Open Pollinated Maize Seed Systems Linkages through Farmer Research Group in Central Rift Valley of Ethiopia

Bedru Beshir
bedritemam@yahoo.co.uk
Graduate School of International Development, Nagoya University, Fro-cho, Chikusa-ku, Nagoya 464-8601, Japan

Abstract

Though both systems have their own peculiarities and deficiencies, the informal seed sub-system is dominant over the formal seed sub-system. The informal one has a competence to serve local community; while it is relatively restricted in access to improved varieties and larger markets. Conversely, the formal sub-system is in better access to wide range of varieties, but fails to serve small-scale farming community. So, there is a need to ameliorate this situation by linking the two. In this respect, Farmer Research Group in open pollinated maize seed production and dissemination in the Central Rift Valley of Ethiopia is a point in case. Farmers evaluated and selected better yielding, drought tolerant, or nutritionally enhanced varieties. Subsequently selected farmers produced seed of the chosen varieties in close follow ups of researchers and seed experts. The seed shared on: sale, exchange, gift, and credit. Besides, Oromia Seed Enterprise purchased and disseminated to distant places. High rate, 90%, of farmer produced seed was dispatched. Personal contacts, farmers' field days, research, and agricultural development workers were the sources of information. Intensive dissemination took place 5.4 km radius from seed producers. Informal seed production is found socially beneficial and economically paying. Reasonable number of farmers accessed the seed on exchange, credit, and gift. The cost benefit ratio for the business was 20% to 80% over good and bad, respectively.

1. Introduction

Seed is a fundamental and the single most important input that affects the maximum output of other inputs as well in crop production (Almekinders and Louwaars 1999; Jaffe and Srivastava, 1992). Seed has special values to different stakeholders in the seed sector. For resource poor farmers, seed is the most precious of all resources. Famers including those living under complex and uncertain conditions carefully selected, stored, and passed seeds from generation to generation. It is, therefore, the result of continual adaptation and innovation in the face of ever challenges for survival. On the other hand, seed is an investment for large corporation that attracts advanced biotechnological research and sophisticated marketing techniques (Tripp, 1998). For researchers, seed is an output of years of hard work and the subject of job satisfaction, confidence, and a landmark of innovation.

The seed forms it own system at different levels. This system can be divided into two broad categories of formal and informal sub-systems at national level. The formal seed system can be explained as a hierarchically organized and conditioned by explicit laws and regulations. This sub-system comprises variety development/improvement, production, regulation, quality control, processing, storage and transportation units or services. It is largely well functioning in developed countries some commercial crops such as hybrid maize in developing countries. On the other hand, in the informal seed sub-system seed production and exchange are integrated into crop production and their socio-economic process of farming (Tripp, 1998). In the informal sub-system farmers save, select, exchange seed through social networks and market. In this paper the informal sub-system deals with the seed produced under farmers' condition from research released varieties and certain technical supports as well. So, the approach is a blend between the formal and informal sub-system functions.

The informal seed production is still dominant (80%) worldwide (Almekinders and Louwaars 1999; Almekinders et al., 1994; Jaffe and Srivastava, 1992). In Ethiopia most of the farmers (80 to 90%) use their own saved seeds or seeds obtained from their locals (Sahlu et al., 2006). In Ethiopia, annually less than 5% of crop area is

covered with new seeds of certified seeds of cereals and pulses (for example it was only 3.2% in 2005/6, and 4.7% in 2007/8) (CSA, 2007 and 2008). By the same token, in one of the central zones of Ethiopia, East Shewa, the area annually planted to seeds of improved variety was only 6.2% of the annually required seed on average for eight major crops: including wheat, maize, tef, and common beans over 2004 to 2008 (Ibrahim et al., 2008). In East Shewa, maize, tef, and wheat are the most important food crops in terms of area and production while common bean is main cash crop for farmers of drought prone districts.

Maize is an essential food crop in Ethiopia in general and the Central Rift Valley in particular. The area is characterized by erratic rainfall that hampers crop production. In the East-Shewa zone, maize is a principal food crop in five districts out of the ten districts totally claiming 44% of the crop area (CSA, 2008). The crop is also leading in terms of productivity where open pollinated maize varieties are dominantly grown. Research has been working in the improvement of maize for drought prone area quite recently. Over the last one decade and so eight Open Pollinated varieties (OPV) were released both under conventional and farmer participatory research approaches by Melkassa Agricultural Research Center under the name "Melkassa-n_s". A series of Melkassa-1 to Melkassa-8 were released over a period of 1999 to 2005.

Farmer participatory research approach in maize breeding came into action by CIMMYT (International Maize and Wheat Improvement Center) under mother -and-baby trial (Abebe et al., 2005). On the other hand, Farmers' Research Group approach for different commodities including maize has been under way for the past nearly on decade by the financial supports of The World Bank and JICA. However, farmer participatory research approach in the area has fine tuned through FRG project. The FRG approach has been intensively tested and used in EIAR-OARI-JICA (Ethiopian Institute of Agricultural Research-Oromia Agricultural Research Institute-Japan International Cooperation Agency) join pilot project over 2004 to 2009 periods. The approach enhanced the release and dissemination of OPV maize, at least in the project sites. In the seed dissemination farmer research group and informal seed production approaches are the primary instruments. The Farmer

Research Group members and social institution (such as church) were involved in seed production and dissemination processes typically in their area through existing social networks and linkage developed with formal seed system (research and seed enterprise).

In the informal seed dissemination of OPV maize farmers shared the seed in sale, exchange, credit, and gift with their fellow friends, neighbors, and relatives. This horizon of dissemination would be satisfied (as there was such tendency in Anano-Shisho area ATJK district, for example) in short period while still the demand falls in short of the supply in some nearby (neighboring) and distant places in the same agro-ecologies. Anano-Shisho is a kebele where intensive FRG works have been done and seed producers' area well established. Formal Seed enterprises have not actively involved in OPV seed production and dissemination of those varieties in drought prone areas. This is due to formal seed enterprises are more interested in hybrid maize. This typically true for private seed enterprises (personal communications). This tendency is widely narrated (Jaffe and Srivastava, 1992; Langyintuo, 2010). Besides, cost of production and distribution and demand creation or identification of the demand takes longer time for seed enterprises.

The two seed systems have their own merits and deficiencies. In the informal seed sub-system the seed dissemination would be restricted to limited area. It was observed that geographic and ethnic boundaries do reduce seed diffusion in farmer seed (Almekinders et al., 1994). Besides, local seed system can be highly affected by natural disasters such as drought, insect, or disease outbreak. In the formal seed system there might be a cyclical constraint of supply and demand (Almekinders et al., 1994). That is, the cost of seed production is usually high to make enough bulk through several cycles from breeder seed to high quality commercial seed in the first place. Second, costs for labor, expensive infrastructure, and logistics (for certification, processing, and distribution) escalate seed price. In Ethiopia, Yonas et al (2008) documented that high production and transportation costs, low effective demand, production of less preferred varieties by smaller farmer and inconsistent seed quality in the seed enterprise as recurrent problem. On the other hand, it has been long witnessed that farmers can produce

adapted varieties of good quality seed at a reasonable cost. This has a demonstration effect at local level and enhances seed availability. Nevertheless, the formal system has access to new germplasm and it is in a better position to reach wider clients of similar agro-ecology to that of seed producer farmers. Thus, it has potential and capacity to avail basic seed, do quality control, and disseminate beyond the local (narrow) area. In this way linkage between formal and informal seed system plays a complementary role in the local seed system and contribute to the national seed system.

Alemu et al (2008) studied maize seed system in the Central Rift Valley of Ethiopia and identified a limited dissemination of modern varieties as a consequence of seed shortage. They further argued that public sector dominance restricted the seed market competition and resulted in low modern maize variety seed supply implicitly suggested for more involvement of private seed enterprises. However, the private sector is not well developed in the country. Moreover, a few existing private seed enterprises are less interested in OPV and focused on hybrid maize seed (Langyintuo et al., 2010).

In cognizant of shortage of adapted open pollinated varieties and their seeds shortage farmers group based informal seed production has been launched and the group linked to research and seed enterprise- the formal system. The linkage is aimed to maintain flow of seeds (genetic materials), share knowledge, experience, and resources, develop mutual understanding and the combination of these.

2. Methodology and Approach

A series of consultation meetings and group discussions were held among farmers, researchers, and experts from the East Shewa Zone and District Agricultural and Rural Development Offices, Farmers Cooperatives Unions, and Oromia Seed Enterprise on how to improve availability of the OPV drought tolerant and quality protein maize (Melkassa-2 and Melkassa-6Q) seeds, their multiplication and dissemination. During the consultation on -farm seed production and scaling up approaches of the new varieties were taken as the main approach for execution.
Then, sites for seed production and seed producer farmers were

identified. The selection was done on consensus and suitability of the location for seed production meeting the criteria of isolation distance, relative reasonable size (half hectare and above) and host farmers experience and interest. Subsequently, the farmers and development agents were trained on the techniques of improved maize seed field management, basic differences between seed and grain, required isolation distances mainly in theory. This was followed by practical trainings and field selection and monitoring. Researchers, seed experts, and Agricultural development workers visited the selected sites and confirmed the fulfillment of the minimum required isolation distances of 200 m in all directions. For cooperative member seed producer farmers the training included cooperative management principles, practices and record keeping in collaboration with experts from ATJK district cooperative management beyond the technical matters in seed production.

The basic seed was provided by Melkassa Research Center to the seed producers. The seed was planted under a close supervision of technicians from research and respective agricultural and rural development offices.

To ensure the minimum field isolation distance of 200 m where maize is predominantly grown seed of the target variety (i.e. Melkassa-2 or Melkassa-6Q) was shared with the neighboring farmers and planted to avoid contamination and assure the seed genetic purity. The plot for isolation demanded more seed than area allocated to seed production (Table 1), 60% area planted for isolation purpose). The fields were periodically monitored by experts from research and or seed enterprises to make sure the field level quality maintenance of the farmers produced seed. Off types and diseased planted were roughed out before and immediately after flowering. The harvest was done at full physiological maturity of about 12% seed moisture content. Shelling was done by threshers and the seeds were stored separately to avoid contaminations.

Seed producing communities were established at four locations in Adama, Adami Tulu Jido Kombolcha (ATJK), Doddota, and Boset districts from 2007 to 2009 cropping seasons.

Table 1: Description of farmers participated in OPV maize seed production, 2007-2009
Source: Field data of 2007 to 2009.

Year	Kebele[1] (Village)	Area allocated to seed (ha)	Area planted for isolation (ha)	Total area (ha)
2007	Anano-Shisho (Tora)	0.875	4.5	5.375
	Anano-Shisho kebele-(Tabo)	0.5	2.375	2.875
	Wakie Mia Tiyo kebele-(Tiyo)	0.25	5	5.25
	Dongoye Tiyo	1	1	2
2008	Anano-Shisho (Shisho Tora)	1.5	6	7.5
	Melkassa St Michael Church	4.25	0	4.25
2009	Kenenisa & Anano-Shisho farmers' Cooperative[2]	11.5	13.8	25.3
	Malima Bari Village	2	0	2
Total		21.875	32.675	54.55

Besides individual and group of farmers, a church (Awash Bishola St. Michael) also took part in 2008. At Anano-Shisho, two cooperative societies established in 2009 from both farmer research group members and non- members based on experience gained in previous years from FRG activities. Among the cooperatives, one group has organized as sole seed producer; while the second is a multi-purpose cooperative including seed production activity.

To facilitate seed sale, the cooperative entered into contract agreement with a public seed enterprise- Oromia Seed Enterprise (OSE). The parties signed agreements prior to planting by checking adherence to isolation distance and assessing the field cropping history. OSE and Melkassa RC controlled the quality of seeds produced by the cooperatives. Then collect the seed at a premium price of 10% over the existing market price.

3. Result and Discussions

3.1. Production and dissemination of OPV maize seed

Reasonable amount of quality improved OPV maize (Melkassa-2)

[1] *Kebele* is the smallest administrative unit in Ethiopia
[2] The cooperative Produced Melkassa-6Q while all others involved in Melkassa-2 seed production. That is partly because of the varietal age; Melkassa-2 release before Melkassa-6Q.

seed was produced on farm (Table 2). The produced seed was shared on sale, exchange, and gift. The dissemination among farmers is high (90%) in terms of percentage of volume dispatch in most of the locations by the FRG members. At Bishola St. Michael church was sold the seed immediately after harvest in December and the volume sold as a seed is relatively less (22%) as compared to individual and group of farmers who sold at planting or close to planting time when the seed price is remunerative. The church did so because it had no store for seed.

Table 2: On farm Drought Tolerant Maize (M-2) Seed Production and Dissemination Efficiency, 2007-2009/10

Location/ village	Year	Total seed produced (ton)	Sale (ton)	Exchange (ton)	Gift (ton)	% seed dissemination
Anano-Shisho	2007- 8	15.70	13.30(85%)	1.17(7%)	0.116(1%)	94
Dongore	2007	3.50	2.05(59%)	0.23(6%)	0.10(3%)	68
Wakie	2007	2.00	0.50(25%)	0.61(30.5%)	0.00	56
Malima Bari	2009	10.00	10.00(100%)	0	0.00	100
Sub-total	*2007-9*	*31.20*	*25.98(83%)*	*2.005(6%)*	*0.216(1)*	*90*
Bishola st Michael Church	2008	32.40	7.2(22%)	0	0.00	22
Grand total		*63.6*	*33.18(52%)*	*2.005(3%)*	*0.21(.3%)*	*56*

Figure in parenthesis indicate percentage. The number of sale, exchange, and gift may not add up to 100% since some amount of was not reported to be used for seed.
Source: Field data 2007-2009/10

3.2. Mode of Informal Seed Dissemination

The dissemination of seed was happened mainly through the existing traditional modes. In the process sale claims the lion share followed by exchange and gift. These three modes were observed in the first two years (2007 and 2008). However, credit, which is paid in cash, come into view in 2009/10 for 2010 planting since there was a significant harvest failure from area planted to local varieties and other long maturing. Seed lending as a seed dissemination mechanism was not noticed in this study. Lending was reported to constitute 50% of the cases in secondary informal seed multiplication activity for the same crop in the late 1990s and beginning of 2000 in the Central Rift Valley (Deressa et al., 2002).

The seed was shared among farmers and other clients (NGOs) primarily on sale. The sale makes up 88% by volume and 70% by number of buyers followed by exchange and gift (Fig 1). Some part of the seed purchased from seed producers re-sold to others farmers which in turn would boost the actual number of users.

Such case was observed in a kebele of ATJK district (Negalign) where a farmer re-sold the seed to ten other farmers. This is may be the reason why the average seed purchase is high as compared to land holding size of the farmers.

On average each buyer purchased 90 kg (STD 140 kg, mode 50 kg) in 2008. This is because there were farmers/individuals that purchased large volume (up to 1t) of seed for redistribution. However, the majority of the farmers purchased less than 50 kg. For instance, two-third of the seed buyers purchased up to 50 kg seed per buyer. The dissemination largely took place in nearby distance from the seed producer farmers' residence. For example, 67% of the seed buyers live within 5.35 km radius, which is about an hour walking distance. The information source for the seed buyers is primarily the seed producer farmers, field days and friends largely obtained on personal relation or social networks.

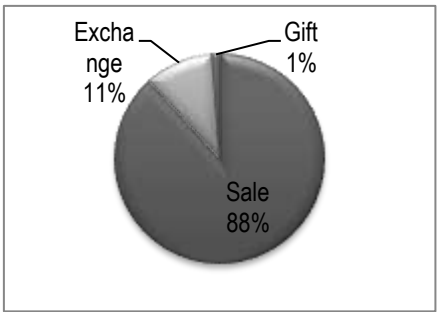

Chart 1a: Seed Dissemination by per cent Volume

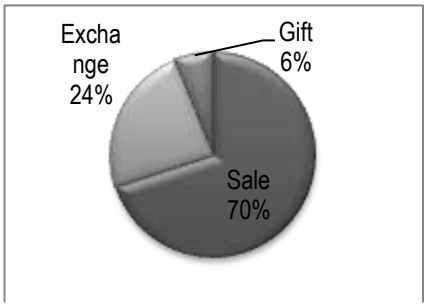

Chart 1b: Seed Dissemination by per cent Clients

Fig 1: Mode of on farm produced seed exchange between farmers at Anano- Shisho, ATJK, 2007/8 (N=86)
Source: Field Data, August 2008

In addition to the three seed producing kebeles, 26 more kebeles were benefited reaching a total of 29 *kebeles* over 2007 to 2009. The larger majority were reached in 2007/8 followed by few *kebeles* (three) included in 2009 largely within 30 km distance though there are few cases where farmer seed transported long distance (up to 800 km to Gambella and few hundred kilometers to Southern Region, example, Siltie and Wolaita zones).

The informal seed production has enhanced dissemination of improved maize. This is can be evidenced by area planted to Melkassa-2 maize in selected *kebeles* of Adama and ATJK

districts as compared to old varieties which were released before two decades. In short period (two years) Melkassa-2 stood third position in five kebeles of ATJK and Adama in terms of area (Table 3). The dissemination of the variety is relatively high in FRG kebeles (Adulala-Hate-Haroreti, Awash Melkassa and Anano-Shisho) as compared to Non-FRG ones. In ATJK the dissemination is mostly likely enhanced by the informal seed production and dissemination.

Grain and seed price changes

As indicted in table4, when the price of maize grain increases towards the beginning of the rainy season the seed price shoots up at an alarming rate in March and April compare as compared to Jan and Feb. These two years are typical ones in terms of price change. In the normal years the price does not change this much over those months for the crop. For instance, in 2009/10 the price of maize grain price change was about 15% increase as compared to harvest time which is an indicator for price of local seed.

Table 3: Area (ha) planted to different maize varieties in selected kebeles of East Shewa zone, 2008

District	Kebele	Hawassa- 511	BH 540	Melkassa-1	Melkassa-2	Katumani	Local maize	Pioneer HB
Adama	Adulala Hatie Haroreti	11.5	0	5	13.8	0	87.3	0
	Awash Melkassa	30	9	16	15	0	0	0
	Subtotal (rank)	*41.5(2)*	*9(2)*	*21(4)*	*28.8(3)*	*0(6)*	*87.3(1)*	*0(6)*
ATJK	Anano-Shisho	250	50	2	700	0	172	0
	Habule Gutumuma	0	320	0	2.5	1	1093.5	0
	Hurufa Lole	13	75	2.5	23	0	886.5	0
	Negalign	0	115	0	114	0	0	20
	Oda Anshura	0	493	0	2.5	0	849.5	0
	Subtotal(rank)	*263(4)*	*1053(2)*	*4.5(6)*	*842(3)*	*1(7)*	*3001.5(1)*	*20(5)*
Grand Total and Rank		*304.5 (4)*	*10629(2)*	*25.5 (5)*	*870.8 (3)*	*1 (7)*	*3088.8 (1)*	*20 (6)*

Source: Data Collected in collaboration with Respective Kebele Development Agents, Aug 2008
NB: Figures in the parenthesis indicate rank

Table 4: Average maize seed and grain prices (Birr) in ATJK area

		Maize seed and grain price in Adami Tulu area		
Year	Month	Average grain price	Farmer seed price	Price difference Seed price over grain price
2007	Jan	210	300	+43%
	Feb	240	350	+46%
	Mar-Apr.	270	505	+87%
2008	Dec	222	255	+15%
	Mar-Apr.	278	500	+80%

Source: Field data, August 2008 for farmer seed price and unpublished data collected by FRG project on market price

Melkassa-6Q seed production and dissemination

Melkassa-6Q seed production is relatively recent. The seed production started under irrigation in off season of 2008/9 at Melka-Oba Kebele, Adama (Table 5). A total of 5 ton of seed was produced and 4.2 ton collected by Oromia Seed Enterprise. The balance was not used for the same year planting due to harvest delay to use in the same season.

In 2009 farmers' cooperative societies produced Melkassa-6Q in the main rainy season. Relatively small part seed produced collected by OSE while the remaining sold locally. This time, other than on cash seed sale cooperative societies distributed the seed on credit bases (to be paid in cash at harvest). The seed was used by the cooperative members and the neighboring farmers in the production area - Anano-Shisho. In this way one cooperative distributed 10 ton seed at 350 birr per quintal price while the grain price was 300 birr expecting a 16.7% premium price at as compared to 10% signed agreement.

Table 5: On farm Melkassa-6Q seed produced and disseminated, 2008-2009/10

District	Location/village	Total produce (q)	Sale (q)	Seed disseminated (%)
ATJK	Anano-Shisho	113	100	88.5
Adama	Melka-Oba	50	42	84
Total		163	142	87

Source: Field data 2009/10

Cost-benefit Analysis of Informal Maize Seed Production

The major costs for maize seed production are the field operations and input costs. The operation costs include land preparation, cultivation, weeding, harvesting, transporting, and shelling. The input costs are fertilizer, seed, and fumigating chemical. The average production cost for a hectare of maize seed at Anano-Shisho kebele in 2008 was 5070 birr with net-benefit of

11,728 birr per ha and cost benefit ratio of 20%; that is for every 0.20 birr investment the farmer earned one birr. This was the case when the farmers directly sold to other farmers in 2008 a good year. At this time the farmers were not created agreement with seed enterprise. This year was special: first it was during grain price jumping period secondly it was in the beginning of the variety (M-2) seed and a kind of window fall benefit.

In the second scenario and different year when farmers sold their seed to seed enterprise at 10% premium price over market price typically in 2010. In this scenario still the farmers earn net benefit of 830 birr per hectare and cost benefit ratio 80% for the small amount sold to Seed Enterprise since the seed is needed in the area in 2010. However, farmer would benefit from the linkage since they would have continued access to seed market and the enterprise is working to establish linkage though infrastructural development for example store. For the seed distributed on loan the net benefit is 1,599 birr per hectare and cost benefit ratio is 81% (that is for 81 birr investments 100 birr gained). In the two later scenarios the benefit is so shrunk mainly due to low production in year 2009 as a result of poor moisture at especially which was encountered flowering time. And large proportion of the harvest failed from lands planted to local and other long maturing varieties. This last scenario had served the local community by giving seed on credit to farmers lost their seed to the 2009 drought.

3.3. Characteristics of Maize Seed Buyers

Seed buyers are middle aged farmers of about 40 years (Table 6). They have high family size (9.4) which would supply ample labor for relatively intensive work required in improved variety production. The farm size was 3.57 ha (higher than regional average 1.63 ha per household) of which 62% allocated to maize.

Table 6: Farmer produced seed buyers characteristics, ATJK, 2008 (N=26)

Character	Seed buyer	
	Mean	STD
Age (year)	39.4	14.3
family size (n)	9.4	5.5
Land allocated to maize (Per cent holding)	61.4%	20.6%
Land holding size(ha)	3.57	2.7

Source: own survey, August 2008

3.4. Reasons for buying on farm produced maize, farmers opinion on the seed quality and challenges of informal seed production

Modern variety maize seed were purchased for high yield, earliness, and drought tolerance. The farmers also appreciated the seed physical purity at first step then good germination and viability on field. In 2008, Anano-Shisho area farmers purchased Melkassa-2 seed for high yield (42.3%), earliness (38.5%), and drought tolerance (19.2%) as their number one criteria. Besides, the buyers indicated that quality of the seed is of very good or excellent. Concerning seed physical purity about 85% indicated very good or excellent quality. All of them witnessed complete germination while 77% the farmer indicated drought tolerance of the variety is very good or excel as compared to the local (Table 7).

Table 7: Seed buyer farmers' opinion (%) about farmer produced modern variety maize seed quality (M-2), 2008 (N=26)

Reasons for purchasing	Excellent	Very good	Good
Seed purity (compared to local)	7.6	77	15.4
Viability (germination and establishment)	14.4	84.6	-
Drought tolerance	3.8	73	23.2

Source: own survey, August 2008

The local seed production has its own advantages and challenges. The primary advantage is its easy accessibility at walking distance. Secondly, the farmers do trust the seed and each other since they observe the performance of the seed plot on different occasions such field days and personal businesses for work and easily access information. Moreover, the social relations provide security and trust on the seed quality thereby enhances the seed dissemination. Concerning social network considerable number of the farmers are friends, relatives and/or have marital relationships; a plus for the informal seed diffusion.

The informal seed production has its own technical and managerial paucity. In the Central Rift Valley area maize farm fields are located in the same places at the lower valley bottoms or more 'fertile' land and maintaining the isolation distance pose a challenge. The other constraint is storage and marketing of the seed beyond the locality since the local market is easily saturated in few years. Again it might have hampered by long standing farmers' experience of a variety seed recycling behavior for

extended years. Besides, access to basic seed supply need attention since the seed provision is done on ad-hoc or temporary project basis of institutions such research centers. Thus sustained access to seed and other inputs put is a challenge at present and in the near future.

4. Conclusion and suggestions

Informal improved maize seed production has shown enhanced seed dissemination efficiency. Nearly all of the seed produced disseminated in the adjoining of seed producing farmers' areas and beyond. The seed production and marketing is a remunerative business as shown at pilot level which is promising to build-up on it. Still, there are technical and organizational constraints in informal seed production of maintaining isolation distance and reaching beyond local community. Hence, informal seed production needs the formal system for sustained basic seed supply, quality control, and wider seed dissemination. This would simultaneously benefit the formal seed sector from the seed marketing and 'technology' dissemination. Hence, there is call for searching for optimum mode and level of collaboration between formal and farmers' seed sub-systems for effective and sustained linkages. Further, farmer seed security which can be explained in access to modern variety seed in such drought prone area, preferred seed supply sources; institutional linkage among research and farmer in the generation, dissemination and adoption of new variety seeds food and cash crops needs in depth scrutiny.

References

Abebe G,T Assefa, H Harun, T Mesfin and M Al-Tawaha, .2005. Participatory selection of drought tolerant Maize varieties using mother and baby Methodology: A case study in the semi Arid zones of the central Rift Valley of Ethiopia. World Journal of agricultural sciences 1(1): 22-27, 2005, IDOSI publications, 2005

Alemu D, M Mwangi, M Nigussie and D 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

Almekinders CJM and NP Louwaars, 1999. Farmers' Seed Production. New Approaches and Practices. London, Intermediate Technology Publications.

Almekinders CJM, NP Louwaars, and GH de Bruijn. .1994. Local Seed Systems and Their Importance for an Improved Seed Supply In Developing Countries. Euphytica 78 : 207-216, Kluwer Academic Publishers, the Netherlands

CSA (Central Statistical Agency). 2007. Agricultural Sample Survey, 2006 / 2007 (1999 E.C.). Volume I , Statistical Bulletin 388, Addis Ababa.

CSA.2008. Agricultural Sample Survey 2007 / 2008 (2000 E.C.) Volume I, Statistical Bulletin 417, Addis Ababa.

Deressa A, H Adamassu, B Seboka and M Nigussie.2002. Participatory decentralized secondary improved (*Zea mays* L.) seed multiplication in the central rift valley of Ethiopia, Pp:423-427. *In:* DK Friesen and AFE Palmer (eds.). Integrated Approaches to higher maize productivity in the Millennium. Proceeding of the Seventh Eastern and Southern African Regional Maize Conference. 5-11 February, 2002, Nirobi, Kenya.

Jaffee S and J Srivastava.1992. Seed System Development. The Appropriate Roles of the Private and Public Sectors. The World Bank Discussion papers 167, The World Bank, Washington, D.C.

Jemal I, H Geremew, M Sime and N Kebede.2008. East Shewa Zone Seed system survey report. *In*: Bedru Beshir, Abebe Mijena, Sherif Aliy and Gurmessa Umeta eds. East Shewa Zone Research Extension Advisory council 12th Regular meeting Research and development activity report. Amharic (Unpublished)

Langyintuo AS, W Mwangi, A Diallo, O. MacRobert, J, Dixon, M Bänziger.2010. Challenges of the maize seed industry in eastern and southern Africa: A compelling case for private–public intervention to promote growth. Schemes: lessons learnt. *In:* Thijssen, MH Z Bishaw, A Beshir and WS de Boef (eds.). Farmers, seeds and varieties: supporting informal seed supply in Ethiopia. Wageningen, Wageningen International. 348 p.

SahluY, B Simane B and Z Bishaw.2008. The farmer based seed production and marketing

Tripp R.1998. New Seed and Old Laws. Regulatory Reform and the Diversification of National Seed Systems. Intermediate Technology Publications, London.