GSID

Discussion Paper No.189

Why seed issues matter in Ethiopia: the need for short and long-term strategies

Dawit Alemu

March 2012

Graduate School

of

International Development

NAGOYA UNIVERSITY
NAGOYA　464-8601, JAPAN

〒464-8601　名古屋市千種区不老町
名古屋大学大学院国際開発研究科

GSID

Discussion Paper

Why seed issues matter in Ethiopia: the need for short and long-term strategies

Dawit Alemu

Ethiopian Institute of Agricultural Research

Dawit96@gmail.com/socioecon@eiar.gov.et

August 2011

Table of contents

Acknowledgment

I am very grateful to the Graduate School of International Development (GSID) at Nagoya University, Japan, the Ethiopian Institute of Agricultural Research (EIAR) and to Farmers' Research Group II project of JICA Ethiopia for facilitating my research stay. I would like to thank Professor Yoshiaki Nishikawa, my research associate, for his intellectual guidance and kind supervision and also for making may stay pleasant by arranging different study trips to different parts of Japan, Mr Ryosuke Kondo for facilitating administrative matters, Dr Kazuhiro Nemoto of Shinshu University for facilitating the visit to local seed producers, traders and market center, and Mr Hisato Suzuki of the National Agriculture and Food Research Organization (NARO) for facilitating visits of the different institutes of NARO in Tsukuba and the Ministry of Agriculture, Forestry and Fisheries (MAFF) in Tokyo.

Acronyms and abbreviations

ASE	Amhara Seed Enterprise
BoARDs	Bureaus of Agriculture and Rural Development
CSA	Central Statistics Agency
EIAR	Ethiopian Institute of Agricultural Research
ESE	Ethiopian Seed Enterprise
FSS	Farmer's Saved Seed
GDP	Gross Domestic Product
GOE	Government of Ethiopia
GTP	Growth and Transformation Plan
HLIs	higher learning institutes
IBC	Institute for Biodiversity Conservation
ILRI	International Livestock Research Institute
ISSD	Integrated Seed System Development Project
JICA	Japan International Cooperation Agency
MoA	Ministry of Agriculture
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
MoTI	Ministry of Trade and Industry
NARS	National Agricultural Research System
NGO	Non-Governmental Organization
NTSP	National Tree Seed Project
NVRC	National Variety Release Committee
OPVs	Open Pollinated Varieties
OSE	Oromiya Seed Enterprise
QDS	Quality Declared Seed
RARI	Regional Agricultural Research Institute
SNNP	Southern Nations, Nationalities and Peoples region

Why seed issues matter in Ethiopia: the need for short and long-term strategies

Dawit Alemu

Ethiopian Institute of Agricultural Research

dawit96@gmail.com/socioecon@eiar.gov.et

Abstract

The socio-political importance of the issue of seed in Ethiopia emanates from interlinked domestic and international agendas associated with seed. These are the lead role given to the agricultural sector as an engine of economic growth domestically and the intent different international agencies and donors to ensure food security along with sustaining the country's biodiversity resources. The paper documents the overall poor performance of the seed sector in terms of the trends in the proportion of revealed demand covered by supply, the level of use of improved varieties, and the trends in the productivity gaps. Accordingly, the paper recommends: (i) creation of a coherent and multifaceted seed system with a joint vision of all actors, (ii) gradual liberalization of the sector not only in the production but also marketing of the produced seeds, (iii) further strengthening the public seed system actors mainly for addressing seed market failures, (iv) promotion of the participation of the private sector along the value chain for improved competition and accountability, (iv) promotion of group action among the scattered and small-scale farmers especially through cooperatives and small-scale seed enterprises in seed production and marketing, (v) promotion of seed retailing mainly through agro-dealers, and (vi) promotion of efficient regulatory and certification mechanism.

1 Introduction

The socio-political importance of the issue of seed in Ethiopia emanates from interlinked domestic and international agendas associated with seed. These are the lead role given to the agricultural sector as an engine of economic growth domestically; the different international agencies and donors intent to ensure food security in the county; and sustaining the country's biodiversity resources and its role in the global biodiversity.

The consideration of the agricultural sector as the core driver for Ethiopia's growth and long-term food security is highly associated with the importance of the sector in the economy: agriculture directly supports 85 percent of the population's livelihoods, 45 percent of Gross Domestic Product (GDP), and over 80 percent of export value; and 15-17 percent of GOE's expenditures are committed to agriculture. Thirteen million smallholder farmers account for 95 percent of total production, and yet five to seven million households are chronically food insecure year-round (Dawit Alemu et al, 2010; Dawit Alemu, 2010, Zeleke et al, 2010). Moreover, the agriculture is dominated by the crop sector as the contribution of livestock sector still remains low estimated at 12% of national GDP and 26% of agricultural GDP (NBE, 2009). The importance of the seed system can also be linked to the the new Growth and Transformation Plan 2010 - 2015 (GTP 2010 - 2015), which targets the production of major crops is to grow from 18.08 in 2009/10 to 39.5 million tons in 2014/15 production season (MoFED, 2010).

In the last decade, the economy has registered rapid growth rates averaging 11 percent per annum, which is among others associated with increased growth rate of the agricultural sector (MoFED, 2010). Even though, the agricultural sector has been growing, it is still characterized by (i) the dominance of subsistence farming with low input-low output and rain-fed farming system; (ii) continuous expansion of the cropped area to more marginal lands, which is leading to severe land degradation in some areas; and (iii) the prevalence of droughts periodically reverse agricultural sector performance gains with devastating effects on household food security and poverty levels. The national agricultural research system recognizes the development of crop varieties for different agro-ecologies and tolerance to adverse biotic and abiotic stresses. Similarly, farmers have long developed indigenous knowledge and skill to overcome different challenges they face in crop production.

Theoretically, seed can play a critical role in increasing agricultural productivity as it relatively determines the maximum upper limit of crop yields and the productivity of all other agricultural inputs given optimum environment in any farming system (Mywish et al., 1999). Under Ethiopian condition, the productivity gaps due to the limited use of good seed are considerably high. If we consider teff, the national average yield is 11.67 qt/ha whereas, the yield levels range from 15 - 27

under research field and from 13 - 23 under farmers field using good seed (Dawit Alemu et al., 2010). Thus, it is logical that in a country where there is close to nine million ha allocated only to cereal crops a quintal productivity gain means considerable amount at national level.

In order to reduce the productivity gaps, improving the performance of both the formal and informal seed system along with promotion of their efficient integration is crucial, which requires setting short and long term intervention strategies. This paper explores the possible short and long term intervention strategies for the seed sector development of the country that recognizes promotion of production and productivity using good seeds of both improved and indigenous crop varieties without compromising the country's rich biodiversity.

2 Methodology

The required data were generated from both secondary and primary sources. The primary data related with the farmers' and experts' perception about farmer saved seed was generated through a formal survey done in East Shewa zone of Oromiya, Ethiopia. A total of 65 experts (agricultural researchers, MoA experts, Cooperative experts, and development agents) and 92 randomly selected farmers in three districts of East Shewa (Ada'a, Lome, Gimbichu and Adama districts) were interviewed using a pre-tested questionnaire.

3 Result and discussion

3.1 The seed system and its performance

3.1.1 Overview of the seed system

The national system is composed of both the formal and informal dimensions. However, though its contribution in terms of volume is small, the formal sector play critical role. The formal seed system comprises the National Agricultural Research System (NARS), seed producers, seed distributors and regulators. The role of the different actors in the seed system is summarised in Table 1.

Even though, different public and private actors are involved in seed production, the pricing and marketing of seed is made centrally by the government along a support of loan grants. The distributors of seed are normally cooperative unions and their respective member primary cooperatives.

Table 1 Major actors in the seed system and their role

Components of the seed system	Institutions	Regulatory bodies	Regulatory measures
Plant breeding	EIAR, RARIs, and HLIs	MoA	Targets in terms of crop, improvement targets
Variety release	NVRC	MoA	Distinctiveness, uniformity and stability, uniqueness, value for cultivation
Breeder seed production	EIAR, RARIs, and HLIs	Variety Maintaining Research Centre	Seed quality control
Pre-basic seed production	EIAR, RARIs, HLIs and ESE, OSE, ASE		Seed quality control
Basic seed production	ESE	MoA	Seed quality control
Basic seed distribution and sale	MoARD	MoA	Fair distribution among regions
Certified seed production	ESE, OSE, ASE, SSE, Private seed companies	MoA	Seed quality control
Farmers based seed production	ESE, BoARDs, NGOs and farmers	BoAs	Seed quality control
Seed distribution and sales	ESE, OSE, ASE, SSE, Co-operatives, BoARDs	BoARDs	Price, quantity to respective buyers
Overall sight on the seed system	National Seed Production and Distribution Committee	MoA / EIAR	Planned production Fair distribution of different classes of seed

Source: Dawit Alemu, 2010

Note: EIAR, Ethiopian Institute of Agricultural Research; RARI, Regional Agricultural Research Institute; HLIs, higher learning institutes; NVRC, National Variety Release Committee; ESE, Ethiopian Seed Enterprise; OSE, Oromiya Seed Enterprise; ASE, Amhara Seed Enterprise; BoARDs, Bureaus of Agriculture and Rural Development; MoA, Ministry of Agriculture

Official estimates from the Central Statistics Agency (CSA) show that while the total quantity of seed of improved crop varieties supplied nationally has been increasing since last 90s, farmer use of seed of improved varieties ranges from 3-6 percent of farmers' actual seed need considering total area of production. This implies that most farmers still rely primarily on farmer-to-farmer exchanges or saved seed. However, these data are often unable to provide real insights into the adoption of the seeds of improved varieties mainly because they lack to answer the real question that what type of variety is a farmer cultivating, and when did he or she purchase seed. For improved openly-pollinated varieties such as wheat and teff, farmers do not necessarily need to purchase seed each season as they would for hybrid maize; rather, they might purchase seed every 4-5 years to replace their stocks of saved seed with seed that has a higher level of purity, and thus better performance when cultivated (Spielman et al., 2010; Doss et al., 2003).

3.1.2 The performance of the formal seed system

The performance of the formal seed system is evaluated in terms of (i) the trends in the proportion of revealed demand covered by supply, (ii) the level of use of improved varieties, and (iii) the trends in the productivity gaps that can be achieved if the performance of the system is improved.

a) The seed demand and supply trends

As indicated in Table 2, the trend in the proportion of revealed demand covered by the supply is consistently increasing since 2006/07 production season for both hybrid and non-hybrid seeds. A huge increase in the supply of seed is observed in the last production season (2010/11). This is highly associated with the crush seed multiplication program[1] that has been implemented by the GoE since 2009. The program has increased the supply considerably to reach a bit more than one million tons of seed, which is about 80% of the revealed demand for the 2011 production season from the different regions.

Estimates of revealed demand for improved seed in Ethiopia are based entirely on official projections that are developed at the local (kebele) level and then transmitted through official channels to zonal and regional levels, after which they are aggregated nationally to produce estimates of the type and quantity of seed that needs to be supplied in the coming season (Dawit Alemu et al., 2007). In general, this demand assessment approach can serve as an indication, however, it ignores (i) the possible demand shift that may occur due to changes in the production and market conditions (weather shift, diseases and pest incidence, price change, shift in product demand, emergence of better opportunities etc), and (ii) the need for provision of choice for different type of seed (inter and intra-crop varieties).

[1] The crush program was an ad hoc program initiated mainly to overcome the critical shortage of hybrid maize seed and it was implemented by EIAR, ESE and MoA. It was blamed to crowd out the private sector and for its high cost

Table 2 Trends in the revealed demand and actual supply of certified seed in quintals (2006/07 - 2010/11)

Year	Certified hybrid maize			Certified non-hybrid crops			Total		
	D	S	%	D	S	%	D	S	%
2006/07	123,777	35,244	28	629,422	205,680	33	753,199	240,924	32
2007/08	143,847	86,787	60	841,458	246,051	29	985,305	332,838	34
2008/09	193,079	95,735	50	737,992	278,353	38	931,071	374,088	40
2009/10	333,249	168,123	50	723,588	433,049	60	1,056,837	601,172	57
2010/11	432,648	365,335	84	930,980	716,512	77	1,363,628	1,081,847	79

Source: The national Seed Production and distribution committee, 2011

The problem related with poor effective demand assessment is reflected in the considerable amount of seed leftovers each year. The data for 2011 production seasons considering only the Ethiopian Seed Enterprise (ESE) shows that a bit over 87 thousand quintals of seed produced by ESE were not sold. Of which, interestingly, 33 thousand quintals is for hybrid maize. Due to the critical shortage of seed for hybrid maize, each year the distribution and appropriation for the different regions of hybrid maize seed used to be made by higher officials at federal level. The main reason for the considerable amount of hybrid maize seed leftover is associated with the late arrival of the rains, which forced farmers to shift to early maturing crops and varieties (Table 3).

Table 3 Amount of seed leftover at ESE warehouses in 2010/11 production season (quintals)

Region	Hybrid	Non-hybrid	Total
Oromiya	3,716	13,779	17,495
Amhara	457	26,350	26,807
SNNP	28,433	12,341	40,773
Tigray	69	115	184
Benishangul Gumuz	424	1,374	1,798
Harari	50	33	83
Total leftover	33,149	53,991	87,140
Total seed produced			207,429
Percentage of leftover from ESE production			42%
Percentage of leftover from total production			8%

Source: The national Seed Production and distribution committee, 2011

b) Use of seed of improved varieties

While there is limited data about the national level of adoption of different seed varieties, there are some location-specific studies on adoption of improved varieties for specific crops (Table 4). The uptake of improved varieties seems to vary considerably by crop and location. Findings show that improved varieties can substantially improve the productivity of small-scale farmers. However, this table indicates that although farmers welcome new varieties of some crops, for others rates of adoption are less than 50 percent, and adoption rates are highly variable by region.

Table 4 Use of improved varieties: results of location-specific adoption studies

Crop	Location	Rate of adoption of improved varieties (%)*
Bread wheat	Amhara (W. Gojam and S. Gondar)	80
Wheat	Oromiya, Bale	42
Bread wheat	Oromiya	70
Maize	Sidama and North Omo	22-30
Maize	NW Amhara	43
Maize	SNNP, Amhara and Oromiya	40
Maize	SNNP	47
Maize	SW Oromiya	39
Chickpea	Oromiya	18
Haricot bean	Oromiya	70
Lentil	Oromiya	30
Sorghum	Tigray	8

Source: Tesfaye Lemma et al., 2006

Note: * The definition of "improved variety" varies across studies; in some cases it does not include older varieties released by the research system.

The main targets of the National Agricultural Research System (NARS) is generation of crop varieties for different agro-ecologies, where for most important crops the crop improvement programs are promoted through lowland, intermediate, and highland breeding programs. In addition, breeding programs for different stress conditions are performed. As the result, the NARS has generated more than 500 types of varieties for different crops. However, the production and dissemination of these varieties in the county is very limited. In this regard, Tripp (2010) documented the characteristics of crop varieties supplied by Ethiopian Seed Enterprise (ESE) in terms of the number of varieties supplied, their average age and respective proportion in the supply (Table 5). The second column of the table illustrates that most formal seed production is for only two crops, bread wheat and maize. The third column shows that in most cases only two varieties account for the vast majority of seed production for any crop. Given the wide range of growing conditions and farming systems in Ethiopia

(the country has 18 major agro-ecologies), this is surely an inadequate offering. The fourth column summarizes the average age (time since release) of the varieties in seed production. Only in the case of sorghum (and private hybrid maize) it is less than 10 years; for most crops it is 15-20 years and OPV (open pollinated variety) maize varieties offered for sale are, on average, more than 33 years old. This implies that the newly released varieties are not reaching the farmers.

Table 5 Characteristics of crop varieties sold by ESE, 2009

Crop	Quantity of seed ('000 mt)	Number of varieties accounting for > 80% of seed sale	Weighted average age of varieties (years)	Proportion of seed from new varieties (released since 1999) (%)	New varieties in seed production / total new varieties released
Bread wheat	12.20	2	14.0	12.7	8/25
Durum wheat	0.12	3	19.2	24.2	2/18
Hybrid maize (public)	2.97	2	15.2	8.2	4/6
Hybrid maize (Pioneer)	2.69	3	9.4	51.7	3/4
OPV maize	0.85	2	33.1	9.1	3/7
Barley (food)	0.32	2	20.8	0.0	0/21
Teff	0.78	2	22.6	3.4	1/17
Sorghum	1.50	2	9.9	91.8	3/21
Field pea	0.04	1	15.9	0.0	0/7
Faba bean	0.23	2	23.4	22.1	1/11
Haricot bean	0.40	2	19.5	0.5	0/16
Chickpea	0.29	1	10.7	95.5	2/4

Source: Tripp, 2010.

c) Performance in terms of narrowing productivity gaps

The stakes for increasing the quality and usage of commercial seed are high since widespread adoption could bring significant benefits for smallholder productivity (Dawit Alemu et al., 2010). As shown in Table 6, current national average yields for cereals and pulses are much lower than yields achieved both in research fields and in farmer test fields, using recently released varieties. These figures demonstrate the considerable yield gaps between current yields and the potential yields with improved seed varieties.

Table 6 National Average Yield Levels and Yields for Recently Released Varieties

Crops	National average yield (q/ha)	Research field yield (q/ha)	Farmers' field yield (q/ha)	Variety considered
Teff	11.67	15 - 27	13 - 23	Kena
Food Barley	13.76	24 - 49	20 - 43	Guta
Bread wheat	16.25	44 - 50	35 - 47	Gasay
Durum wheat	16.25	23 - 68	24 - 40	Flakit, Obsa
Maize[2]	21.22	80 - 110	50 - 60	Morka
Faba bean	13.23	24 - 52	20 - 42	Walki
Field pea	10.95	28 - 40	15 - 20	Ambericho
Haricot beans	10.43	20 - 30	18 - 22	SUG – 131

Source: Dawit Alemu et al. (2010)

3.2 Public and donor supported interventions in the seed system

In recent years, the interest in developing a vibrant seed system is accompanied with a growing recognition in some policy circles of (i) the existence of agricultural technologies (improved varieties and breeds) that can considerably improve productivity and (ii) the limited access of these technologies to farmers. In addition, there is a substantial improvement in the level of farmers' awareness about the use of those improved technologies (Dawit Alemu, 2010). These trends are opportunities to further look into options of improvement of the seed system in the country. Accordingly, there are different initiatives promoted by the public and donor communities in creating strong integrated seed sector in the country. Among the most important initiatives are (i) decentralization of the seed system, (ii) promotion of the participation of private sector and licensing of public varieties, (iii) promotion of in situ and ex situ conservation, (iv) institutionalization of seed and seed technology education in HLIs.

a) Decentralization of the seed system

Following the decentralization of the political system, the seed system has been also decentralized that give way to the emergence of regional public organisations and heterogeneous arrangements across regions. To mention some, the emergence of regional agricultural research institutes, regional seed enterprises and regional seed quality laboratories etc. Currently, there are seven regional

[2] Note that the Morka maize variety is OPV, while the national yield includes both hybrid maize and OPV

agricultural research institutes, three regional seed enterprises (Amhara Seed Enterprise, Oromiya seed enterprise, and South seed enterprise).

The experience so far shows that the decentralisation of the seed system has both opportunities and challenges. The opportunities are related to: better research coverage of the different agro-ecologies; improved possibility of expanding the production and marketing of seed for all crops; improving the human and physical capacity at regional level, improving the possibility of producing locally demanded crop varieties, and the possibility of marketing at relatively lower cost due to reduced cost of transportation. The challenges are related to: the need for strong national coordination of agricultural research and development, seed production and marketing activities for better efficiency and creation of institutional synergies; avoiding unnecessary competition among the three regional seed enterprises for the same resources, such as facilities, human resources and markets; and if the regional seed enterprises are to serve only their respective regions, the role of ESE will need to be redefined as a national seed enterprise (Dawit Alemu, 2011).

b) Promotion of the participation of private sector and Licensing of public varieties

Following the liberalization of the economy, the participation of the private sector in the seed system was also promoted, where there are currently close to 30 private companies licensed for seed production. Currently, different incentives are provided to support the private agricultural investment, either through overall investment incentives and/or seed sector specific support. These incentives are related to preferential access to land, duty-free import of capital goods, grace periods of up to five years on land rents and tax holidays (MoTI, 2007). In addition, the government is supporting the organisation of the private seed companies through the creation of the Ethiopian Seed Growers and Processors' Association. Though still weak, the association is improving the engagement of emerging private seed companies in the system.

While the private sector is growing it remains poorly integrated into the national seed production and distributions system and focuses only on particular seeds, i.e. hybrid maize in some regions. Under the current set-up, all private seed companies, except the multinational private seed company, are dependent on the public supply of source seed (basic seed) and also have to align to the public distribution system. Even the currently licensed private seed companies who own parental lines for the popular hybrid maize varieties remain aligned to the public distribution channels and pricing mechanism. This has created a disincentive for the private seed companies to invest in distribution channels and market outlets. This discouragement also is the core reason for lack of seed shops and retail outlets in Ethiopia, unlike other countries where agro-dealers are central to delivery systems (Dawit Alemu, 2011, 2010).

c) Promotion of in situ and ex situ conservation

Ethiopia is considered to be one of the richest centres of plant genetic resources in the world. Wide altitude and temperature ranges, high humidity and extreme forms of rainfall pattern, coupled with complex topography, make the country a major region of genetic diversity for many crop plants (Balcha et al., 2003). Cognisant of the need to sustain this diversity, considerable efforts have been in place for both ex situ and in situ conservations in the country.

Ethiopia is one of the African countries that established an ex situ conservation facility early in 1976. The ex situ conservation activities in the country have been promoted through (i) the different seed banks (Institute for Biodiversity Conservation-IBC, National Tree Seed Project-NTSP, and Forage Genetic Resources Centre at ILRI), (ii) field gene banks especially for crops with desiccation-intolerant seeds (like for coffee, yam and ginger), (iii) on-farm conservation, which targets the landrace conservation and enhancement that provides a unique opportunity to conserve and develop traditional seed materials that are adapted to often high environmental stresses within certain local agro-ecological zones (operational at 12 sites in the country by integrating community knowledge with conventional in situ methods, and (iv) germplasm exchange mainly with CGIAR members IRIs.

In the less-favoured areas of the world where crop production is risky and opportunities are limited for insuring against risk, many farm families still depend directly on the diversity of their crops for the food and fodder they use both in terms of inter-specific (among crops) and intra-specific diversity (within a crop) (Benin et al., 2004). It is under this premise that in-situ conservations are promoted in Ethiopia. However, the on-farm conservation of crop diversity poses obvious social, economic and policy challenges.

d) Institutionalization of seed and seed technology education in HLIs

Some higher learning institutions (HLIs) like Haramaya University have started offering M.Sc. level training on seed and seed technology, which is expected to improve the availability of trained manpower in the seed system. One of the critical gaps in the system was lack of trained manpower reflected in the fierce competition for manpower among the public seed enterprises.

e) Specific major measures underway in the seed sector

The major specific measures underway by the public sector and also by development partners are summarized in Table 7. The main public sector measures are the amendment of the national seed law, which is expected to be approved soon; further expansion of the public seed sector as regions without regional seed enterprise are planning to establish like in Tigray and Somali; and the strengthening of the ex situ and in situ conservation of crop biodiversity.

Table 7 Interventions underway for the country's seed system improvement, 2011

	activity	current status	Responsible institute
Public driven	Amending the Nation seed law	Draft seed law ready for approval	MoA
	Establishment of regional seed enterprises	three enterprises in Oromiya, Amhara, and SNNR already established other regions at least Tigray and Somali regions to establish soon	Regional BoA and regional governments
	Supporting the improvement the national seed system	Prioritization of interventions underway	Agricultural Transformation Agency
	Ex situ and in situ conservation of crops	expanded ex situ and in situ conservation underway in collaboration with international organization	Institute of biodiversity Conservation (IBC)
Development partners	Integrated Seed System Development (ISSD project)	supporting farmers' organizations to produce and sell seed locally supporting local seed business	The Royal Dutch Embassy
	Supporting the establishment of seed enterprises in the form of cooperative	Edget seed producers' cooperative union established in SNNP operational in two zones	Self Help Africa (International NGO)
	Quality Seed Promotion Project for Smallholder Farmers	Implementation underway in three pilot districts in three regions	JICA Ethiopia

Among the donor supported measures are (i) the ISSD is practically piloting the establishment of small-scale seed businesses linked with the formal sector, (ii) experiences with the established seed cooperatives as business entities in the SNNP through the support of SelfHelp Africa, an International NGO, is showing the possibility of expanding the approach to other regions, and (iii) the JICA supported project implemented in collaboration with the MoA is piloting how and what is required to produce quality seed under farmers' condition.

3.3 Existing understanding of farmers' saved, improved and good seeds

3.3.1 Defining farmers' saved, improved and good seeds

In general, there is confusion in understanding the terms "improved/good variety" with "good seed". In order to clearly define these terms, there has to a clear understanding about from whose perspective the goodness of a variety or a seed are looked into. In this paper, we view that the goodness of a variety or a seed has to be first looked from the farmers' perspective. The farmers' perspectives are determined by the factors related to both the biophysical (biotic and abiotic circumstance) and socioeconomic circumstances (resource ownership, markets, institutions etc) that are inherent in the production system the farmers are engaged with. Therefore, a good variety can be either improved or local depending upon the circumstances that face the farmers. These circumstances determine whether the variety is good in terms of (i) tolerance for abiotic and biotic stresses, (ii) food quality, (iii) industrial quality, (iv) high yield and/or (v) other variety attributes like color and size. A good seed is then the seed of the good variety that fulfills the requirements of seed i.e. (i) true to type (ii) required purity, (iii) required germination rate and (iv) other attributes. The hybrid maize seed supply for the 2011 production season in Ethiopia can be a good illustration. Close to 80 thousand quintals of hybrid maize seed was leftover due to the limited demand by the farmers associated with the late arrival of rainfalls. Farmers obviously shifted to the good maize varieties i.e. to those that mature early within the remaining months of the production season. However, the seed used for the early maturing varieties was not good as in most cases it was a grain, which was a bit cleaned.

3.3.2 Perceived performance of farmers' saved seeds (FSS)

The perceived performance of farmers' saved seed was assessed based on the a survey made in East Shewa zone of Oromiya Region, Ethiopia using two questionnaires administered with 65 relevant agricultural experts (Development Agents, Subject Matter Specialists, Agricultural Researchers) and with 92 randomly selected farmers. The main objective of assessing the perceptions is to really see the understanding of farmers and experts on the farmers saved seeds in order to identify the existing gaps about farmers' saved seed.

a) Perceptions about the use of the different classes of seed

The assessment of the perceived performance of farmers' saved seeds was made for the different classes of seed: basic, C1, C2, C3, and local variety and for different categories of crops: cereals and pulses. Table 8 summarizes the perceived performance of both farmers and experts for cereal crops. The perception between farmers and experts for the different classes of cereal crop seeds is not statistically significant.

Table 8 Perception on type of seed mostly used by the farmers for cereals (% of respondents)

Seed class	Perception	Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Basic	Not used	78	75	76	1.5
	Less important	18	23	21	
	Important				
	Do not know	3	2	3	
Certified	Not used	42	36	38	0.98
	Less important	43	46	45	
	Important	12	16	15	
	Do not know	3	2	3	
C2	Not used	11	10	10	1.49
	Less important	63	65	64	
	Important	23	23	23	
	Do not know	3	2	3	
C3	Not used	15	16	16	2.37
	Less important	57	52	54	
	Important	25	29	27	
	Do not know	3	2	3	
Local variety	Not used	28	40	35	3.61
	Less important	32	29	31	
	Important	37	28	32	
	Do not know	3	2	3	

Source: own survey, 2011

The most important perception is observed for certified seed and seed of local seed variety. About 38% of the respondents perceive that certified seeds for cereal crops are not used by the farmers, which is in line with the overall low adoption of improved varieties. In terms of local varieties, 35% of the respondents perceive that they are not used by the farmers, whereas 32% of the respondents perceive the opposite that local varieties are mostly used by the farmers (Table 8).

Like cereal crops, the perceptions about the use of the different classes of seed of pulse crops between farmers and experts were not significantly different (Table 9). Even though, the trend of perceptions seems reasonable, considerable proportion of respondents perceives that local seed are mostly used by the farmers. Similarly, 75%, 55% and 24% of respondents perceive that basic, certificated and C2 seeds are not used by the farmers, respectively. Good proportion of the respondents (32%), on the other hand, perceives that local varieties of pulses are less importantly used by farmers.

Table 9 Perception on type of seed mostly used by the farmers for pulses (% of respondents)

Seed classes		Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Basic	Not used	75	74	75	2.73
	Less important	9	14	12	
	Important	5	3	4	
	Do not know	11	9	10	
Certified	Not used	55	54	55	2.170
	Less important	28	24	25	
	Important	6	13	10	
	Do not know	11	9	10	
C2	Not used	22	26	24	1.240
	Less important	48	47	47	
	Important	20	18	19	
	Do not know	11	9	10	
C3	Not used	28	29	29	1.210
	Less important	43	42	43	
	Important	18	20	19	
	Do not know	11	9	10	
Local variety	Not used	17	22	20	0.980
	Less important	31	33	32	
	Important	40	36	38	
	Do not know	12	10	11	

Source: own survey, 2011

b) Perceived performance of farmers' saved seed (FSS)

The perceptions about the poor performance of FSS were not statistically different between farmers and experts. Of the total respondents, 52% perceived that FSS perform poor for all crops and the rest 48% perceived that the poor performance is for some crops (Table 10). In terms of the perception of the poor performance of FSS for the different crops, statistically significant differences were observed between farmers and experts except for teff. For teff, 11% of the respondents perceive that FSS do not necessarily perform poorly. In case of wheat, maize, chickpea, and haricot beans higher proportion of farmers compared to experts perceive that FSS perform poorly. The impressive result is that more than 50% of the surveyed experts reported that they do know about the performance of FSS for maize, chickpea and haricot beans, which implies that considerable number of experts' knowledge about FSS is limited compared to farmers.

Table 10 Perceived poor performance of FSS by farmers and experts (% of respondents)

Poor performance of FSS	Responses	Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Agree for	All crops	57	49	52	0.980
	some crops	43	51	48	
Teff	Yes	75	78	77	1.290
	No	9	12	11	
	Do not know	15	10	12	
Wheat	Yes	66	82	75	6.63**
	No	2	3	3	
	Do not know	32	15	22	
Maize	Yes	40	70	57	13.73***
	No	3	2	3	
	Do not know	57	28	40	
Chickpea	Yes	37	66	54	20.08***
	No	9	14	12	
	Do not know	54	20	34	
Haricot beans	Yes	45	66	57	8.45**
	No	3	4	4	
	Do not know	52	29	39	

Source: own survey, 2011

The estimated reduction due to the use of FSS is presented in Table 11 and overall, there is not statistically significant different in reduction of yields due to use of FSS between the farmers and experts estimates for all crops. The estimated yield reduction are considerably high ranging from close to 6 quintals/ha for teff and haricot beans to close to 9 quintals/ha for chickpea, 10 quintals/ha for wheat, and about 14 quintals/ha for maize. It should be noted that these estimates are from respondents who perceived that FSS perform poorly and do not consider the estimates of respondents who do not agree with the poor performance of FSS.

Table 11 Estimated reduction in yield due to use of FSS by farmers and experts by crop

Crop	Indicators	Experts (N=65)	Farmers (N=92)	Total (N=157)	Mean difference test (F-value)
Teff	Mean	5.88	5.79	5.82	0.022
	Std.	3.16	3.13	3.13	
	N	48	68	116	
Wheat	Mean	9.66	10.34	10.08	0.380
	Std.	5.14	5.75	5.50	
	N	40	63	103	
Maize	Mean	14.70	13.80	14.22	0.070
	Std.	11.22	10.86	10.91	
	N	20	23	43	
Chickpea	Mean	9.07	8.72	8.85	0.060
	Std.	5.13	5.18	5.12	
	N	21	36	57	
Haricot Beans	Mean	5.78	5.75	5.76	0.002
	Std.	3.34	3.28	3.28	
	N	28	36	64	

Source: own survey, 2011

c) Source of information of the discourse that FSS give less production

In general, the source of information of the discourse about the poor performance of FSS are related with trainings, seminars, and workshops, which are mainly related with the extension packages promoted by the government in promoting the use of improved crop varieties, technologies and knowledge in the agricultural sector. As indicated in Table 12, there is no statistically significant difference between farmers and experts in source of information for the discourse that FSS perform poorly.

Table 12 Source of information of the discourse that FSS give less production (% of respondents)

Source	Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Trainings	48	43	45	0.27
Seminar/workshops	40	35	37	0.45
Informal sources	28	24	25	0.29
Demonstration and field days	22	20	20	0.09
Radio/TV	15	13	14	0.17
Publications	15	11	13	0.69

Source: own survey, 2011

d) Perceived performance of different types of farmers' saved seed

The types of FSS considered were from local variety, OPVs within the years of two to three of the first use as a certified seed, OPVs beyond three years of the first use as a certified seed, and hybrid seed. The result shows that there is no statistically significant different in the perceptions between farmers and experts in the performance of the different types of FSS (Table 13). The result is interesting that experts do not have better understanding compared to farmers especially in terms of the responses for hybrid varieties. There are about 14% experts who do not know whether the FSS from hybrid varieties perform poorly.

Table 13 Perceived poor performance of different types of farmers' saved seed (% of respondents)

type	less production	Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Local variety	Yes	78	79	79	0.12
	No	17	15	16	
	Do not know	5	5	5	
OPV 2-3 years	Yes	66	59	62	1.14
	No	32	38	36	
	Do not know	2	3	3	
OPV more than 3 years	Yes	92	90	91	0.49
	No	5	4	4	
	Do not know	3	5	4	
hybrid variety	Yes	85	76	80	2.02
	No	2	1	1	
	Do not know	14	23	19	

Source: own survey, 2011

In general, if properly managed, FSS from OPVs can be used without any genetic deterioration and loss of production potential up to three years. Some authors even suggest up to five years (Spielman et al., 2010; Doss et al., 2003). The perception of about 62% of the respondents that FSS from OPVs within the years of two to three of the first use as a certified seed that they on average perform poorly implies two things: (i) there is a general misunderstanding about the performance of these varieties, and/or (ii) farmers' ability to manage the saved seed is limited.

Table 14 Perceived reasons for poor performance of FSS (% of respondents)

Reasons for low performance of FSS	Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Variety deterioration	77	72	74	0.53
Poor post-harvest management	57	49	52	0.89
Pest and disease damage	42	46	44	0.26
High contamination	31	27	29	0.24
Poor quality due to open pollination	25	21	22	0.35

Source: own survey, 2011

The perceived reasons for poor performance of FSS provided by respondents are summarized in Table 14. The perceptions about the stated reasons between farmers and experts are found to be not significantly different. Majority of the respondents perceived that the poor performances of the FSS are associated with the variety deterioration, poor post harvest management, and pest and disease damages. The other perceived reasons are related with poor quality due to open pollination and high contamination, which are of course related with variety deterioration.

e) Perceived ability of actors to conserve landrace varieties

The respondents' perception about the ability of farmers and relevant organizations (the national research system-NARS and the Institute of Biodiversity Conservation-IBC) in conserving landrace varieties is summarized in Table 15. Interestingly, there is a statistically significant difference in the perception of the ability of conserving landraces between respondent farmers and experts where 58% of the experts and 48% of the farmers perceive that farmers can not conserve landrace varieties. In addition, 77% of the experts and 63% of the farmers perceive that relevant public organization can not conserve landrace varieties.

Table 15 Perceived ability of farmers and relevant organizations in conserving landrace varieties (% of respondents)

Actor	less production	Experts (N=65)	Farmers (N=92)	Total (N=157)	Chi-square test
Farmers	Yes, fully	42	43	43	
	Yes, partially	-	16	10	13.29***
	No	58	40	48	
Public organizations (NRS, IBC)	Yes, fully	23	25	24	
	Yes, partially	-	22	13	17.57***
	No	77	53	63	

Source: own survey, 2011

3.3.3 Assessed performance of Farmers' saved seed

In a broader sense, FSS means any seed kept from own production for use as a seed for next production season. However, it is commonly associated to the seeds of local varieties that can be landraces or well adapted introduced varieties.

In the less-favoured areas where crop production is risky and opportunities are limited for insuring against risk, many farm families normally depend directly on the diversity of their crops in the production process (Benin et al., 2004). In this regard, the role of FSS to ensure both inter- and intra-crop diversity at household and community level is enormous. Studies have confirmed that seeds of OPV crops can be reused up to 5 years without losing their genetic potential of productivity (Doss et al., 2003, Spielman et al., 2010). Thus, farmers do not necessarily need to purchase seed each season as they would hybrid maize; rather, they might purchase seed every 3-5 years to replace their stocks of saved seed with seed that has a higher level of purity, and thus better performance when cultivated.

In Ethiopia, were the seed system is at its infant stage and where there are about 262 weredas (districts) where crop production is too risky due to unreliable rainfall (out of the 748 weredas), promoting crop diversity through FSS can be an important strategy for improved production risk management. However, as Asiedu et al. (2006) states the performance of FSS is highly dependent on the seed management skill of farmers.

As indicated in part 4.1.1, even though there are crop varieties released by the national research system that can fit to the different demands/requirements of farmers, due to the poor performance of the national seed system, the availability of these seeds is limited. In general, the seeds available are for few varieties mainly suitable for high potential areas with reliable rainfalls. Thus, promoting FSS especially in those less potential areas augmented with farmers' skill development can be an alternative strategy to ensure better access to good seed.

3.3.4 Implication of misunderstanding about good seeds

The debates, the public and donor supported interventions and the current status of the seed system imply the limited understanding and emphasis given to good seed from the view of farmers' perspectives, rather in a mere strong promotion of the multiplication and distribution of popular high yielding crop varieties. In case of maize, for instance, almost the whole emphasis is the multiplication and distribution of hybrid maize varieties (BH 660 and Bh 540). This has resulted in the poor performance of the seed systems in terms of: (i) limited choice for farmers, (ii) considerable pressure on the country's biodiversity, (iii) a pressure on public funds to balance Supply and demand for seed, and (iv) considerable missed opportunity of increase productivity.

a) Limited choice for farmers

The mere focus of promoting improved varieties has resulted in the provision of very limited choice to the farmers in terms of both inter- and intra-crop varieties (see Table 5). This has resulted in the use of poor seeds by the farmers in case of changes in both biophysical and economic conditions (rainfall, pest and diseases, prices, markets etc).

b) Pressure on the country's biodiversity

Even though, there have been efforts in maintaining the biodiversity resources through both ex-situ and in-situ conservations, the general trend of focused emphasis on selected improved varieties has deteriorated farmers' capacity in conserving seeds of important crops that has been developed traditionally as an indigenous knowledge.

c) Pressure on public funds

Even though, the pressure on public funds is highly associated with the poor demand assessment approaches followed, the ignorance to FSS has also resulted, in most of the years, in considerable amount of leftovers even in the years of supply shortage as farmers normally shift to good seeds they consider based on the situation they face, in most case to local varieties. If we consider only the Ethiopian Seed Enterprise, the amount of seed carried over is close to 42% of the total production in 2010/11, which is close to 8% of the total seed produced in the year from the formal sector (see Table 3).

d) Missed opportunity of increased productivity from use of good seeds

If the seed provided by the formal sector is not good for the farmers, they normally shift to the seeds of local varieties available. These local varieties are not, in most cases, as good as the varieties that may be available, which are suitable for the changed situation. A study by Dawit Alemu et al. (2008) in the rift valley area documented that the maize seeds supplied normally are hybrids (mainly BH 540) and in case of late arrival of rainfall, farmers in the rift valley areas normally shift to local varieties that are either good for the situation but poor quality seeds or not good varieties. However, the research system has varieties that are early maturing with better yield than the local varieties like Melkassa 1 OPV variety. Therefore, due to the limited access to good seeds of varieties suitable for circumstances farmers are facing, there is a considerable foregone benefit from the use of good seeds, as the result.

4 Conclusion

Ethiopia is expected to create a vibrant agro-ecology and socioeconomic situation based seed systems, if it is going to achieve the agricultural development goal set in the new Growth and Transformation Plan 2010 - 2015, which targets the production of major crops to grow from 18.08 in 2009/10 to 39.5 million tons in 2014/15 production season. The paper presents current performance of the seed system along with the possible short and long term intervention strategies for the seed sector development of the country that recognizes promotion of production and productivity using good seeds of both improved and indigenous crop varieties without compromising the country's rich biodiversity.

The current seed system is composed on the NARS, the public and private seed enterprises; the MoA as a regulatory institutions, National Seed Production and Distribution Committee, an ad hoc committee playing a role of oversight in the system, and farmers and their organizations. Official estimates show that while the total quantity of seed of improved crop varieties supplied nationally has been increasing since last 90s, farmer use of seed of improved varieties ranges from 3-6 percent of farmers' actual seed need considering total area of production.

Even though, the NARS targets variety development for lowland, intermediate, and highland and also for selected stresses and has released more than 500 varieties, the availability of the seed of these varieties is very limited. In general, most of the formal seed production is for only two crops, bread wheat and maize and in most cases only two varieties account for the vast majority of seed production for any crop. Given the wide range of growing conditions and farming systems in Ethiopia (the country has 18 major agro-ecologies); this is surely an inadequate offering. The same trend is observed in the productivity gaps, where the national average yields for cereals and pulses are much lower than yields achieved both in research fields and in farmer fields using recently released varieties.

Both the public and development partners in the country are attempting to improve the seed sector and among these efforts the most important are (i) decentralization of the seed system, (ii) promotion of the participation of private sector and licensing of public varieties, (iii) promotion of in situ and ex situ conservation, (iv) institutionalization of seed and seed technology education in HLIs.

In general, the scientific and also in the political economy discussion, there is serious confusion about farmers' saved, improved and good seeds, which has led to misperception about the different classes of seed in the country among farmers and also agricultural experts. The paper presents a clear distinction between farmer saved seed, seeds of improved and local varieties and, and good seed. In

addition, agricultural experts and farmers were asked for their perception on the discourse that the farmer saved seed performs poorly in view of the important role of farmer saved seeds within the national seed system. Interestingly, the perception between farmers and experts in the discourse of the poor performance of farmer saved seed did show statistically significant difference against the theoretical expectation there will be difference.

5 Recommendations: pillars and strategies for improved seed system

In order to create vibrant seed system that provides choices of seeds for farmers in terms of type, quantity, quality and time at affordable prices, the following pillars of interventions need to be considered. These are: (i) the recognition of the need for diverse approaches and systems in line with the main characteristics of the production system i.e. the agro-ecological diversity of country, the small-scale nature of the production systems with emerging commercial farming, and the dominance of rain-fed agriculture along with the emerging irrigated agriculture; (ii) recognition of providing options/ choices of crops and varieties to farmers; (iii) promotion of market based solutions from production to marketing of seed (market led incentives); and (iv) recognition of public responsibilities where market does not work like biodiversity, risk of drought and floods and other natural calamities.

Along with these pillars then there is a need to redirect the discussion and interventions for improved seed system through (i) creation of a coherent and multifaceted seed system with a joint vision of all actors, (ii) gradual liberalization of the sector not only in the production but also marketing of the produced seeds, (iii) further strengthening the public seed system actors mainly for addressing seed market failures, (iv) promotion of the participation of the private sector along the value chain for improved competition and accountability, (iv) promotion of group action among the scattered and small-scale farmers especially through cooperatives and small-scale seed enterprises in seed production and marketing, (v) promotion of seed retailing mainly through agro-dealers, and (vi) promotion of efficient regulatory and certification mechanism.

a) Joint vision among actors

The on-going changes in the agricultural sector in terms of (i) the decentralization of the seed system and the emergence of different public and private actors, (ii) the gradual transformation of the agricultural production system and emergence of considerable number of commercial farms and increased importance of irrigated agriculture, (iii) increased vulnerability to climate change and instability farmers demand for seed, (iv) confusions about the farmers' saved seeds, and (v) increased importance of maintaining the country's biodiversity, requires the promotion of joint vision about the national seed system in line with the long-term agricultural and economic development targets of country. Some of the areas that require joint vision are (i) what should be the role and responsibility of

every actor in the system, (ii) what should be the role of farmers' saved seed linked with the farmers' right agenda, and (iii) what should be the code of conduct, ethics, and mode of implementation for all actors (the governance issue).

b) Gradual liberalization of the sector

Even though, there is a good start in promoting the participation of different actors both public and private, still the pricing and marketing aspect is not liberalized. This has prolonged the existence of malfunctions observed in the sector like sale of fake seed and limited regard to the farmers' interest and preferences. Similarly, all the risks associated with the distribution and marketing of seed remains the burden of the public sector as all the guarantees of loan for marketing are provided by the government. The expected fair competitions among all actors for the sector's efficiency in all aspects are hindered as there is no any competition among actors.

c) Strengthening the public seed system actors

Along with the need to clearly identify the role of the public seed enterprises within the seed system and also among the seed enterprises themselves (regional Seed enterprises and ESE), there is also a need to strengthen the their role in terms of addressing the production and market of seed for which there is market failure or there is no commercial interest to do so. The focus of these enterprises in the production and marketing of same hybrids and OPVs for which there is a commercial interest was instrumental for the competition and unclear relationship among these public enterprises and also with the other private actors. These competitions are not for seed but for source seed and other inputs like land.

d) Participation of the private sector

There are more than 20 private seed companies involved in hybrid maize seed production without any competition among themselves as the amount they are going to produce is determined by the amount of source seed they are allotted by the government and what they produce is totally submitted to government making the marketing risk to these companies to be zero. Thus, it is important to further liberalize the activities of private companies so that they share also the market risk linked with price liberalization.

e) Promotion of seed cooperatives and farmers' seed enterprises

Many studies associate the low adoption of modern varieties among small-scale farmers in developing countries like Ethiopia with the inability of formal and centralized seed production systems to meet farmers' complex and diverse seed requirements (David and Oliver, 2002, Doss et al., 2003, Dawit Alemu et al., 2007). Among the different alternative strategies proposed, farmer seed enterprises (FSEs) are widely promoted as they help meeting dual objectives, which are related with the

possibilities (i) to sustainably distribute and promote modern crop varieties, and (ii) to establish a regular source of good seed of either local or modern varieties.

The farmer seed enterprises have been promoted in Ethiopia by NGOs like SelfHelp Africa in SNNP through promotion of seed cooperatives as business enterprises and recently by the Integrated Seed System Development Program (ISSD) of the Royal Netherlands Embassy to Ethiopia. The experiences of these interventions show promising results (Dawit Alemu, 2011a). Thus, it is important that FSEs are promoted by the public sector especially in capacitating existing cooperative unions and their member primary cooperatives to consider seed production and marketing as a business along with other activities.

f) Promotion of efficient regulatory and certification mechanisms

In the Ethiopia, there have been attempts to promote rigorous centralized seed quality control targeted to the formal seed system, which has been decentralized along with the decentralization of the seed system where regional seed quality control laboratories became into picture. Currently, there are six seed labs under the Ethiopian seed enterprise, one under the federal Ministry of Agriculture and ten under regional Bureaus of Agriculture. In general, the current seed quality regulatory efforts have two major short-comings, which are related with (i) the focus on quality assurance during seed production with limited involvement during seed marketing, and (ii) ignorance and lack of appropriate approach to the quality assurance for seeds from the informal sector.

In general, quality problems can emerge in the production and in the marketing process. If the country is to promote decentralized and competitive seed system, putting in place vibrant regulatory and certification system along with the seed chain from production to marketing i.e. until the seed reaches the farmers, is mandatory. Similarly, lack of a mechanism to promote seed quality control mechanism for the informal seed sector has limited the integration of the formal and informal seed system. This is more important considering the dominant contribution of the informal seed sector in Ethiopia. The new draft seed law recognizes the need to promote Quality Declared Seed (QDS) as a mechanism of linking the informal sector to the formal. However, it should be noted that the QDS system should not be promoted to replace the formal regulatory and certification system and to replace the formal seed trade. Experiences of the promotion of QDS shows that in order to assist the growth of the formal seed trade, while encouraging the use of quality certified seeds, the QDS should only be sold locally in small quantities in areas where they are produced and where certified seed is not used or sold (Granqvist, 2009; FAO, 2006).

6 References

Amstel H. van, J.W.T. Bottema, M. Sidik, and C.E. van Santen (eds). 1995. Integrating Seed Systems for Annual Food Crops. Proceedings of a Workshop Held in Malang, Indonesia. October 24-27, 1995. CGPRT Centre. Regional Co-ordination Center for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific

Asiedu EA, R Asante, P Adusei-Akowuah, OA Danquah, PYK Sallah, E Avah and A Baduon. 2006. Agronomic performance and yield of farmer-saved and certified seeds of maize. Trop. Sci. 2006, 46(3), 166–170

Benin, S. M. Smaleb, J. Pender, B. Gebremedhin, S. Ehui. 2004. The economic determinants of cereal crop diversity on farms in the Ethiopian highlands. Agricultural Economics 31 (2004) 197–208

David, S. and B. Oliver. 2002. Business skills for small-scale seed producers: Handbooks for small-scale seed producers. Handbook 2. Network on Bean Research in Africa, Occasional Publications Series no. 36, Kampala, Uganda: CIAT.

Dawit Alemu, Mwangi, W., Nigussie, M., Spielman, D.J., 2007. An Analysis of Maize Seed Production and Distribution Systems in Ethiopia's Rift Valley. Ethiopian Institute of Agricultural Research (EIAR) research report no. 72. Addis Ababa: EIAR.

Dawit Alemu, Shahidur Rashid, and Rob Tripp. 2010. Seed system potential in Ethiopia: Constraints and opportunities for enhancing the seed sector. International Food Policy Research Institute. Washington DC. 62pp

Dawit Alemu, Wilfred Mwangi, Mandefro Nigussie and David J.Spielman. 2008. The maize seed system in Ethiopia: challenges and opportunities in drought prone areas. African Journal of Agricultural Research Vol. 3 (4), pp. 305-314. April 2008.

Dawit Alemu. 2010. The Ethiopian agricultural Development programs: achievement, challenges, key lessons, and future directions. Paper presented at A National Conference on "Leaving the Legacy of Hunger & Famine behind: Progress towards food security in Ethiopia", 9th -10th, February 2010.

Dawit Alemu. 2011a. Farmers' Based Seed Multiplication in the Ethiopian Seed System: approaches, priorities and performance. Paper presented at the International seed conference: "Sustainable Seed System in Ethiopia: challenges and opportunities" June 1 - 3, 2011 in Addis Ababa, Ethiopia hosted by EIAR.

Dawit Alemu. 2011b. The Political Economy of Ethiopian Cereal Seed Systems: State Control, Market Liberalisation and Decentralisation. IDS Bulletin Volume 42 Number 4, July 2011. PP 69 - 77.

Doss, C.R., Mwangi, W., Verkuijl, H., De Groote, H. 2003. Adoption of Maize and Wheat Technologies in Eastern Africa: A Synthesis of the Findings of 22 Case Studies. Economics Working Paper 03–06. Mexico, D.F.: CIMMYT.

Doss, C.R., Mwangi, W., Verkuijl, H., De Groote, H. 2003. Adoption of Maize and Wheat Technologies in Eastern Africa: A Synthesis of the Findings of 22 Case Studies. Economics Working Paper 03–06. Mexico, D.F.: CIMMYT.

FAO. 2006. Quality Declared Seed System. FAO Plant Production and Protection Paper No 185. ISSN 0259-2517.

Gete Zelleke, Getachew Agegnehu, Dejene Abera, and Shahid Rashid. 2010. Fertilizer and Soil Fertility Potential in Ethiopia: Constraints and opportunities for enhancing the system. . International Food Policy Research Institute. Washington DC. 66pp

Girma Balcha, Tim Pearce, and Abebe Demissie. 2003. Biological Diversity and Current Ex Situ Conservation Practices in Ethiopia. Chapter 45. Pp 848 - 856: In: Smith,Roger D., Dickie,John B. , Linington,Simon H. , Pritchard,Hugh W. and Probert,Robin J. (eds.) (2003), Seed Conservation: turning science into practice. Royal Botanic Gardens, Kew. ISBN 1842460528.

Granqvist Britt. 2009. Is Quality Declared Seed Production an effective and sustainable way to address Seed and Food Security in Africa? Accessed on August 23, 2011 from http://knowledge.cta.int/.

Lemma, T., Mugerwa, W. and Anandajaysekeram, P. 2006. Review of Agricultural Research Impact, Ethiopia. IFPRI paper prepared for World Bank, Addis Ababa.

MoA (Ministry of Agriculture). 2010. Wereda Disaster risk profiling program. Disaster risk management and food security sector, Ministry of Agriculture, Addis Ababa, Ethiopia. 21p.

MoFED, 2010. Growth and Transformation Plan: 2010/11 - 2014/15. Federal Democratic Republic of Ethiopia. Ministry of Finance and Economic Development (MoFED). Volume I: Main Text. Addis Ababa, Ethiopia. 135p.

MoTI (Ministry of Trade and Industry). 2007. Export and investment incentives available for exporters and investors in Ethiopia. Export Promotion Department. Ministry of Trade and Industry, Addis Ababa, Ethiopia. Pp 90.

Mywish Maredia, Julie Howard, and Duncan Boughton, Anwar Naseem, Mariah Wanzala, and Kei Kajisa. 1999. Increasing Seed System Efficiency in Africa: Concepts, Strategies and Issues. MSU International Development Working Paper No. 77, 1999. MICHIGAN STATE UNIVERSITY

NBE. 2009. National Bank of Ethiopia: Annual Report. Economic Research and Monetary Policy Directorate, National Bank of Ethiopia. Addis Ababa, Ethiopia. 183p.

Spielman David, Derek Byerlee, Dawit Alemu, and Dawit Kelemework. 2010. Policies to Promote Cereal Intensification in Ethiopia: The Search for Appropriate Public and Private Roles. Food Policy. Food Policy 35 (2010) 185–194.