRI 2006). The public sector

supply channels have also changed; whereas extension agents initially managed distribution, the responsibility was shifted to local input supply offices in more recent years.

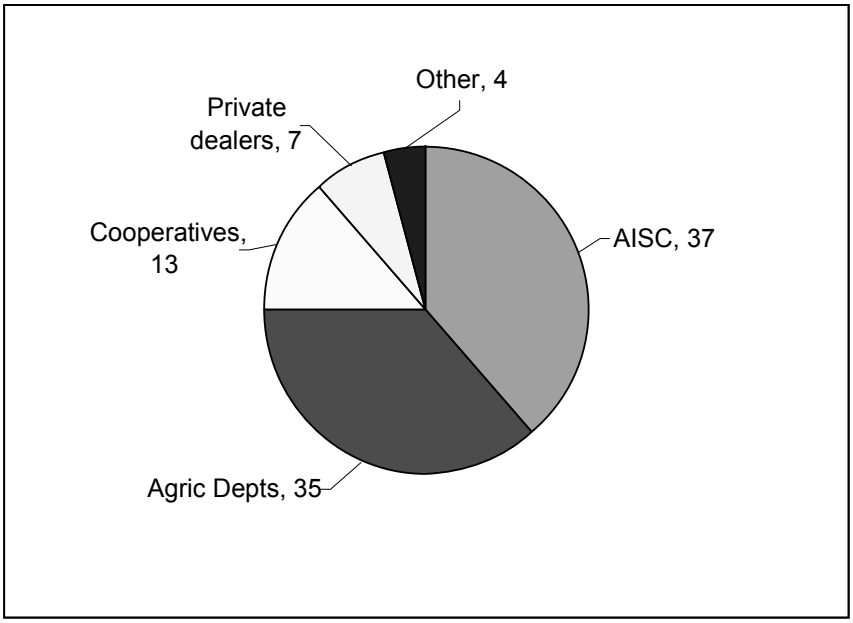
Figure 8. Import shares by type of importer (in thousand metric tons)[a]



[a] The term "coops" denotes cooperative unions.

Source: DSA 2006; various.

Figure 9. Farmers' source for fertilizer, 2004 (percent)



Source: EEA 2006.

The decline of the private sector 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, in lots of 25,000 tons. The importer almost always requires financing as well, given that a single shipment of fertilizer alone requires about $US 5 million over several months. However, while 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, the AISE and party-affiliated companies have privileged collateral requirements.

Difficulties are also evident in the estimation of demand and distribution of fertilizer. Estimates of demand are compiled through official channels and aggregated to the national level as in the case of seed. Importers respond to official demand estimates and organize distribution through the regional bureau of agriculture or cooperatives, depending on the region (DSA 2006). The current government policy is to target at least 80 percent of fertilizer sales through cooperatives, which are eventually intended to replace the public sector involvement in retail distribution of fertilizers.[14] This process, as with the importation process, tends to favor those firms or organizations with access to capital markets and experience in navigating the regulatory and administrative systems at both the federal and regional levels.

Credit

To ensure the uptake of the seed-fertilizer technological packages, regional governments in Ethiopia initiated a 100 percent credit guarantee scheme beginning in 1994. Under this system, about 90 percent of fertilizer is delivered on credit at below-market interest rates as part of packages (incorporated with extension programs), displacing what had previously been retail sales from the private sector (including a substantial share on cash basis). In order to finance the seed-fertilizer technology packages, credit is extended to farmers by the Commercial Bank of Ethiopia (a state-owned bank), through cooperatives, local government offices, and more recently, microfinance institutions (MFIs) and one cooperative bank. Since 1994, the number of active cooperatives, cooperative unions and MFIs has expanded. These organizations have gradually assumed part of the guaranteed credit program, which had reached some four million farmers with guaranteed credit of nearly $70 million in recent years.

Credit recovery, using extension agents and a degree of coercion by local administrative officials, was generally successful until the collapse of maize prices in 2001 and the subsequent

[14] There is anecdotal evidence suggesting a widespread belief among cooperative officers, local administration officials and the private sector that private sector retailers are “not allowed” to sell fertilizers, and that it is illegal for farmers to sell fertilizers they buy from the cooperatives or extension agents, essentially restricting the emergence of a secondary market.

drought. In Oromiya, for example, recoveries had averaged above 80 percent up to 2001, but this figure dropped to 60 percent in 2002, forcing major rescheduling of loans. As a result of the credit guarantee, the total amount of the defaults is now deducted from the Federal government block grants to each of the regions.

Performance of the fertilizer/credit supply system

The overall performance of the current system can be assessed in several ways—price competitiveness, services provided, and fiscal and other costs to the public sector.

At first glance, fertilizer prices in Ethiopia are competitive. The margin between domestic and international prices is higher in Ethiopia than in Asian and Latin American countries, but comparable to the margin in other African countries, including South Africa (Heisey and Norton 2006). A comparison of the price build-up of fertilizer from port to farm gate indicates that marketing margins in Ethiopia are somewhat lower than those in comparable African countries, and that costs may have decreased over time with improvements in transportation (Table 7).

Another way to measure this is to compare prices in Ethiopia with prices in comparable countries that are deemed to have a relatively dynamic fertilizer industry. By this measure, prices in Ethiopia do not seem to be out of line, and are in fact often lower than those in Kenya, a country where fertilizer use by smallholders is growing rapidly (Ariga, Jayne, and Nyoro 2006).

In reality, however, these apparently low prices reflect the peculiarities of the Ethiopian fertilizer markets. For example, a part of the cost-build up in fertilizer delivery does not show up in retail prices because the bottom end of the supply chain is essentially subsidized, with extension agents and cooperatives assuming the retailing functions.

Table 7. Cost structure for imported urea ($US/metric ton)

	USA, 2003	Malawi, 2003	Nigeria, 2003	Kenya, 2004[b]	Ethiopia, 2005	Ethiopia, 1998
CIF price	160	167	165	204	283	125
Domestic transport	10	60	50	40	38	100[a]
Interest	2	13	17	Na	16	7
Other costs	54	81	104	Na	29	11
Retail price	226	321	336	311	366	243
Total margin	66	154	171	107	83	118

[a] Includes storage and handling. [b] Calcium Ammonium Nitrate (33 percent N)

Source: Gregory and Bumb 2006; Jayne et al. 2003; DSA 2006; Ariga, Jayne, and Nyoro 2006.

In addition, fertilizer prices represent only one dimension of market performance. 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, 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. NFIA (2001) reported that 12 to 46 percent of farmers received fertilizer late, depending on the region. Many farmers also complained that bags were underweight, and 30 percent of farmers in two regions registered a negative response on quality.

A more recent survey by Bonger, Ayele, and Kumsa (2004) reinforced these findings, reporting that half of farmers noted that the fertilizer arrived after planting, 32 percent reported underweight bags, 25 percent indicated poor quality, and almost 40 percent reported that their planting was delayed by fertilizer problems. Most recently, DSA (2006) and EEA/EEPRI (2006) noted that fertilizer quality problems had been reduced but delays in delivery were still common—25 percent or more of farmers complained of late delivery. Timely availability of fertilizer is critical in rainfed agriculture; fertilizer applied late causes it to be unprofitable, while delayed planting can incur even higher costs. Also unlike neighboring countries, Ethiopia does not offer fertilizer in smaller packages or different formulations needed for non-cereal crops.

Furthermore, fertilizer is tied to credit programs and fed by GoE targets for fertilizer consumption at the local, regional and national levels. This may result in the promotion of fertilizer where it is not profitable, and could explain the negative returns to fertilizer noted above. It may also tend to create moral hazards among farmers with respect to careful use of credit, and may discourage the development of their skills in independent financial management.

In addition, input distribution tied to credit tends to limit the space available for the emergence of private sector retailers. Thus, those farmers with sufficient resources to purchase fertilizer for cash, often on more favorable terms than on credit, are unable to do so since there are very few private traders. This problem is compounded by the exit of private firms and the rise of party-affiliated companies—a situation that is widely perceived as reflecting the lack of a level playing field in the agricultural input sector (Jayne et al. 2001). Similarly, the guaranteed loan program with below-market interest rates creates an un-level playing field in the rural finance sector by undermining efforts to set up alternative institutions such as MFIs, branches of commercial banks, or independent financial cooperatives.

There are also high fiscal costs and fiscal risks associated with the guaranteed loan 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, the Oromiya Region was obliged to pay out 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 input supply parastatal and administrative offices. These include the costs resulting from the "central planning" system of estimation of demand by extension agents at the local level and then aggregation at the national level as the basis for allocation import permits. This understandably results in substantial inefficiencies due to the lack of a market clearing mechanism. 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.[15] Finally, the implicit costs include those resulting from damage done to extension-farmer relationships when harsh measures have been employed to ensure loan repayment.

In sum, it is apparent that the current system in Ethiopia is inefficient and unsustainable in the long run, and that it severely hinders the development of sound input markets and financial institutions in rural areas. A review of the situation in Kenya reveals how a dynamic private sector can promote smallholder use of fertilizer even when prices are relatively high (Ariga, Jayne, and Nyoro 2006).

Agricultural risk mitigation policies

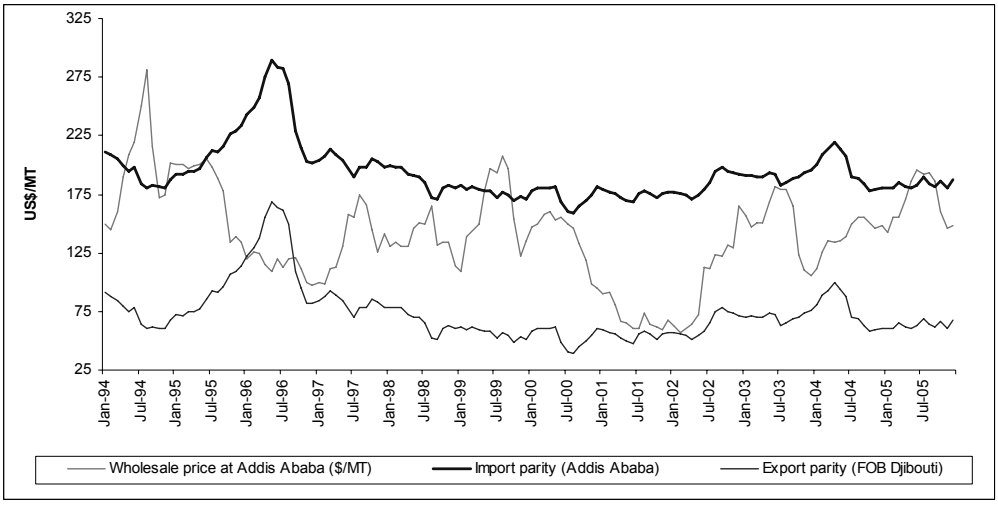
Both production and price variability are high for cereals in Ethiopia, and domestic price variability is higher than the corresponding variability in world prices. The wide fluctuations in grain prices from 1999 and during the 2002/03 drought have shown that use of modern inputs is risky in most areas of Ethiopia, as weather-related variability in yield has a negative impact on farmers' incentives to use fertilizer. Given the risks, producers are less likely to use yield-enhancing inputs (or to use them at "recommended" levels), as this is unprofitable in poor-rainfall years. A generic estimate suggests that in a risky rainfall environment a risk-averse farmer would

[15] Kenya, which has a fully private sector supply, has an inter-annual carryover average of less than 10 percent (Ariga, Jayne, and Nyoro 2006).

reduce fertilizer use by 40 percent (World Bank 2006b), a figure that is probably representative of the situation in Ethiopia (Dercon and Christiaensen 2005).

This production risk is compounded by volatility and uncertainty in grain prices (Figure 10). The principle underlying reason for price variability is, again, climatic shocks, compounded by weak domestic markets and lack of integration with world and regional grain markets due to poor infrastructure (World Bank 2006a).[16] With weak domestic demand, high transaction costs of trade, and the low tradability of some of Ethiopia's principle crops (teff, millet, sorghum, and barley), variability in production results in sharp price movements (i.e. demand is highly inelastic). Following heavy promotion of the seed-fertilizer technology package and excellent harvests in 2001/02, maize prices crashed to an all-time low. This was followed by a severe drought that caused prices to rise sharply again (Figure 10). Risks due to price variability have effects on incentives to intensify that are similar to those described above for the direct weather risk.

Figure 10. Wholesale maize prices in Addis Ababa relative to import and export parity prices based on US white maize, 1994-2006



Source: Del Ninno, Dorosh, and Subbarao 2005; Rashid (pers. comm.) 2006.

Price stability relates largely to capacity and incentives to store, as well as to engage in trade. Public interventions and reforms aimed at promoting price stability and improving grain markets have been implemented in Ethiopia with limited success. These efforts have included stockpiling of emergency food reserves, creation of a marketing directorate at the ministerial

[16] In particular, local procurement of food aid aimed at strengthening local markets is often timed just before harvest when prices are highest, rather than post-harvest.

level, development of a new marketing strategy for the country, creation of a cooperative commission and associated legal framework, piloting of a warehouse receipts and inventory credit system, promotion of trade associations for various sub-sectors in the agricultural sector, and stakeholder dialogue between private and public actors in the market, among others (Gabre-Madhin and Goggin 2006).

In 2006, with consumers facing record grain prices, the GoE banned cereal exports. While this may have had a small dampening effect on domestic price increases in the short term, it is likely to negatively impact exports to regional markets in the longer term when domestic prices are low, since neighboring countries are likely to follow similar discretionary policies.

Many of the interventionist policy options used in Asia to stabilize prices in previous decades are unlikely to be workable options for Ethiopia (Cummings, Rashid, and Gulati 2006), due to budgetary implications and management complexity (Byerlee, Jayne, and Myers 2006). To date, calls for more interventionist policies by the Ethiopian Grain Trade Enterprise (EGTE) to establish a dual pricing mechanism (i.e. ceiling and floor prices) have not been seriously implemented by the GoE.

Food aid, however, continues to be one of Ethiopia's primary means of managing risk and augmenting supply after a bad harvest, constituting a significant share of the grain market in Ethiopia. Following efforts to strengthen domestic markets, some donors have begun procuring food aid locally in food surplus regions. However, poor timing of these purchases has actually increased market risks and price variability (World Bank 2006a) with the result that food aid is more part of the problem than part of the solution, at least in terms of price stability and incentives.

Overall, the evidence suggests that risk mitigation measures are needed to facilitate the efficient use of inputs by farmers, and to alleviate the costs to consumers of short-term spikes in basic food prices (Rashid and Assefa 2006). In recognition of this, the GoE is presently developing a coordinated strategy to build a central commodity exchange to address problems of market information and transaction costs and risks, and to exploit scale economies though cooperatives (Gabre-Madhin and Goggin 2006; Bernard, Birhanu, and Gabre-Madhin 2006). The commodity exchange and its associated institutions, such as the use of warehouse receipts, should help smooth prices and eventually allow both farmers and traders to forward contract and lock in harvest prices.

Likewise, on the production side rainfall-indexed insurance is being piloted as a way to increase farmers' incentives to use inputs, especially fertilizer. Ideally such insurance should be tied to provision of credit, a method that was successfully implemented in India. However, the credit guarantee policy in Ethiopia acts as a disincentive for financial institutions to package loans with insurance.

In sum, 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 be a major policy priority for the country. The non-market-based options, such as dual pricing mechanisms, 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.

4. CONCLUSION

There is little doubt that intensification of cereal production is needed in Ethiopia, given the precarious food situation and acute land scarcity in the country. 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 agroecologies characterized by high variability in rainfall and other related risks. Success will require improvements not only in the public provision of rural services and inputs, but also in the market infrastructure.

State-led policies to push seed-fertilizer technologies initially generated some positive impacts in Ethiopia over the last decade. The PADETES approach helped increase fertilizer use per hectare at a time when many other African countries were experiencing declines, whereas fertilizer prices in Ethiopia were maintained at levels generally comparable to neighboring countries such as Kenya and Sudan.

However, experience suggests that seed-fertilizer technology *packages* are not very appropriate in heterogeneous rainfed areas, especially when they are tied to credit conditions. Rather, smallholders need access to flexible and divisible technologies combined with the capacity to select and adapt practices appropriate to their particular field and seasonal conditions.[17] Because of the standardized package approach and inflexible input distribution systems used in Ethiopia to date, farmers have had little opportunity to experiment, learn and adapt technologies to their own needs. Meanwhile, extension agents have been preoccupied with the distribution of fertilizer and recovery of credit.

More importantly, experience also suggests that an approach that relies almost exclusively on 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. While an entirely private sector-led approach may not be a viable or desirable solution in Ethiopia, more consideration should be given to long-term policies designed to build a dynamic private sector to promote fertilizer, improved seed, credit, and market information systems.

Following recent policy reforms in Ethiopia, there have been some signs of market-oriented change that are complementing public investment and service provision to the rural

[17] See for example, Byerlee and Hesse (1986) and Byerlee (1988).

sector. In extension, there has been some recognition of the need to decentralize advisory services to the local level in order to increase responsiveness, tailor advisory services more to the local agroecological and economic/market circumstances, and promote farm-level development (including livestock and non-staples production) rather than emphasizing a single commodity or technology.

In the seed sector, there has been some discussion of privatization of the seed supply system, and legislation on plant breeders' rights has already come into effect. The logical first step—promotion of private investment in hybrid maize seed production and distribution—could provide the necessary stimulus to building a vibrant seed sector. However, this move should be supported by policies aimed at realigning the public sector's role in the regulation, production, distribution and marketing of seed.

With respect to fertilizer and credit, some consideration has also been given to encouraging greater private involvement in the sector. However, greater emphasis should be placed on phasing out of the guaranteed loan program, rapidly increasing private sector involvement in fertilizer marketing, and removing the involvement of extension services in the supply of fertilizer and recovery of credit.

Still, it will take time to stimulate private investment in the seed market, rebuild private sector interest in fertilizer markets, and change routines and behaviors in the extension system. And given the extent and volume of public financing and investment in the input sector, it appears unrealistic to switch from the current system to another without a significant transition stage.

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. Nonetheless, some simple measures would facilitate the transition, including: opening the market (and pricing) for hybrid maize seed; liberalizing collateral requirements for fertilizer imports and commercial seed production; 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.

This could be complemented by policies intended to build the confidence and capacity of private input suppliers, scale up the weather insurance schemes currently being piloted, and

develop a comprehensive market information system. As these changes come into place, the GoE should maintain a role in the input supply sector, but as a regulator to ensure that the system performs effectively and efficiently.

In sum, many of the state-led policies put in place to promote cereal intensification in Ethiopia have 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.

REFERENCES

Alemu, D., H. de Groote and D. Bacha. 2006. The role of market information system in improving rural livelihood and the status of the service in Ethiopia. *Ethiopian Journal of Agricultural Economics* 6 (1): 87–108.

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. Unpublished manuscript. Ethiopian Institute of Agricultural Research, Addis Ababa.

Alemu, D. and D.J. Spielman. 2006. The Ethiopian seed system: Regulations, institutions and stakeholders. Paper presented at the "Ethiopian Strategy Support Program 2006 Policy Conference," June 6–8, Addis Ababa, Ethiopia.

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 No. 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

Bekele, E., and P. Anandajayasekeram. 2006. Review of agricultural extension impacts in Ethiopia. Unpublished manuscript. Addis Ababa, Ethiopia.

Belay, S. 2004. The seed regulations and standards of Ethiopia: The way forward. Draft report. Eastern and Central Africa Program for Agricultural Policy Analysis (ECAPAPA), Addis Ababa.

Belay, S. 2002. The national seed industry policy and strategy: Current status of sorghum and millets. Paper presented at the "First Sorghum and Millet National Workshop," October 12 -14, Melkassa Agricultural Research Center, Melkassa, Ethiopia.

Bernard, T., A. Birhanu, and E. Gabre-Madhin. 2006. Linking Ethiopian smallholders to markets: The promise and pitfalls of collective action. Paper presented at the "Ethiopian Strategy Support Program 2006 Policy Conference," June 6-8, Addis Ababa, Ethiopia.

Bonger, T., G. Ayele, and T. Kumsa. 2004. *Agricultural extension, adoption and diffusion in Ethiopia.* Research Report 1. Addis Ababa: Ethiopian Development Research Institute.

Byerlee, D and E. Hesse. 1986. Farmers' stepwise adoption of technological packages: Evidence from the Mexican altiplano. *American Journal of Agricultural Economics* 68(3): 519–527.

Byerlee, D. 1988. Agricultural extension and the development of farmers' management skills. In *Training and Visit Extension in Practice*. J. Howell (ed), Occasional Paper no. 8, Overseas Development Institute, London.

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: 275–87.

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.

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 no. 22. Washington D.C.: World Bank.

Chamberlin, J., and J. Pender. 2006. Development domains in Ethiopia: Capturing the geographical context of smallholder development options. Paper presented at the "Ethiopian Strategy Support Program 2006 Policy Conference," June 6-8, Addis Ababa, Ethiopia.

CSA (Central Statistical Authority), Federal Democratic Republic of Ethiopia. 2006. *Statistical abstracts*. Addis Ababa: CSA.

_____. 2004. *Statistical abstracts*. Addis Ababa: CSA.

_____. 2001. *Statistical abstracts*. Addis Ababa: CSA.

_____. Various years. *Agricultural sample survey: Report on farm management practices. Statistical bulletins for 1996-2001.* Addis Ababa: CSA.

Cummings, R., S. Rashid, and A. Gulati. 2006. Grain price stabilization experience in Asia: What have we learned. *Food Policy* 31: 302–12.

Del Ninno, C., P.A. Dorosh, and K. Subbarao. 2005. *Food aid and food security in the short and long Run: Country experience from Asia and sub-Saharan Africa.* Social Protection Discussion Paper no. 0538. Washington, D.C.: World Bank Institute and World Bank.

Dercon, S., and L. Christiaensen. 2005. Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. Draft paper. Washington, D.C.: World Bank.

DSA (Development Studies Associates). 2006. *Study on Improving the Efficiency of Input Markets.* Addis Ababa: Ministry of Agriculture and Rural Development.

Diao, X. and A. N. Pratt. 2007. Growth options and poverty reduction in Ethiopia—an economy-wide model analysis. *Food Policy* 32: 205–228.

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 no. 15. Washington, D.C.: International Food Policy Research Institute.

Doss, C. R., W. Mwangi, H. Verkuijl, and H. de Groote. 2003. *Adoption of maize and wheat technologies in Eastern Africa: A synthesis of the findings of 22 case studies.* CIMMYT Economics Working Paper no. 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.

ESE (Ethiopian Seed Enterprise). 2005. various official documents and records. Addis Ababa:ESE.

FAOSTAT (FAO Statistical Database). 2005. Agriculture, Fishery, Forestry and Nutrition 2005. CD-ROM. Rome: FAO.

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.

Gabre-Madhin, E. Z. 2001. *Market institutions, transaction costs, and social capital in the Ethiopian grain market.* Research Report no. 124. Washington, D.C.: International Food Policy Research Institute.

Gabre-Madhin, E., and I. Goggin. 2006. Does Ethiopia need a commodity exchange? An integrated approach to market development. Paper presented at the "Ethiopian Strategy Support Program 2006 Policy Conference," June 6-8, Addis Ababa.

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.

Gregory, D.I., and B.L. Bumb. 2006. *Factors affecting supply of fertilizer in Sub-Saharan Africa*. Agriculture and Rural Development Discussion Paper no. 24, Washington, D.C.: World Bank.

Heisey, P., and G. W. Norton. 2006. (forthcoming). Fertilizers and other farm chemicals. In *Handbook of agricultural economics volume 3: Agricultural Development: Farmers, farm production and farm markets.* R. E. Evenson and P. Pingali (eds). Amsterdam: 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," nd, Addis Ababa, Ethiopia.

Jayne, T.S., J. Govereh, A. Mwanaumo, A. Chapoto, and J.K. Nyoro. 2001. False promise or false premise? The experience of food and input market reform in Eastern and Southern Africa. In *Perspectives on Agricultural Transformation: A View from Africa,* T.S. Jayne, G. Argwings-Kodhek, and I. Minde (eds). New York: Nova Science Publishers.

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.

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.

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.

MoARD (Ministry of Agriculture and Rural Development), Federal Democratic Republic of Ethiopia. 2006. Agricultural Inputs Marketing Department: various official documents and records. Addis Ababa: MoARD.

_____. 2005. Agricultural Inputs Marketing Department: various official documents and records. Addis Ababa: MoARD.

_____. 2004. *Crop Variety Register* 7. Addis Ababa: Crop Development Department, MoARD.

MoFED (Ministry of Finance and Economic Development), Federal Democratic Republic of Ethiopia. 2006. *Ethiopia: Building on progress: A plan for accelerated and sustained development to end poverty*. Addis Ababa: MoFED.

_____. 2005. *Sustainable development and poverty reduction program (SDPRP)* Annual Progress Report 2005. Addis Ababa: MoFED.

_____. 2002. *Ethiopia: Sustainable development and poverty reduction program*. Addis Ababa: MoFED.

Pingali, P.L. (ed.). 1999. CIMMYT 1998-99 world wheat facts and trends. Global wheat research in a changing world: Challenges and achievements. Mexico, D.F.: International Maize and Wheat Improvement Center.

Pray, C. E. 1992. Plant breeders' rights legislation, enforcement and R&D: Lessons for developing countries. In *Sustainable agricultural development: The role of international cooperation*, G. Peters and B. Stanton, eds. Proceedings of the Twenty-First International Conference of Agricultural Economists, August 22–29, 1991, Tokyo, Japan. Brookfield, Vt., U.S.A.: Dartmouth.

Pray, C., B. Ramaswami, and T. Kelley. 2001. The impact of economic reforms on R&D by the Indian seed industry. *Food Policy* 26: 587–598.

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, Addis Ababa, Ethiopia.

Sahlu, Y. and M. Kahsay. 2002. Maize seed production and distribution in Ethiopia. In: *Proceedings of the Second National Maize Workshop, Addis Ababa, Ethiopia, November 12 - 16, 2001,* pp. 160 - 165.

SAA (Sasakawa Africa Association). 2004. From subsistence to sustainable agriculture in Africa. Papers presented at a workshop "From Subsistence to Sustainable Agriculture: Policies, Strategies, and Implementation," nd, South Africa.

Spielman, D.J., M. Negash, and K. Davis. 2006. The smallholder farmer in a changing world: The role of research, extension and education in Ethiopian agriculture. Paper presented at the "Ethiopian Strategy Support Program 2006 Policy Conference," June 6-8, Addis Ababa, Ethiopia.

Tripp, R., and N. Louwaars. 1997. Seed regulation: Choices on the road to reform. *Food Policy* 22 (5): 433–446.

World Bank 2006a. *Ethiopia: Policies for pro-poor agricultural growth*. Washington, DC: World Bank.

_____. 2006b. *Promoting fertilizer use in Africa; Lessons learned and good practice.* Africa Region paper. World Bank, Washington, DC.

_____. 2006c. World Bank support to the Ethiopian seed sector. Unpublished document. Addis Ababa: 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.

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 International Food Policy Research Institute.

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