An Analysis of Maize Seed Production and Distribution Systems in Ethiopia's Rift Valley

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Introduction

Discussions on agriculture and rural development in Ethiopia inevitably lead to the subject of seed. Through a combination of modern science and modest changes in farmers' cultivation practices, improved seed can yield remarkable abundance for small-scale farmers in Ethiopia. This abundance can contribute to greater production and productivity and can contribute to the country's food security and poverty reduction efforts (Dawit and Spielman 2006; Dawit *et al.* 2004; Deressa *et al.* 2001).

An example of this potential abundance is captured in the recent introduction of several drought tolerant and nitrogen-use efficient maize varieties in Ethiopia. The varieties – Melkassa II, III, IV and V – were introduced under the first phase of the African Maize Stress (AMS) project, a joint undertaking of the International Maize and Wheat Improvement Center (CIMMYT) and national agricultural research institutes across eastern and southern Africa (Banziger and Diallo 2001; Banziger and Diallo 2002; Worku *et al.* 2002; Diallo *et al.* 2002; Muasya and Diallo 2002; and Siambi *et al.* 2002). They were specifically developed for the semi-arid environments of Ethiopia's Rift Valley[1] and are now being disseminated through demonstration trials with smallholders in the area.

However, these breeding successes are tampered by the difficulty in delivering improved seed to smallholders. Despite an active agricultural extension system, a large state-owned seed enterprise and the recent liberalization of seed market regulations, the availability and adoption of improved seed in the Rift Valley area remains low (Muhammad *et al.* 2003).

The purpose of this study is to evaluate the maize seed production and distribution system in Ethiopia, to assess the roles of various players in the system, and to make recommendations that are specifically relevant to improving the marketing and distribution of improved maize varieties to smallholders in the Rift Valley area.

Data for the study were gathered in 2005 from primary and secondary sources. Primary data were collected in Ethiopia's Rift Valley area using rapid rural appraisal methods highlighted by group discussions using pre-prepared

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[1] *The Rift Valley area in Ethiopia comprises the central part of the country and is characterized by lowland to intermediate agro-ecologies and access to relatively greater irrigation than other parts of Ethiopia due to the Awash River and lakes found throughout the area.*

checklists, and by key informant interviews with maize farmers using a pre-tested questionnaire. Secondary data were collected from different public agencies and private companies directly and indirectly involved in the seed industry.

The Seed Industry

Many different factors play a role in determining farmers' access to improved seed and their decision to adopt new varieties. In drought tolerant and nitrogen-use efficient maize varieties in the Rift Valley area, the key constraint relates to access – access to distributors and stockists who carry the improved varieties and information on how to cultivate them properly. Access itself is a function of several key issues, including the area's commercial potential, the purchasing power of farmers in the area, and the ease through which improved maize varieties can be approved, released, multiplied and distributed under the existing regulatory framework. We examine several of these issues below.

Origins

The origins of Ethiopia's formal seed industry can be traced back to the 1950s with the establishment of plant breeding research activities at Jima University (established as a junior college of agriculture in 1947) and Haramaya University (formerly Alemaya University and founded as the Imperial College of Agricultural and Mechanical Arts in 1953).

Until the 1970s, however, the system was largely ad hoc and uncoordinated. It was not until 1976, with the establishment of the National Variety Release Committee (NVRC) by the National Crop Improvement Committee (NCIC) that a more methodical approach was taken to testing, registering, and releasing new crop varieties in Ethiopia (Belay 2002). The NVRC originally functioned under the National Seed Industry Agency (NSIA), but following organizational reforms in recent years, it is now administered under the Crop Development Department of the Ministry of Agriculture and Rural Development (MoARD).

Formal seed multiplication and distribution operations began with the establishment of the Ethiopian Seed Corporation in 1979, later renamed Ethiopian Seed Enterprise (ESE) as a state-owned enterprise mandated to produce, process, and distribute seed for the entire country. Today, ESE continues to dominate the market for improved seed in Ethiopia, and it is the major supplier of improved maize seed.

In terms of maize, maize breeding research activities began in the 1960s and were coordinated by the Institute of Agricultural Research (IAR, now the Ethiopian Institute of Agricultural Research (EIAR)) from its Bako Research Station. The country's first maize research program was formed in 1980 and program coordination was shifted to Haramaya University until 1982. Then it was given back to IAR and its Hawassa Research Station (1983 to 1985), and then back to the Bako Research Center in 1986. Since then, the Bako Research Center has operated as the national coordinating center for maize research in the country (EARO 2002).

Players

Seed industry players range from non-market actors, such as public sector research organizations, state regulatory agencies, and public extension services to market actors, including private breeders, seed companies, stockists, and trade associations; civil society actors such as non-governmental, farmers' and community-based organizations; and the farmers themselves (Spielman *et al.* 2006; Mywish *et al.* 1999).

Breeding, research, and biodiversity conservation

EIAR, a semi-autonomous body under the Ministry of Agriculture and Rural Development (MoARD), represents the key agency responsible for the coordination of agricultural research in Ethiopia. In maize research, the essential functions include maize breeding, producing breeder or foundation seed, and supplying breeder/foundation seed to basic seed producers. EIAR's activities are carried out at the Melkassa Agricultural Research Center (MARC), the Bako Agricultural Research Center (BARC), and several of the seven regional agricultural research institutes (RARIs).

These activities are further complemented by researches conducted in the Ethiopia's higher learning institutes (HLIs). The key HLIs, which are active in the area of agricultural research, are Haramaya University, the Jima and Ambo Colleges of Agriculture of Jima University, Mekelle University's Institute of Dryland Agriculture, and Hawassa College of Agriculture at Hawassa University.

The Institute for Biodiversity Conservation (IBC) is responsible for the conservation of the country's biological resources, and thus plays a key role in the ex-situ and in-situ conservation of local maize germplasm and the introduction of new maize germplasm to the country's existing stock from international sources. Chief among these international sources is the

International Maize and Wheat Improvement Center (CIMMYT), an institute that plays an important supporting role to Ethiopia's maize research program with technical backstopping, germplasm exchanges, and financial support.

ESE is the lynchpin of Ethiopia's seed industry. It operates as a state-owned enterprise responsible for the production and distribution of improved seed for all major crops (cereals, pulses, fruits, vegetables and forage). It is governed by a board of directors, which is in turn accountable to the Agricultural Inputs and Marketing Department of MoARD. It is internally organized into several departments including the seed production technology and extension, quality control, and seed marketing departments. It also operates its own seed farms located in different parts of the country.

Seed industry regulation and management

In seed industry regulation, the most important players are the NVRC – the body responsible for testing and registering new varieties – and the Agricultural Inputs Quality Control Department of the MoARD – the unit responsible for certifying seed for distribution and issuing licenses for seed production, processing, importing, retailing, and/or exporting.

The Agricultural Inputs Marketing Department, another unit under the MoARD, is responsible for assessing national seed demand and supply and developing strategies to address any shortages. These shortages typically result from changes in farmers' demand for seed itself, the result of their price and rainfall expectations. In recent years, strategies to address seed shortages have been designed by the department in collaboration with regional bureaus of agriculture, the Agricultural Input Quality Control Department, the ESE, and private seed companies. In 2003/04 production season for instance, the strategy employed to address a seed shortage were the following: purchase the seed that had been produced without the supervision of the Agricultural Inputs Quality Control from farmers; clean, grade, assess quality and germination rates; and distribute the portion of the seed that met the standards to farmers as certified seed.

Public sector marketing and distribution

In seed marketing and distribution, regional and *woreda* bureaus of agriculture have traditionally played a key role over the last decade. However, since 2003/04 production season, the distribution of inputs (including seed) has been routed through the cooperative unions and cooperatives to their farmer-members, thus representing a new channel for seed. State farms, once a significant buyer of seed, account for just a fraction of the market today.

The major purchasers of maize seed produced by ESE include regional extension programs; the Food and Agriculture Organization (FAO) of the United Nations and other donors for their relief and development programs; cooperative unions and cooperatives; and state farms (Table 1). The total quantity sold to these various purchasers has been increasing over the years, although there have been significant fluctuations in quantities purchased since 1996.

Table 1. Trends in quantity of maize seed purchased, by user type (q)

Source	Year								
	1996	1997	1998	1999	2000*	2001	2002	2003	2004
State farms	3,757 (20)	1,895 (11)	2,354 (6)	1,165 (3)	-	-	532 (2)	830 (1)	457 (2)
MoARD	596 (3)	228 (1)	-	-	-	-	(1)	1,259 (2)	152 (1)
FAO and donors	3,480 (18)	155 (1)	783 (2)	69 (0)	-	1,658 (3)	772 (3)	5,385 (9)	1,877 (9)
Extension programs	9,333 (49)	12,888 (77)	38,252 (90)	43,494 (96)	-	47,612 (87)	16,438 (64)	34,761 (59)	13,886 (70)
Cooperatives	1,726 (9)	856 (5)	800 (2)	595 (1)	-	5,061 (9)	7,878 (31)	15,265 (26)	2,955 (15)
Others	-	658 (4)	337 (1)	174 (0)	-	407 (1)	104 (0)	1,624 (3)	568 (3)
Total	18,892	16,680	42,526	45,497	71,198	54,767	25,725	59,124	19,893

Note: **Disaggregated data was unavailable*
Numbers in brackets are percentages
Source: MoARD 2005. Empty cells indicate that information was not available

Private sector production, marketing, and distribution

Over the last decade or so, the private sector has made some initial forays into Ethiopia's seed industry and, more specifically, into the maize seed business. Some 26 firms are licensed to produce seed in the country, while 33 are licensed to retail and 4 to export seed. However, only eight firms are actively engaged in seed production, primarily as contractors to ESE, which then distribute seed to state farms, regional/district bureaus of agriculture, and more recently, cooperatives and cooperative unions.

Private companies licensed to produce maize seed are Pioneer Hi-Breed Seeds PLC, Hawasa Agro-Business, Awassa Green Wood, Hadiya Trading Enterprise, Ethio Flora, Chombe Agricultural Development Enterprise, and Ano Agro Industry (see Annex I for details). All these companies are involved in the production of hybrid maize seed, except a few that produce open-pollinated varieties (OPVs).

Increasingly, these firms (along with state farms and small-scale farmers) are producing seed on contract to ESE. For example, in 1998, ESE contracted the Upper Awash Agro Industry Enterprise (UAAIE, a state-owned farm) to produce maize seed for the hybrid BH 660. In 2004, ESE contracted Tepo Valley (a privately-owned farm) to produce maize seed for the OPV Melkassa-I. Similarly, Ziway Horticulture Development Enterprise is producing hybrid maize seed for both ESE and Pioneer Hi-Bred. While many of these contractors may be licensed to produce seed, licensing is not a necessary pre-requisite for an ESE contract.

In selecting these types of farms for seed multiplication, the ESE considers such criteria as irrigation facilities, isolation and production potential, availability of skilled workforce and accessibility. State farms tend to receive priority from the ESE.

Only Pioneer is involved in the production and marketing of its own branded maize hybrids developed from breeding materials imported from Zimbabwe and South Africa (Adugna and Melaku 2002). Pioneer produces its seed by outsourcing the multiplication of its hybrids to private farmers with irrigated land in the Ziway area, usually on one-year terms of agreement with payment based on the quantity of dried seed delivered. It then distributes its seed through regional bureaus of agriculture or other channels. In 2004, for example, approximately 47% of Pioneer's seed was routed through the bureaus as part of the government's improved maize seed and fertilizer package program, while the remaining 53% was sold to commercial farms, state farms, and through its own retail centers in major maize-producing areas, directly to farmers.

In 2004, Pioneer held approximately about 11% of Ethiopia's maize seed market. Necessarily, Pioneer's involvement in the sector hinges on the fact that farmers must purchase new hybrid maize seed every year to capture the gains conferred by hybridization: so long as Pioneer's hybrids remain competitive in the market and their lineage remains a trade secret, the company can operate a profitable trade in seed year on year.

Yet in spite of the active participation of Pioneer and other companies in Ethiopia's seed industry, the size and reach of the private sector is extremely limited. Apart from Pioneer, few other firms are directly marketing their own products – most of them work for ESE as subcontractors. Moreover, very few of these companies produce maize varieties that are suitable to the agro-climatic conditions of the Rift Valley area.

Civil society

Other players in Ethiopia's seed industry include a variety of international, non-governmental and community-based organizations that assist farmers in establishing and operating local seed banks and on-farm seed multiplication projects. Key players include World Vision, CARE, Catholic Relief Service (CRS), and the Catholic Church.

For example, the Catholic Church and the *woreda* bureaus of agriculture are collaborating with local communities to promote seed banks for improved maize varieties in the Alem Tena and Meki areas of Ziway. The banks are essentially farmer-managed that provide farmers seeds of local and improved OPVs that can be sold at a premium,i.e., grain market price plus 15%, to neighboring farmers. Experience to date suggests that these seed banks are helping improve access to different varieties in step with changes in expectations of price and rainfall.

Seed banks play an important role in improving availability and timeliness of seed, and in mitigating the risks of adverse agro-climatic shocks by ensuring that stores of seed are available in case of crop failures, but their impact on the wider seed industry is limited.

Size

A useful measure of seed industry size is the degree to which farmers have adopted improved seed. Official estimates from various sources in Ethiopia suggest that farmer use of improved seed stands at approximately 3 to 5%, implying that farmers rely primarily on saved seed and farmer-to-farmer exchanges[2]. Figures from the Central Statistical Authority (CSA) estimate crop-specific areas sown with improved seed at 4% for wheat, 16% for maize, and 1% for both pulses and sorghum (CSA 2004).

Other estimates suggest much higher rates of improved seed use in Ethiopia. For instance, CIMMYT reports that in 2002, 71% of all wheat area in the country was sown with improved varieties, although only 43% of the area was sown with varieties released since 1995 (Lantican *et al.* 2002). CIMMYT also reports that 19% of all maize area was sown with improved varieties (roughly

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[2] *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.*

18% hybrid and 1-2% open-pollinated). Adoption studies of improved varieties undertaken at the sub-national level reported median adoption rates for wheat at 55%, maize at 30%, pulses at 30%, and sorghum at 10% (Lemma *et al.* 2006).

In short, the use of improved seed, particularly in combination with fertilizer, is low in Ethiopia. Studies by Diao and Pratt (2007), Howard *et al.* (2003) and others suggest that use of modern inputs in Ethiopia could lead to a doubling of average yields.

Another useful measure of size is found in production figures from various producers. During the 2004/05 season, the official demand for seed, based on estimates developed by woreda and regional bureaus of agriculture, was 1,117,597 q for the major cereal, pulse, and oilseed crops in Ethiopia. Note, however, that the supply of seed through the ESE totaled 304,000 q, or about 73% short of official demand (Table 2). This figure is not inconsistent with past performance and is characterized by significant crop-specific variability in the shortfall, variation in seed quality, and poor timeliness of distribution (Byerlee et al. 2006; Alemu and Spielman 2006; Alemu et al. 2006). And while official figures suggest that ESE production of seed has improved over the last five years, supply remained short of requirements, and for major cereal crops such as wheat and maize, fairly volatile as well (DSA 2006).

Table 2. Demand and supply for seed during the 2005 agricultural season

Crop	Quantity demanded (q)	Quantity supplied (q)	Supply as a percentage of demand
Wheat	518,487	106,279	20
Maize	155,215	82,458	53
Barley	70,839	11,628	16
Tef	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: Agricultural Inputs Marketing Department, MoARD 2006.

Prices

Since the seed industry in Ethiopia is, for all practical purposes, a state-controlled monopoly, the price of seed is set by the ESE. Current estimates suggest that ESE prices have remained constant in real terms since 1995 (Figure 1), with a fairly constant profit margin for the ESE ranging from 3 to 5%.

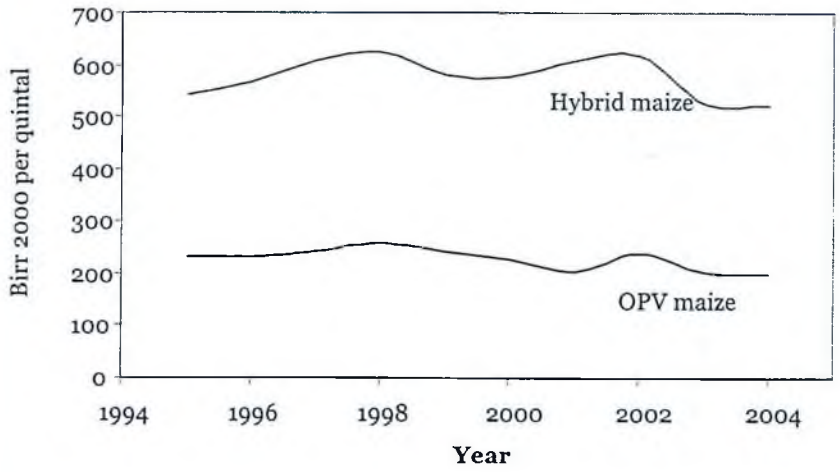

Figure 1. Maize seed prices, measured in constant 2000 birr/q, 1995– 2004

Structure

The Ethiopian seed industry can be divided into five major components: plant breeding, breeder/foundation seed production, seed quality assessment, certified seed multiplication, and marketing/distribution. An assessment of each component – specifically, the extent to which each component is undertaken by the public or private sector – provides a clearer picture of where Ethiopia's seed industry lies relative to other developing countries.

For example, in most developing countries, plant breeding activities are undertaken by the public sector through breeding programs at agricultural research centers and universities. This is also the case in Ethiopia where breeding is conducted by EIAR, the RARIs, and the HLIs.

Breeder or foundation seed production in many developing countries is also a function commonly undertaken by the public sector, although experience from

other developing countries suggests that outsourcing these functions to the private sector is also feasible. In Ethiopia, breeder seed production is exclusively a function of the various research and higher learning institutes.

In most developing countries, seed quality assurance is an exclusively public sector function, although outsourcing and licensing to the private sector has also proven feasible in several countries. The key here is the problem posed by information asymmetries between those who sell seed and those who buy.

Since the genetic qualities of seeds are only discernible through utilization, experience or reputation, seed sellers often hold more information about their product than seed buyers who are unable to make an ex ante assessment of the product. The absence of a reliable means of conveying information from buyer to seller leaves open opportunities for rent seeking behavior and market inefficiency. A reliable information transmission itself depends on seed quality assurance system: certification systems, labeling regulations, and consumer protection laws (Tripp 2001; Tripp and Rohrbach 2001).

It is worth noting here an important distinction with respect to seed industry reform (Tripp and Louwaars 1997). The term "liberalization" of the seed industry suggests privatization of state-owned seed monopolies, reduction of barriers to market entry, and relaxation of germplasm and seed import restrictions – policies that have been pursued in many developing countries quite successfully. "Deregulation," on the other hand, would suggest a reduction in the rules and procedures designed to regulate the production and distribution of seed, and designed specifically to reduce information asymmetries between buyers and sellers. Thus, a more nuanced understanding of deregulation – changing regulations to better address imperfections in a changing market – is critical to understanding this particular component of the seed industry.

Certified seed multiplication, seed marketing, and seed distribution in many developing countries has emerged as a private sector activity in recent decades (Morris, Rusike and Smale 1998; Tripp and Rohrbach 2001; Bett *et al.* 2003). This is particularly true in maize seed markets in Latin America and Asia, and, increasingly, in smaller seed markets such as hybrids of rice, sorghum and pearl millet in India (Gerpacio 2002; Tripp and Pal 2001; Morris, Singh, and Pal 1998; Ribeiro 1998). Common to all of these examples is hybridization: so long as the lineage of a given company's hybrid remains a trade secret and the hybrid performs competitively, the company can multiply market and distribute a unique product and appropriate the gains from their investment season after season.

Taking into consideration the respective roles of the public and private sectors in the seed industry, we can identify four distinct developmental phases applicable to developing countries (Maredia, Howard, and Boughton 1999; Morris, Rusike, and Smale 1998). In phase 1, the informal seed system predominates – farmers select and save their own seed, exchange seed with neighboring farmers or villages – resulting in a low rate of varietal development and improvement. In phase 2, seeds of improved varieties developed by publicly-funded research begin to replace local varieties, while use of complementary inputs – mainly fertilizer – begins to increase alongside the emergence of a private sector that is involved in multiplication and distribution of public varieties.

In phase 3, the private sector begins to play an active role in research and development, particularly in developing hybrids and seeds for specialized cash crops or other high-value crops. Seed distribution systems become more organizationally varied and decentralized. In phase 4, the seed system gives way to commercial research, development, production and marketing of improved seed, extensive adoption of improved varieties, and a relatively limited role for the public sector in all but the most basic research and in seed quality assurance.

Available evidence suggests that the Ethiopian seed system is in the transition from phase 1 to 2. However, the maize seed system, which has been the focus of research and development efforts in the country for a long time, is in transition from phase 2 to 3, where the private sector starts to be involved in research and development in addition to the public sector. Notable example is the active participation of Pioneer Hi-Bred PLC in the development and distribution of hybrid maize varieties.

Management and Regulation

The formal seed industry in Ethiopia is illustrated in Figure 2. This schematic diagram describes the management and regulation of seed for major cereal and pulse crops such as maize, wheat, tef, and beans. Note that seed for horticulture crops such as vegetables are generally not subjected to the same management and regulation processes because they are either imported or planted from seed saved by farmers.

In this system, the national research system provides breeder and foundation seed to the ESE, which then multiplies the seed on its own farms or contracts seed multiplication out to private companies, state farms, or small-scale

farmers. The quantity of seed produced for each crop is determined by the ESE based on estimates of demand compiled by woreda and regional bureaus of agriculture. Distribution is managed through cooperative unions and cooperatives throughout the country, in collaboration with regional and woreda bureaus of agriculture.

The MoARD manages regulatory issues such as variety release procedures, seed certification, and licensing to produce or distribute seed; and is involved in issues relating to plant breeders' rights. Each regulatory issue represents a key element in the development of Ethiopia's seed industry, and is examined in detail below.

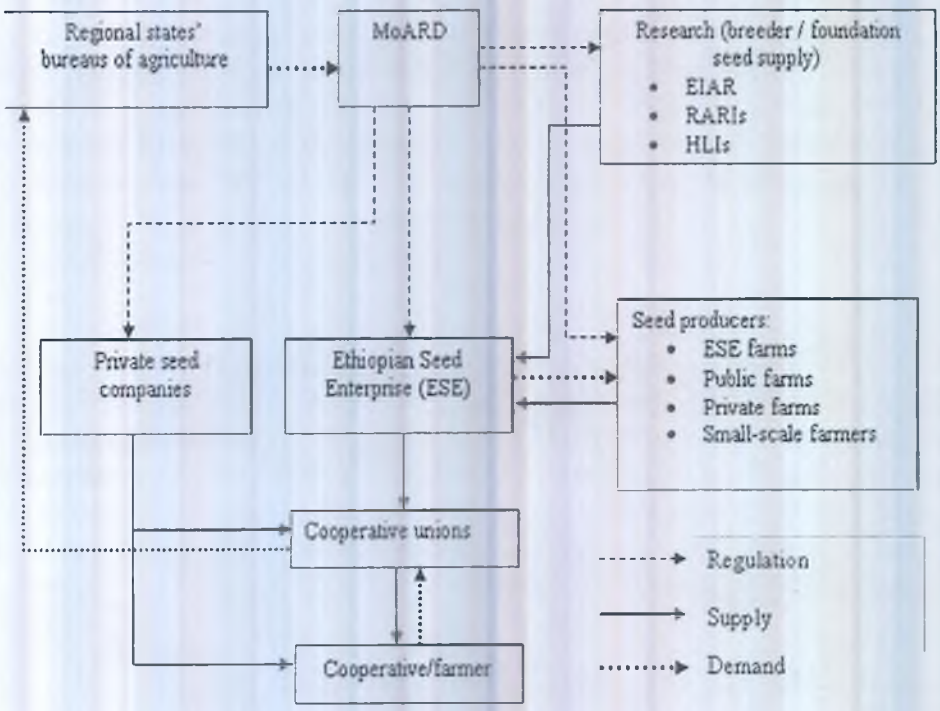

Figure 2. Organization of the formal maize seed system in Ethiopia

Variety release procedures

The NVRC manages both testing and registering procedures in Ethiopia. The committee is composed of senior professionals from MoARD, EIAR, the HLIs, and other relevant organizations/institutions. By profession, its composition includes two breeders, an agronomist/physiologist, an entomologist, a pathologist, an economist, a food scientist, a research-extension specialist, and others as required.

Pre-requisites for the release of a crop variety are as below (NSIA 2001):

- The new variety must show excellent performance in a sufficient number of test locations in comparison with the standard cultivars grown in the ecological zone(s) where it is supposed to be used.
- The variety should be tested for yield, disease reaction and other important characteristics for a minimum of two to three years in Regional or National Variety Trial (RVT or NVT) at least in three to five locations.
- The variety to be released should be uniform, stable and distinctly superior to the recently released commercial cultivar for the area in one or more characteristics important for the crop, and should be satisfactory in other requirements. However, when there is no adequate number of released cultivars of a particular crop, the NVRC may consider releasing a variety even if it is not superior to the existing cultivar, without compromising the requirements of the grower.
- The new variety should be planted along with the established local or improved cultivar as the case may be in relatively large plots (at least 100 m^2 at two to three sites). One of the sites should be on-station and the other two on-farm for verification trials during the anticipated year of release for assessment by NVRC.
- Prior to preparing a proposal for release of a variety, the researcher should consult with commodity program leader and other concerned researchers. The consensus reached on the merits of the variety should be communicated to the NVRC.
- Appropriate data to support recommendations on yield, agronomic characteristics, disease reaction and other support data for individual locations and years should be presented in addition to complete morphological description and distinguishing characteristics of the candidate variety.

The RVT and NVT process represents an important step in the introduction and adaptation of imported maize germplasm. Materials tested under the RVT are evaluated mainly for yield, disease resistance, and other desirable traits in Preliminary Yield Trials (PYTs) and the Pre-national Variety Trials (PNVTs) for two years. Promising genotypes are then included in the National Variety Trial (NVT) for further evaluation for two to three years at five to seven locations in major maize growing environments. The best materials from the NVTs and RVTs are included in the Variety Verification Trial (VVT), which is conducted both on research stations and in farmers' fields under recommended

management levels and farmer management levels for one to two years. The objectives of the VVT are to obtain farmers' pre- and post-harvest assessment of varieties, evaluate the performance of the varieties in a real production system, and assist in the decision of the variety release committee (Abdisa *et al.* 2001).

Once such pre-requisites have been met, a proposal for a variety release may be submitted to the NVRC. Proposals are accepted for review by the NVRC chairperson by 30 May of each year, and the party submitting the proposal may be called to appear in person before the NVRC to answer questions about the proposal during its review.

Upon acceptance of a proposal, the NVRC appoints a technical committee composed of NVRC members and other relevant specialists to examine the submitted data, evaluate the verification trial plots, and report on the variety's performance. The technical committee's evaluation report is expected to cover performance data evaluation, field performance evaluation, general comments, and recommendations.

The decision to place a variety on the release list or reject it is taken at the NVRC's November/December meeting. The decision reached by the NVRC is published or reported at the National Agricultural Research and Development Forum annually. At such time, the variety should be assigned a permanent designation (preferably a short local name) as a pre-condition for release and registration. The variety must then be planted on a one-hectare plot at a research center for final inspection by the NVRC.

Following final NVRC approval, the variety is registered along with its agronomic and morphological descriptions, and the variety's owner is charged with the responsibility of maintaining an appropriate quantity of the breeder and basic seed for use in replenishing and restoring commercial seed of the variety to the requisite level of genetic purity.

Note that while the testing, release, and registration procedures outlined above apply to both domestically developed and imported varieties, many horticulture varieties fall outside this process. Specifically, vegetable and fruit seed that are certified by the International Seed Testing Association (ISTA) and meet standards set by the Organization for Economic Cooperation and Development (OECD) can be released with a minimum of procedure. Similarly, there are cases where the government has imported and released seed for cotton, lentil, chickpea and soybean without undertaking the extensive and lengthy procedures outlined above.

Seed certification

The general procedure of seed certification is managed by the Agricultural Inputs Quality Control Department. The process requires verification of the source of the basic seed to be used in production of certified seed, and continues through to the evaluation of germination rates and other important qualities. As noted earlier, however, formal seed certification procedures are sometimes forgone in situations where acute seed shortages require that seed be obtained from any and all sources possible, including smallholders who may not be producing seed for certification.

Through the end of 2004, the Agricultural Inputs Quality Control Department operated eight seed laboratories in four regional states. However, due to the continuing process of decentralization, these laboratories have since been turned over to the regional bureaus of agriculture. Two laboratories now operate in Tigray (in Mekelle and Axum); in Amhara (Gonder and Durbete); in Oromiya (Ambo and Assela); and Southern Nations, Nationalities, and Peoples Regional (SNNPR) state (Wolkite and Durame). Through the support of the Canadian International Development Agency (CIDA), two seed labs have been built in Debre Markos and Dessie, Amhara. The labs are responsible for ensuring the quality of seed produced for use in their respective regions, with the department taking responsibility for seed produced or imported for use in more than one region. The department and the regional labs also collaborate in the areas of training and experience sharing.

Licensing to produce or distribute seed

The existing rules and regulations set forth a long list of technical requirements for parties seeking a license to produce, prepare, import or export seed. For example, individuals or companies seeking a license for maize seed production must be at least a diploma holder with at least 5-year experience in the agricultural sector, have an investment license and have suitable land. In the case of maize, it means a land area of not less than 5 ha for each maize variety, not less than 30 ha for each maize hybrid, and a total land size in a given location not less than 100 ha. The existing rules for seed preparation and seed import/export licenses are equally stringent.

Licensing is basically required for those who produce seed for commercial purposes or for those who intend to either import or export seed. However, licenses are not required for commercial seed production activities that are conducted locally to supply inputs for agricultural processing companies like the Assela Malt Producing Company and other food processing units.

Plant breeders' rights

In order to provide recognition and reward to the developers of new plant varieties, the Plant Breeders' Right proclamation was passed in Ethiopia in February 2006 (Proclamation No. 481/2006). This proclamation, if properly implemented, is expected to boost the involvement of individual scientists and the privates sector in the development of different crop technologies for the different major and sub-agroecologies that have so far not received due attention. This proclamation is especially expected to strengthen the participation of the private sector in the development of hybrid maize varieties, which has been mainly done by the public sector and to some extent by Pioneer Hi-Bred PLC. However, until now it is not clear how the proclamation will be implemented.

Breeding and Seed Production

Maize is an increasingly popular crop in Ethiopia. It is currently grown in 13 agro-ecological zones which together cover about 90% of the country. Improved maize varieties and hybrids have been developed for a variety of agro-ecological zones (Table 3), although the public sector's breeding program strategically focuses on three particular types of zones (low, medium and high altitude maize-growing areas of the country), four types of varieties (extra-early, early, intermediate, and late maturing varieties), and four types of strategic attributes (yield improvement, drought tolerance, earliness, and disease resistance).

Since the start of formal maize research in Ethiopia, about 30 maize varieties have been developed by the national research system. Development of most of these varieties has depended significantly on imported germplasm used as parental stock for adaptive research, or introduced directly through the Regional Variety Trial (RVT) process described above.

Of the 30 maize varieties released, 18 are OPVs and 12 are hybrids (Tables 3 and 4). The OPVs were developed by public institutions, primarily EIAR, Hawassa College of Agriculture, and Haramaya University. While most of the hybrids were similarly developed by EIAR, three were developed by Pioneer. OPVs released specifically for drought-stressed areas (where cultivation is rain-fed only) include Katumani, Tesfa, Fetene, Melkassa-I, Melkassa-II, Melkassa-III, Melkassa-IV, Melkassa-V, and A-511. These improved varieties are grown alongside local varieties such as Sheye, Hararghe, Bukuri, Limat, and China (Mandefro *et al.* 2002).

Table 3. Agro-ecological targets of maize research in Ethiopia

Agro-ecology	Growing area /region	Breeding strategy	Currently available maize varieties/hybrids
A1	Afar Region, Dire Dawa, Alemaya (partly), Negele Borena (partly)	For irrigation	BH 140
SA1	Humera, Metema, Abderafi (N. Gonder), Omorate		
SA2	Rift Valley (Ziway, Alemtena, Shashemene, Wonji and Koka)	Earliness, Drought tolerance	Katumani, Melkasa-I, Melkassa IV
SM1	North Wollo (Kobo area), Alamata, Sheket (Tigray), Asebot, Afar Region, Bale, Fike, lowlands of west Harraghe and Afder	Earliness, Drought tolerance	Katumani, Melkassa I
SM2	Tigray, North Shoa, East Shoa, North Wollo, Merabete, Wogeltena, Gursum	Earliness, Drought tolerance	A 511, Melkassa-II, Melkassa-III, Melkasa-V
M1	Pawe, West Afar, South Omo, Segen Valley, Teltelie, Negele Borena, Bale, Somali border area, Abay Gorge, Abomsa, Asebe Teferi, Bedesa, Alemaya, Karians, Tirma, Liben, Moyale	High yield	Rare I
M2	Adet, Alemaya, Sirinka, Ambo, Holetta, Sinana, Kulumsa, Yabello, Dabat, Finote Selam, Debre Tabor, Fiche Degem	High yield	BH 660, AMH-800, BH 540
SH1	Abobo, Asosa, Anfilo, Denbidollo, Waka, Sawla, Gibe Valley, Omo Valley, Baro and Akobo areas and Gumer		
SH2	Bako, Awasa, Areka, Gimsi, nejo, Shambu, areas along Bure to Nekemte, Gilgel Gibe areas, Sekoru, Asendabo, Sodo, Arba Minch, Hosana, Silte, Kondaltiti, Butajira, Buie, Mareko, Dodoalla, Agarfa, Robe, Gelemso, Deder, Mechara, Girawa, Kobo (North Hararghe), Arjo and Endibir	High yield, Disease resistance	BH-140, BH-540, BHQP-542, BH-544, BH-660, BH-541, BH-543
H1	Tepi, Jinka, Konso, Derashe	Disease resistance	USB
H2	Areas around Gore, Jima, Bedelle, Mettu, Agaro, Gera, Bore, Bensa, Kibrmengist, Hagereselam, Masha, Aleta Wondo, Ticho (Robe), Adelle, Limu, and Mizan	High yield	BH 660
PH1	Mizan, Bench Maji Zone (Maji partly)	High yield	BH 140
PH2	Southwestern parts specifically around Kefacho, Sekacho and Bench Maji zones	High yield	Kuleni, UCB

Source: EARO 2002; MoARD 2004; Maize Breeding Program (pers. comm.)

Table 4. Maize variety releases in Ethiopia, 1973 to 2006

Variety/hybrid	Adaptation area (m)	Year of release	Source
Open-pollinated varieties			
Melkasa-IV	800-1600	2006	EIAR/MRC
Melkasa-V	1000-1800	2006	EIAR/MRC
Hora	1800 - 2600	2005	EIAR/MRC
Melkassa-II	1200 – 1700	2004	EIAR/MRC
Melkassa- III	1200 – 1700	2004	EIAR/MRC
Melkassa –I	500 – 1600	2001	EIAR/MRC
Gusaw (Gambella Composite or Abobako)	500 – 1000	2002	EIAR/BRC
Gibe Comp-1	1000 – 1700	2001	EIAR/BRC
Raare-1	1600 – 2300	1997/98	Haramaya University
Tesfa (ACV6)	500 – 1600	1996	Hawassa College of Agriculture
Fetene (ACV3)	500 – 1600	1996	Hawassa College of Agriculture
Kuleni	> 1800	1995	EIAR/BRC
Guto	1500 – 1800	1988	EIAR/BRC
Katumani	500 – 1600	1974	EIAR/BRC
Alemaya Composite	1600 – 2300	1973	Haramaya University
A-511	1000 – 1900	1973	HRC (Hawassa Research Center)
Hybrids			
BH-670	1500 – 2200	2002	EIAR/BRC
BH-QP-542	1200 2000	2002	EIAR/BRC
BH-541	1500 - 2000	2002	EIAR/BRC
Shindi (Phb-30G-97)	1500 – 1900	2001	Pioneer
Tabor (30-H83)	1600 - 2000	2001	Pioneer
BH-540	1500 - 2000	1995	EIAR/BRC
Jabi (PHB 3253)	1500 - 2000	1995	Pioneer
BH-541	1000-1800	2002	EIAR/BRC
BH-543	1000-2000	2004	EIAR/BRC
BH-544	1000-2000	2005	EIAR/BRC
AMH-800	1800-2600	2004	EIAR/Ambo
BH-660	1600 - 2200	1993	EIAR/BRC
BH – 140	1100 – 1800	1988	EIAR/BRC

Source: MoARD 2004.
Note: MRC= Melkassa Research Center; BRC= Bako Research Center.

Production

Still, questions remain as to the Ethiopia's capacity to meet growing demand for improved maize seed. The problem begins from the supply of breeder/foundation and basic seed, where the demand for basic seed is consistently greater than the capacity of research centers to produce it in sufficient quantities.

Other problems occur with the supply of certified seed, according to a key informant to this study. Current practice does not require certified seed producers such as the ESE to renew their basic seed stocks for multiplication each year. Since few seed producers have adequate capacity to maintain genetic purity and other necessary qualities of their basic seed, there is concern that this has led to the multiplication and distribution of poor quality certified seed.

Other problems relate to the country's quality assurance system. Under the current system, any licensed seed producer can apply to the MoARD's Input Quality Control Department to obtain a supervisory assessment of their seed production process in order to secure certification. Expert supervision is provided out of one of eight federal Quality control Offices and concentrates on such quality indications as the isolation of the production area, evaluation of the crop stand, and overall seed quality even after harvesting, threshing and cleaning. However, the system is designed and resourced to supervise medium to large-scale seed production operations, and is not geared toward the supervision of small-scale farmers engaged in seed production.

The problems extend further into the entire system of estimating and meeting demand. Several experts and key informants to this study have argued that demand figures drawn from estimates produced by *woreda* and regional bureaus of agriculture are largely meaningless (Byerlee *et al.* 2006). More importantly, these official demand figures probably mask the growing demand for improved maize seed, and the growing demand for quality maize seed, throughout Ethiopia. As a result, the supply of maize seed may be consistently falling short of demand: if only 53% of official demand was met in 2004, it is likely that the real shortfall was much larger.

The issue of meeting demand is further complicated by the tendency for farmers' expectations of price and rainfall to change just prior to planting. Rapid and large-scale changes in expectations pose a challenge for a seed industry that is unable to stock a diverse variety of seed in anticipation of

changes in farmer expectations. In some situations, this problem has led farmers to revert from improved varieties to local varieties, and for public and private maize seed producers to sell their seed as grain.

The supply of maize seed also responds to price signals, thus introducing another challenge for Ethiopia's nascent seed industry. The impact of prices and price volatility is evident in the allocation of land for maize seed production and the total quantity of maize seed produced over the last decade (Tables 5 and 6). The volatility is particularly noticeable in hybrid seed production, where the effects of a bumper harvest of maize and a subsequent maize price collapse in the 2002 led to a dramatic decline in land allocated to hybrid seed production in 2002/03.

Table 5. Area allocated to maize seed production (1995/96 – 2004/05)

Year (cropping season)	Hybrids		OPVs		Total area (ha)	ESE share (%)
	ESE (ha)	Total (ha)	ESE (ha)	Total (ha)		
1995/96	90	323	738	1,241	1,564	53
1996/97	228	794	465	465	1,259	55
1997/98	583	1719	331	331	2,050	45
1998/99	627	1,875	216	216	2,090	40
1999/00	932	3,268	230	260	3,528	33
2000/01	795	3,051	291	291	3,342	32
2001/02	417	1,743	421	421	2,164	39
2002/03	534	566	377	377	943	97
2003/04	483	906	400	400	1,306	68
2004/05	447	1,654	367	432	2,086	39

Source: Agricultural Inputs Marketing Department, MoARD 2005.

Table 6. Maize seed production and processing (1995/96 –2004/05)

Year	Hybrid maize seed				OPV maize seed				Total maize seed produced (q)
	ESE (q)	Total produced (q)	Total processed (q)	Total sold (q)	ESE (q)	Total produced (q)	Total processed (q)	Total sold (q)	
1995/96	3,343	9,017	7,882	9,597	21,708	29,208	24,348	9,295	38,225
1996/97	6,075	16,924	13,494	11,540	9,719	9,719	4,446	5,140	26,643
1997/98	18,473	39,980	36,472	35,911	7,540	7,540	5,185	6,615	47,520
1998/99	20,031	44,597	40,593	41,444	4,223	4,223	4,431	4,053	48,820
1999/2000	6,932	97,023	85,102	67,193	5,735	6,615	3,821	4,005	103,638
2000/01	12,440	93,870	63,785	51,789	6,802	6,802	3,583	2,977	100,672
2001/02	12,194	54,253	29,300	22,856	7,965	7,965	3,449	2,827	62,218
2002/03	9,753	10,065	22,347	52,196	5,107	5,107	6,368	6,928	15,172
2003/04	11,148	23,182	27,257	16,312	9,178	9,178	3,449	3,581	32,360
2004/05	8,444	50,591	45,532	48,562	6,136	8,411	6,729	8,022	59,003

Source: Agricultural Inputs Marketing Department, MoARD 2005
Note: In some years, the quantity produced is less than the quantity prepared and sold due mainly to seed reserves and carryover stocks from previous years.

Other problems relate to the type of maize seed supplied by Ethiopia's seed industry. For example, in 2004, the ESE produced approximately 82% of all OPV maize seed and 70% of all hybrid maize seed. This left open a small but significant of the maize seed market to private companies and other players (Table 7). But, as might be expected, private maize seed production was concentrated in hybrids, with only two private companies producing OPVs.

Table 7. Maize seed production by company and hybrid/variety in 2004

Company	Hybrid/variety	Amount produced (q)	Percentage of the total supply by variety	Percentage of the total hybrid maize seed supply
Hybrids				
ESE	BH-660	23,293	71.0	70.0
	BH-670	405	100.0	
	BH-140	13,750	100.0	
	BH-540	13,261	95.0	
	BH-541	251	100.0	
	BHQP-542	1,145	100.0	
Pioneer Hi-Breed Seeds	Phb-3253	7,000	100.0	16.1
	Phb-30H-83	5,000	100.0	
Hawasa Agro Business	BH-660	180	0.6	0.2
Awassa Farm Development Enterprise	BH-660	962	3.0	1.3
Awassa Green Wood	BH-660	3,500	11.0	4.7
Hadiya Trading Enterprise	BH-660	1,100	3.3	1.5
Bako I Research Center	BH-660	2,397	7.3	4.3
	BH-540	765	5.5	
Ano Agro-industry	BH-660	612	1.9	0.8
Anger Farm	BH-660	842	2.6	1.1
Total	BH-660	32,886		
	BH-670	405		
	BH-140	13,750		
	BH-540	14,026		
	BH-541	251		
	BHQP-542	1,145		
	Phb-3253	7,000		
	Phb-30H-83	5,000		
OPVs				
ESE	A - 511	2,145	100	82
	Katumani	2,772	66	
	Gibe – 1	1,150	100	
	Kuleni	503	100	
Awassa Green Wood	Katumani	1,000	24	13
Ethio-Flora	Katumani	425	10	5
Total	A – 511	2,145		
	Katumani	4,197		
	Gibe – 1	1,150		
	Kuleni	503		

Source: Agricultural Inputs Marketing Department, MoARD 2005.

Finally, there is the issue of farmers' cultivation practices. Farmers in Ethiopia often recycle maize seed – even hybrid seed, despite significant losses in vigor from planting saved seed (Adugna and Melaku 2002). These practices are often results of farmers' insufficient knowledge of the need to renew seed regularly, inadequate access to credit to purchase new seed, or other constraints.

Production Costs

Estimates from a farm sub-contracted by the ESE to produce seed for 2004 reveal some of the underlying issues in maize seed production by a state-owned enterprise (Table 8). The farm's cost of producing one quintal of seed was Birr 392.30 (≈US$ 45.62) for hybrid maize and 407.46 (≈US$ 47.38) for OPV (Annex II)[3]. Overheads account for 54% of the per quintal costs for both.

Table 8. Maize seed production costs for ESE (2004/05 production season)

Cost component	Cost of hybrid maize seed production		Cost of OPV maize seed production	
	Birr per quintal	% of total cost	Birr per quintal	% of total cost
Direct labor costs	32.74	8.35	28.31	6.95
Direct material costs	50.48	12.87	60.82	14.93
Seed	8.14	2.07	1.50	0.37
Chemicals	15.34	3.91	23.21	5.70
Fertilizer	17.18	4.38	26.00	6.38
Harvesting and packing materials	9.81	2.50	10.11	2.48
Center overhead	255.34	65.09	262.98	64.54
Enterprise contribution	53.74	13.70	55.34	13.58
Total production cost	392.30		407.46	

Source: Ethiopian Seed Enterprise 2005

By comparison, private seed companies can produce hybrid maize seed for just a third of the price because of far lower overheads and administration costs (Table 8). After all this, it is likely that other indirect costs militate against private sector entry into the maize seed market, including the costs associated with navigating the regulatory system, accessing financing from the formal banking sector without non-agricultural collateral, or establishing independent distribution and marketing networks.

[3] *The difference in cost between hybrids and OPVs is explained by the relatively lower yield of OPVs: 14 quintals of seed per hectare for OPVs compared to about 21 quintals for hybrids. Further note that, according to a key informant to this study, the average margin between the ESE's sales price and the farmer purchase price is 35 % for both OPVs and hybrids, although variations exist between regions and woredas due to transportation costs.*

Table 8. Breakdown of hybrid maize seed production costs, 2004/05

Cost component	Cost (Brr/q)	
	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: Ethiopian Seed Enterprise 2005; Corporate source.

Efforts to Improve Production

In an effort to increase the production of improved seed – including improved varieties for drought-stressed areas – the ESE has begun exploring new seed multiplication opportunities. In recent years, for example, the ESE has worked with small-scale farmers to produce certified seed for pulses, tef, sorghum and millet (although not maize). Annual land allocated to seed production under this scheme is between 3,000 and 5,000 ha, spread across the Tigray, Amhara, Oromiya and SNNP regions.

The motivations behind the scheme are sound: to improve farmers' skills in seed production, create awareness about the importance of improved seed as a vital input in boosting yields and output, and increase ESE's ability to meet the country's demand for seed. The scheme operates along the following lines:

- Selection of target *woredas* by the ESE production experts who take into consideration the crop type for which seed production is required, the production potential of respective *woredas*, and their accessibility in terms of providing quality control and monitoring.
- Selection of participating farmers by officials from the *woreda* bureaus of agriculture and ESE production experts, taking into consideration the farmer's cultivable land area, its suitability and accessibility for seed production, and the farmers' willingness to participate.
- Registration of the participating farmers, a process highlighted by an agreement that typically provides the ESE with 85% of the seed produced in consideration of a purchase price that is determined based on the prevailing commodity price at the time of threshing plus 15%.
- Training of the farmers by ESE experts on appropriate seed production techniques during germination, flowering, seed setting and harvesting time; supervision from the ESE's quality control department; and supply of bags for collecting the seed.

However, experiences with the scheme have been mixed. In some cases, farmers interviewed for this study argued that crop prices have increased at a rate that makes the ESE's 15% premium relatively unattractive, thus forcing them to break their contracts and sell the seed as grain directly to private traders. In other cases, farmers have found that the portion of the crop they are allowed to retain (15%) is insufficient for their own use. Others have realized that they can make lucrative profits by selling the seed directly to neighboring farmers at ESE prices.

ESE staff interviewed for this study also reported that some farmers consumed the seed because of food shortages, financial difficulties, or other household-level shocks. They further reported that in several *woredas,* collaborations with the bureau of agriculture fell short of expectations because the current administrative systems structures do not provide *woreda* officials with adequate incentives to ensure their constructive involvement.

Sample Farmers' Characteristics

Farmer-level data are drawn from a sample of 60 farmers that were randomly selected from six *kebeles* (peasant associations) in three woredas (districts): Arsi Negele, Dugda Bora and Bosset. Data were obtained using rapid rural appraisal methods highlighted by group discussions using pre-prepared checklists and key informant interviews with maize farmers using a pre-tested questionnaire. Data are for the 2005/06 maize production season.

Descriptions of the sampled farmers are given in Table 9. Total land operated and owned showed significant differences among farmers cultivating different types of maize varieties. Farmers who grew *both* improved and local varieties had high operated and owned land as compared to those growing only local varieties or only improved varieties. However, the number of parcels operated did not vary significantly among farmers growing different maize varieties. Distance to market and development centers also did not vary among farmers growing different maize varieties.

Table 9. Socio-demographic characteristics of sampled households

Socio-demographic Indicators		Type of maize variety			F-Value	Total
		Local	Improved	Both		
Education (years of formal education)	Mean	2.54	4.58	4.18	1.59	4.07
	Std	2.37	3.92	3.37		3.59
Age of the household head (years)	Mean	40.54	41.00	38.09	0.41	40.37
	Std	9.12	9.91	7.82		9.31
Family size	Mean	6.92	8.11	9.73	1.70	8.15
	Std	3.20	3.79	4.03		3.76
Own land (kert)	Mean	7.92	7.08	12.66	5.59***	8.28
	Std	4.54	3.69	7.91		5.23
Total land (kert)	Mean	9.85	8.65	14.75	4.74***	10.03
	Std	4.98	3.98	10.20		6.11
No of parcels of land operated	Mean	2.77	3.06	3.55	0.73	3.08
	Std	1.36	1.49	2.07		1.58
Distance to woreda town (km)	Mean	26.08	29.35	22.00	0.70	27.29
	Std	18.17	19.73	13.58		18.37
Distance to DA office (km)	Mean	1.81	1.83	2.36	0.28	1.92
	Std	1.63	2.45	1.69		2.15
Access to credit	% of farmers	38	31	45		35
Cooperative membership	% of farmers	85	92	100		92

*Source: survey data, *** significant at the 1% level.*

Access to Services

Access to services like credit and cooperatives show that about 35% of the sampled households had access to credit and 92% were members of a cooperative. A higher proportion of farmers who grow both local and improved maize varieties had access to these services as compared to those who grow only local or improved varieties.

Use of Improved Varieties

Descriptive statistics also show that a considerable proportion of maize growers in the Rift Valley use improved maize varieties (60%) and about 22% grow only local varieties and the remaining 18% grow both local and improved varieties. The land allocated for maize varied among farmers based on the type of seed used. Farmers who use both local and improved maize seed allocated more land to maize production followed by those who use local seed only (Table 10).

Table 10. Farm size and land allocation to maize production

Variety	Indicators	Total farm size (ha)	Maize area (ha)	Improved maize area (ha)	Proportion of total farm size allocated to maize	Proportion of maize land allocated to improved varieties
Local	Mean	2.23	1.17	0	0.57	0.00
	Std	1.08	0.78	0	0.29	0.00
Improved	Mean	2.14	1.07	1.06	0.52	1.00
	Std	0.97	0.55	0.55	0.17	0.00
Both	Mean	3.47	1.78	0.84	0.56	0.52
	Std	2.23	1.01	0.60	0.18	0.25
Total	Mean	2.40	1.22	0.79	0.54	0.69
	Std	1.38	0.74	0.65	0.20	0.42
F-Value		4.57**	4.38**	21.62***	0.38	463.69***

Note: *** 1% and ** 5% significance levels. The F-value denotes the test for the mean difference among farmers growing the different types of maize varieties.

The major source of maize seed for the maize growing farmers in the Rift Valley is own seed (43% of the farmers) followed by seed bought from traders (15%), the bureau of agriculture (12%), and other farmers (12%) (Table 11).

Table 11. Maize seed source in 2005 crop season

Seed source	Percentage of farmers (n=60)
Own seed	43
Traders in market	15
Bureau of Agriculture (BoA)	12
Other farmer (s)	12
BoA and own seed	8
Cooperatives/Union	5
Other farmers and own seed	2
Other farmers and traders	2
Traders and own seed	2

Source: Survey data 2006

The surveyed farmers cultivated a variety of hybrids (BH 660, BH 540 and BH 140) and OPVs (A-511 and Katumani) (Table 12). According to farmer responses, the choice between the various hybrids and OPVs relates mainly to the availability of seed and their qualities: the popular hybrid varieties are preferred for their wider adaptability, good drought tolerance and high yield. While many farmers were originally discouraged from planting maize hybrids due to the area's susceptibility to drought-related stress, many choose to plant hybrids if the early (April) rains are adequate.

A considerable number of the surveyed farmers also use local varieties. Among the most prevalent local varieties is Lemat (used by 12% of the surveyed farmers), Shaye (7%), Mered (3%), Israel (3%) and German (2%). About 7% of farmers reported the uses of local varieties but were unsure of their names.

OPV and hybrid maize seed were obtained by the surveyed farmers from different sources (Table 12). The local Bureau of Agriculture constituted the main source for the BH-660 hybrid, while other hybrids were obtained from a variety of other sources. Other farmers, own seed, and traders represent the main sources for OPVs. These figures suggest that a considerable portion of the improved seed cultivated by the surveyed farmers is saved seed for both OPVs and hybrids.

Table 12. Farmer's choices on maize seed type and source

Seed source	Hybrid maize (Percentage of growing farmers)				Improved OPVs (Percentage of growing farmers)			QPM (%)	Pop corn (%)	Local varieties (Percentage of growing farmers)					
	BH660	BH 540	BH140	PH3253	Katumani	A511	Melkassa 2			Shaye	Mered	Limat	Israel	German	Any local
Bureaus of Agriculture (BoA)	45	10	0	0	0	0	0	0	0	0	0	0	0	100	0
Cooperatives/ Union	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other farmer (s)	0	0	50	100	75	21	0	0	100	0	0	0	0	0	0
Traders in market	18	30	0	0	0	11	0	0	0	0	50	0	0	0	50
Own seed	0	20	0	0	25	47	100	100	0	50	50	100	100	0	50
BoA and own seed	10	20	0	0	0	11	0	0	0	25	0	0	0	0	0
Other farmers and own seed	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Other farmers and traders	0	10	0	0	0	5	0	0	0	0	0	0	0	0	0
Traders and own seed	0	0	50	0	0	5	0	0	0	25	0	0	0	0	0
Number of farmers	11	10	2	1	4	19	3	1	1	4	2	7	2	1	4
% of sampled farmers	18	17	12	2	7	32	5	2	2	7	3	12	3	2	7

Source: Survey data, 2006.

About 84% of the surveyed farmers reported that they do not receive the required type of maize seed from any source, while 56% indicated that they do not receive the required quantity and 20% indicated that they do not receive the required quality (Table 13).

Table 13. Availability of seed in terms of type, quality and quantity

Availability in terms of type, quality and quantity	Percentage of farmers answering "No"	Proportion for maize (%)
Do you get the required type of seed each year?	50.00	84.00
Do you get the required quantity of seed each year?	53.33	56.00
Do you get the required quality of seed each year?	25.00	20.00

Source: Survey data, 2006.

Conclusion and Recommendations

This paper reviews recent trends in Ethiopia's maize seed industry and documents some of the challenges facing key players engaged in maize seed production and distribution in the Rift Valley area. With respect to maize varieties developed for drought-stressed areas, the national research system has made significant progress in breeding several varieties that are appropriate to farmers' needs in areas such as the Rift Valley. However, the ultimate availability of these varieties remains limited due to a weak production and distribution system.

Evidence suggests that private sector participation in the maize seed industry is increasing, particularly with respect to the production and distribution of maize hybrids. However, evidence also suggests that the public sector remains the key player in the country's seed industry. This includes the national agricultural research system, the ESE, the regional bureaus of agriculture, and various regulatory agencies under the MoARD. There is scope for greater private sector participation in the production, distribution, and marketing of maize seed, particularly given that the current supply of maize seed through the public sector is falling short of demand, and that the private sector's cost basis may be more competitive than the public sector's. Further analysis of market potential in the maize seed industry is required.

Evidence also suggests the continued need for a strong regulatory system to ensure seed quality in production and distribution processes – a function that the public sector is most appropriately configured to undertake. However, reforms in the regulatory system procedures are needed, particularly with respect to the time and effort required by seed producers to be evaluated for production suitability, management, and quality. Such reforms could significantly encourage greater private investment in the seed industry.

Several recommendations for improving the maize seed production and distribution system in Ethiopia are as follows:

- Promote greater private investment in the production of maize seed, and in the establishment of independent distribution and marketing channels to farmers.
- Promote maize seed bank systems and other community- or farmer-based systems designed to encourage the multiplication and exchange of improved maize varieties.
- Invest in greater production of breeder/foundation and pre-basic seed production. Possible interventions include increasing production capacity by subcontracting to public and private farms and investing on irrigation to support these farms.
- Invest further in reducing the costs of seed certification to make certified seed multiplication by small-scale farmers more feasible by strengthening the decentralized certification procedures and capacity of the staff involved.
- Continue to invest in seed-related extension program to encourage the adoption of improved maize varieties, and provide training to development agents on alternative varieties for different agro-ecologies.

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Annexes

Annex I. List of licensed organizations to produce, process, import, retail and export seed

Name of organization	Type of certificate				
	Producing	Processing	Importing	Retail	Export
Anger PLC	✓	-	-	-	-
Hadiya Trading Enterprise	-	-	✓	✓	-
Biyo Agricultural Development PLC	✓	-	-	✓	-
Gadissa Gobena Private Farm	✓	-	-	✓	-
Ata PLC	✓	-	-	✓	-
Ano Agro Industry	✓	-	-	✓	-
Teppo Agricultural and Trade PLC	-	-	✓	✓	
Awassa Green Wood	✓	-	✓	✓	✓
Ethio Flora	✓	-	-	✓	
Ethiopian Seed Enterprise	✓	✓	-	✓	
Pioneer Hi-Bred Seeds Ethiopia PLC	✓	✓	✓	✓	
Blue Nile Flora PLC	✓	-	-	-	-
Oda Share Company	-	-	-	✓	-
Markos PLC	-	-	✓	✓	-
Nazareth International Trading PLC	-	-	✓	-	-
Chemtex PLC	-	-	✓	✓	-
Harvest General Trading	-	-	✓	✓	-
Alihulugeta Agricultural Development PLC	✓	-	-	-	-
Neget Farm PLC	✓	-	✓	✓	-
Ethiopian Fruit and Vegetable Marketing S.C.		-	✓	✓	-
Hawas Agri-Business PLC	✓	-	-	✓	-
Ajmu Import and Export Trading Enterprise	-	-	✓	✓	-
Multi Agricultural Service Center	✓	-	-	-	-
Multi Farmers Shop and Advisory Service	-	-	-	✓	-
Valley Development and Trade	✓	-	-	✓	-
Akrem Metena	-	✓	✓	✓	✓
Coffee Plantation Development	✓	-	-	✓	-
Kaleabe Farm Development	✓	-	-	✓	-
Bale Farm Development Enterprise	✓	-	-	✓	-
Awassa Farm Development Enterprise	✓	-	-	✓	-
General Chemicals and Trading PLC	-	-	✓	✓	-
Mohamed Bahmud Seed Enterprise	✓	-	✓	✓	✓
Hebist PLC	-	-	✓	✓	-
Segel General Trading P.L.C			✓	✓	-
Gadisa Gobena Farm Produce PLC	✓	-	-	-	-
AGMF PLC	✓	-	-	-	-
Dawn Commercial Enterprise		-	✓	✓	-
Samson Development Service PLC	-	-	✓	✓	-
Teppo Agricultural and Trade PLC	✓	-	-	-	-
NONO Agricultural Development PLC	✓	-	✓	✓	✓
Horticulture Development Enterprise (Ziway Farm Development)	✓	-	-	✓	-
S.O.S Meki Irrigation Project	✓	-	-	-	-
Total	26	3	19	33	4

Annex II. Breakdown of maize seed production cost for ESE (2004/05 production season)

Description	Cost component	Cost of hybrid maize seed production		Cost of OPV maize seed production	
		Birr per quintal	% of total cost	Birr per quintal	% of total cost
Direct labor cost		32.74	8.35	28.31	6.95
	Residual disposal	1.61	0.41	1.70	0.42
	Planting	0.98	0.25	1.04	0.25
	Fertilizing	1.03	0.26	0.25	0.06
	Weeding and Hoeing	3.29	0.84	4.98	1.22
	Detasseling	4.40	1.12	-	-
	Marking	0.15	0.04	-	-
	Male removing	1.59	0.40	-	-
	Thinning	0.71	0.18	-	-
	Pesticide	0.14	0.03	-	-
	Herbicide	0.20	0.05	-	-
	Crop guarding	2.35	0.60	3.62	0.89
	Harvesting	5.52	1.41	5.69	1.40
	Threshing/shelling	1.18	0.30	1.21	0.30
	Loading unloading	6.31	1.61	6.50	1.60
	Cob sorting	1.39	0.35	1.43	0.35
	Others	1.89	0.48	1.95	0.48
Direct material cost		50.48	12.87	60.82	14.93
	Seed and seedlings	8.14	2.07	1.50	0.37
	Chemicals	15.34	3.91	23.21	5.70
	Fertilizer	17.18	4.38	26.00	6.38
	Harvesting and packing materials	9.81	2.50	10.11	2.48
Center overhead		255.34	65.09	262.98	64.54
Enterprise contribution		53.74	13.70	55.34	13.58
Total production cost (birr/quintal)		392.30		407.46	