PROSPECT AND PROFITABILITY OF FARMERS BASED COMMON BEAN SEED MULTIPLICATION IN ETHIOPIA: THE CASE OF SOUTHERN RIFT VALLEY

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Dedication

To my sister Hana Endale and my brothers Samuel Endale, Natnael Endal and Nahom Endale

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Abbreviations

CIAT	Centro Internacional de Agricultura Tropical
CSA	Central Statistics Authority
ECX	Ethiopian Commodity Exchange
EIAR	Ethiopian Institution of Agricultural Research
ESE	Ethiopian Seed Enterprise
FBSPMS	Farmer-Based Seed Production and Marketing Scheme
GDP	Gross Domestic Product
HU	Haramaya University
IFPRI	International Food Policy Research Institution
MoARD	Ministry of Agriculture and Rural Development
MARC	Melkasa Agricultural Research Center
MVN	Multivariate Normal Distribution
NARS	National Agricultural Research System
NBE	National Bank of Ethiopia
NGO	Non-Governmental Organization
OLS	Ordinary Least Square
PABRA	Pan-African Bean Research Alliance
USD	United States Dollars
WIP	Wide Impact Program

Abstract

In Ethiopia, the level of multiplication and distribution of the common bean seed through the formal seed sector is limited. The formal sector is more devoted to wheat and maize seed production. In order to increase the supply of improved seed of the common bean, farmer-based seed multiplication was introduced among smallholder farmers in 2004. This intervention was implemented in collaboration with the NARS and CIAT. This study was therefore conducted with the specific objectives of determining the profitability of farmer-based seed multiplication for common beans; analyzing factors affecting choice of seed source by smallholder farmers, assessing the key determinants of farmers' decision to participate and also their decision on the volume of participation in form of the size of land allocated to the multiplication of common bean seed in Ethiopia. The study was conducted in the southern rift valley in six randomly selected *kebeles*. A total of 195 respondents were randomly selected using sampling weight technique. To determine profitability, gross margin analysis was used and the seed multiplication enterprise was found to be profitable. The enterprise was found to have a 56.57 percent profit margin. Factors affecting choice of seed source among smallholders were investigated using multivariate probit model. The study findings show that the different seed sources have a substitute relationship. The last objective on the factors affecting participation and volume of land allocated to seed multiplication, the Heckman two stage econometric model was used. The result shows that number of years in formal education, farm size, distance to district town and tarmac road, and extension contact affect participation in seed multiplication. Seed multipliers should sell their seed during planning period to enjoy premium price. Local level government must increase the number of cooperatives to increase the availability of farmers' based seed source to smallholder farmers.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Improved seed is a key input in crop production that enhances food security and economic development in developing countries (Crawford et al., 2003; World Bank, 2007). The majority of farmers in Ethiopia use low quality unimproved seed (Thijssen et al., 2008) that is often accessed through informal seed sources. According to Atilaw and Korbu (2011) only 3.5 percent of the cultivated land in Ethiopia is covered by improved seed. This makes the country the lowest improved seed user in Africa (Spielman, 2010).

Seed production and distribution in Ethiopia is normally executed through the formal and informal seed systems. The key difference between the two systems is that the formal seed system supplies improved seed varieties and is regulated and controlled by government. Conversely, the informal seed system has no written rules and regulations; uses own seed saved from previous production seasons and; it thrives through a network of informal social institutions that promotes gift exchange, borrowing and/or purchase from the local market (Rubyogo et al., 2011). The principal player in the formal seed system of Ethiopia is the Ethiopian Seed Enterprise (ESE), which is incapable of meeting the demand of improved seed in the country. In addition to the limited capacity of ESE and its allies, seed production is biased in favor of maize and wheat. Wheat and maize account for about 90 percent of all the total seed production (Atilaw and Korbu 2011), while common bean seed supply by ESE is only 21 percent of the demand by farmers (Habte et al, 2011). These statistics suggest that there is great potential to expand the supply of improved been seed in the country to satisfy the increasing demand.

A similar challenge has been observed in other African countries. Evidence from recent studies shows that with exception of maize and vegetables, smallholder farmers use informal seed systems in southern and eastern Africa (Rubyogo et al., 2007; Sperling and McGuire, 2010). This is true despite the importance of the common bean as a major source of export revenue and food particularly in Ethiopia[1]. Among all pulses exported by Ethiopia, the common bean generates the highest amount of foreign exchange estimated at 138 million dollars in 2009/10 (NBE 2010). The country is also the highest exporter of common bean in Africa (EIAR, 2012). A national survey conducted by the Central Statistics Agency (CSA) in 2010 shows that common beans producing smallholders consume 73.39 percent of their harvest and sell 13.29 percent, while the balance of 11.56 percent is saved as seed for the next production season.

The government owned formal seed enterprises face a number of challenges that constrain their ability to satisfy the demand for common bean seed in Ethiopia. For example, formal systems have difficulty accessing remote areas, they supply in big packs to minimize costs of packing, charge high prices and do not supply on time during sowing period, and thus fail to reach poor farmers majority of whom are women (Langyintuo et al., 2010; Rubyogo et al., 2007; Crowford E. et al., 2003; Katungi et al., 2011). Besides, poor management and government failure render the formal sector inefficient due to high transaction costs (Wiggines and Cromwell, 1995).

Before the farmers' based seed multiplication was introduced recently, most smallholders in Sub-Saharan Africa use the informal seed source for their seed need (Setimela et al; 2004).

[1] Like many legume crops, common beans provides ample amount of protein which provides an equivalent protein as animal meat. It also provides carbohydrates, soluble fiber, and mineral elements such as potassium, magnesium, and zinc, all of which are necessary for life. That is why it occupies an important place in human nutrition in East and Great Lakes Regions of Africa by improving the nutritional status of many low income populations (Admasu et al., 2006). In addition to its nutritional values, common bean also provides health benefits that range from a lower heart attack risk by the soluble fiber, energy to burn while stabilizing blood sugar, iron copper, and manganese that help with energy production, while the embedded antioxidants provide defenses in maintaining memory with thiamin (Vitamin B1) (Ferris and Kaganzi, 2008).

Farmers' based seed multiplication is an alternative means to avail seed for smallholders. Guei et al (2011) discussed that farmers based seed multiplication increases availability of improved rice seed significantly in Cameroon. The increase in quality rice seed together with good agronomic practices increases rice yield more than 4 folds in the same country (ibid). Community based seed multiplication is also found to be a profitable venture among Kenyan smallholders (Katungi et al; 2011). Welu (2015) pointed out that despite the importance of farmer based seed multiplication in the Ethiopia seed supply; smallholders don't participate in seed multiplication sufficiently.

Quality seed is virtually pure with a high germination percentage, free from diseases and disease organisms and with proper moisture content and weight (Biemond 2013). However, the presence of counterfeit seed suppliers in Africa made it difficult for stallholders to identify the attributes of quality seed confidently (Keyser 2013). Smallholders can only use their experience and naked eyes to identify the quality of the seed which made them vulnerable for complicated seed quality altering techniques. Most of the attributes of quality seed are expected to be found in formal seed system but Biemond (2013) argued that for self pollinating crops, the informal seed system can also maintain some of the qualities.

1.2 Statement of the problem

Both the formal and informal seed systems in Ethiopia face various limitations that undermine efficient seed production and distribution to farmers. The limitation of the formal seed sector emanates from the public good nature of the newly developed products, limited involvement of private actors in seed multiplication, and information asymmetry on the types of seed demanded by the smallholders and produced by the formal seed source (Spielman et al., 2011). The

informal seed source has a wider network of seed distribution but the quality of the seed is compromised or unknown (Atilaw and Korbu, 2011). The limited availability of the formal seed source and the wide network of the informal seed system force most smallholder farmers to access seed from the informal seed source.

The inefficiency of these two systems affected the productivity of common beans in the country. There is now need for intervention to increase the production and delivery of improved seed to smallholder farmers. Improved seed and particularly the common bean seed needs to be affordable and easily accessible to farm households in rural areas because of the importance of beans as a food and income source.

There are many active stakeholders and programs in Ethiopia that are engaged in seed production and delivery functions. The main ones include Pan-African Bean Research Alliance (PABRA) through their wider impact program (WIP), Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), and Farmer-Based Seed Production and Marketing Scheme (FBSPMS) (Habte et al., 2011; Buruchara et al., 2011; Sperling and cooper, 2003; Thijssen et al., 2008). Among the available options, farmers based common bean seed multiplication is becoming a major alternative seed source in southern Rift Valley of Ethiopia.

However, while this system has been shown to do well for crops such as sorghum (Sperling and McGuire 2010), there is limited information on its performance with respect to the common beans. A persistent gap exists between the demand and supply of common bean seed, which limits common bean productivity in the area to only 1.04 tons well below the potential of 2.7 tons per hectare (CSA, 2012). This is partly because the number of seed producers is limited and unable to meet the demand for common bean seed in the area. Moreover, most seed producers

source foundation seed from Melkasa Agricultural Research Center (MARC) and/or the Catholic missionary church at a subsidized price or for free. This raises the question of whether the current farmer-based seed multiplication system would be sustainable if farmers were to buy the foundation seed at competitive price.

In addition, smallholder farmers of common bean grain are at liberty to obtain seed from any of the three available seed sources, namely formal, informal, and farmers-based seed sources. But it is not clear what drives the choice of seed source in the study area. The type of relationship between the different seed sources, whether complimentary or substitutes, is also not well understood. Furthermore, it is not clear what motivates farmers to participate in seed multiplication and the proportion of land they allocate to seed multiplication.

This study was undertaken to fill these knowledge gaps through analysis of the profitability of common beans seed production; the preferred choice of common beans seed source by farmers in the study area; as well as the factors that influence farmer's decision to engage in seed production and the extent of this engagement.

1.3 Objectives of the study

The general objective of the study is to examine participation in farmer-based seed multiplication and its profitability in the southern rift valley of Ethiopia, as well as the drivers of choice of seed source among common beans' producers. The specific objectives are:

1. To determine the profitability of farmer-based common beans seed multiplication in comparison with grain production in southern rift valley of Ethiopia.
2. To determine the factors influencing farmer's decision to engage in seed multiplication and amount of land they allocate to multiplication in southern rift Valley.

3. To determine the factors affecting farm household's choice of common bean seed source in southern rift valley of Ethiopia.

1.4 Hypotheses

1. Farmer based seed multiplication is profitable.
2. The decision to participate in seed multiplication is positively influenced by participation in farmers' organizations.
3. The proportion of land allocated for seed multiplication is affected by distance to district town.
4. The choice of seed source is significantly affected by participation in organizations

1.5 Scope of the study

This study covers three districts of southern rift Valley of Ethiopia which includes Boset, Adami tulu jido kombolcha and Shalla. The reason why this area is chosen is because more than 56% of common bean in Ethiopia is produced in the southern rift Valley of Ethiopia. Product-wise, the study embraces all the three types of common bean, the "*white*", "*red*" and "*ranger types common bean*". Primary data on Household characteristics, market access, farm characteristics and profitability information on the common bean was gathered for the main production and marketing season of 2012/13 (June 2012- January 2013), but the secondary data gathered in the study goes back to 1960 when the Ethiopian seed enterprise was established.

1.6 Significance of the study

Access to and use of improved seed is one of the most important inputs in agricultural production. High prices and the related transaction costs of accessing improved seed tend to reduce their uptake and thus, productivity across farms. The introduction of farmer-based seed

multiplication is expected to avail improved seed to smallholders at affordable prices and thus increase the profitability and productivity of the common beans crop. This study is therefore important as it provides better understanding of the profitability of farmer-based seed multiplication, as well as the drivers of the decision to participate and the extent of participation in farmer-based seed multiplication.

The findings of this study will help common beans seed farmers by providing robust evidence on the profitability of famer-based seed multiplication and assist them to make informed decisions on whether or not to participate in seed multiplication. It will also help to highlight differences in the profitability of common beans seed multiplication relative to grain production. The study will also reveal the drivers of choice of seed source by beans producers from among the available three alternatives (formal, informal and farmer-based seed multiplication). This will help government and non-governmental organizations such as MARC and CIAT who are working with common beans seed to design seed delivery models for effective and efficient delivery of improved seed to smallholders. Additionally the information generated by this study will inform policy makers on how to improve the supply of common beans seed to farmers in the area as a means of increasing the profitability and productivity of the common beans sub-sector.

CHAPTER TWO

LITERATURE REVIEW

2.1 Seed system in Ethiopia

Seed system is a general concept that covers the practice of development, multiplication, processing, storage, distribution, and marketing of seed in the country (Loch and Boyce, 2003). It also involves various stakeholders, including the government office, regional office, farmers (large and small scale), Non-Governmental Organizations (NGOs), seed producers and distribution. The seed system in Ethiopia has different classifications; some authors categorize it as simple as formal verses informal (Atilaw and Korbu, 2011; Beshir, 2011). Others include farmer-based (community based) seed multiplication as another category (Habte, 2011). Below are the detailed descriptions of each seed system.

2.1.1 Formal Seed system

This seed system is called formal because it has greater involvement of the government. The main player in the formal seed system in Ethiopia is Ethiopian Seed Enterprise (ESE). Others are public sector agencies such as ministry of agriculture (MoA), regional seed enterprise, and national agricultural research system (Alemu et al., 2008). Most of these organizations have inter-dependent duties. While NARS and MoA play the role of variety development and certification; the ESE and regional seed enterprise engage in the mass production of seed. Other public sector players like cooperatives and unions play the role of distribution and sometimes mass multiplication. Legal institutions also participate significantly in ensuring quality control. There are other relevant regulatory bodies including intellectual property rights, seed standards,

variety release procedures and certification programs (Maredia et al., 1999). The figure below shows the link between the demand, supply and regulations of the formal seed system.

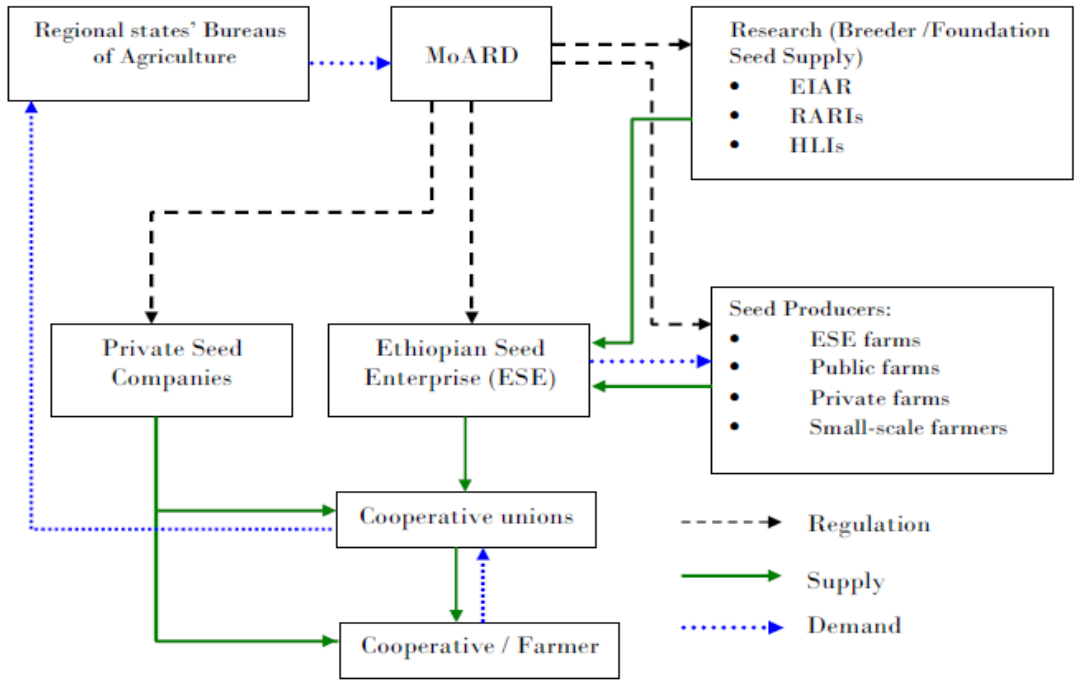

Fig 2.1 Formal seed system of Ethiopia

Source: Alemu et al., 2008

Generally the limitations of the formal seed system are grouped into three major categories. The first one is related with the *public good nature* of new varieties, which gives less credit to the breeder (Tripp 1995). The public good nature of the formal seed sector further contributes to the *limited involvement of private actors* in seed multiplication, distribution and marketing (FAO & ICRISAT. 2015). Finally the third category of constraints represents the problem of *information asymmetry* especially when only the seed producer has information about the availability of the seed, among other things, whereas the farmers have no information on the availability of the improved seed (Spielman et al., 2011). Additionally seed from formal seed source is usually expensive compared to informal and farmer based seed source (Melese et al., 2009).

2.1.2 Informal seed system

Basically this system does not have written rules and regulations and is mostly controlled by smallholder farmers. The system operates either by saving seed from previous production, borrowing seed from friends and relatives or buying seed from the local market (Rubyogo et al, 2011). This system accounts for 96.5% percent of all the seed used by farmers in every production season (Beshir, 2011; Habte et al., 2011, Atilaw, & Korbu, 2011). The informal seed system uses a wide range of exchange mechanisms, including the traditional approaches, which operate at the individual and community levels, and deals with small quantities of seed (Atilaw and Korbu, 2011).

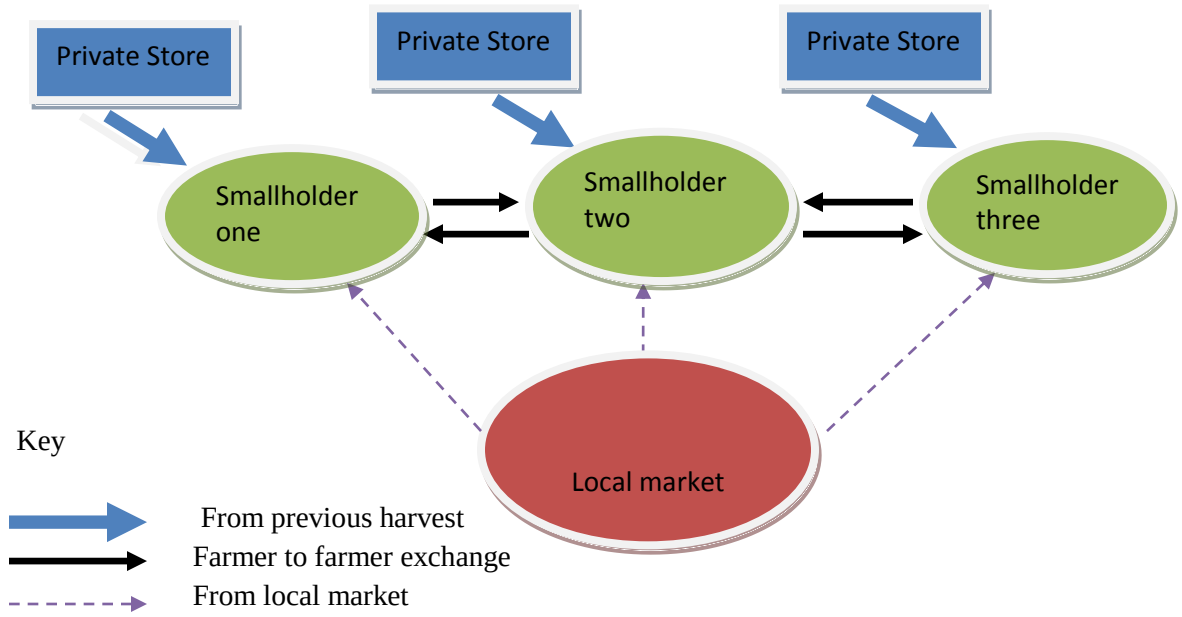

Figure 2.2 informal seed system of Ethiopia (Source: survey observation)

2.1.3 Why the informal system

More than 90% of the farmers in Ethiopia rely more on the informal sector for seed supply than the formal one. This is partly because the informal seed system is easy to access during the

planting season. It is cheap, convenient, reliable and sustainable, and trustable among farmers (Meles et al, 2009). The close relationships between farmers create trust that enhances the seed exchange mechanism (Atilaw and Korbu, 2011; Beshir, 2011).

Conversely the formal system has its own limitations which create frustration among the farmers that end up choosing to follow the ancient way of seed procurement. The limitations of the formal seed system likely compel smallholders to switch to the informal seed system. These range from the lack of proper linkage between different actors involved in seed systems, inadequate supply of good quality seed at affordable prices, focus on few crops (maize & wheat) while ignoring other crops, low level of private sector involvement in the formal system, inefficient seed promotion, poor distribution and marketing mechanisms, weak variety release and seed quality assurance system (Loch and Boyce 2003).

2.1.4 Farmer-based seed multiplication

Following the increasing demand and limited capacity of ESE to supply improved seed, the government, when in collaboration with CIAT, introduced the Farmer-based Seed Production and Marketing Scheme (FBSPMS) in order to narrow the gap between demand and supply of improved seed (Habte, et al, 2011). This system lies between the above mentioned formal and informal seed systems (Atilaw 2010). According to Thijssen et al, (2008) farmer-based seed multiplication and marketing implies farmers' ownership of the enterprise, and full responsibility in running the enterprise with a commercial intent. This definition of Farmer-based seed multiplication suggests that the system revolves around the farmers, yet in the southern rift valley, farmers play only the multiplication role because the selling and distribution is mostly done by MARC, Catholic missionary Church and cooperatives (Alemu, 2011).

The motive behind the development of this system is to increase availability, accessibility and affordability of improved varieties of seeds by capitalizing on the advantages and minimizing the limitations of the formal and informal seed systems. The advantage of formal seed system is developing improved seed which provides quality seed with early maturity, high yield and drought and disease resistance. Whereas the informal seed system has the advantage of well established distribution system over difference geographical locations and remote areas (Atilaw 2010). In the farmer-based seed system government organizations such as ESE, NARS, and research organizations such as MARC supply foundation seed of improved varieties to farmers involved in seed multiplication (Habte et al., 2011). These farmers then multiply quality declared seed for distribution and marketing to farmers of common bean grain.

However, the Farmer-based seed multiplication system, just like other seed systems, has its own limitations which include limited availability and affordability of inputs such as foundation seed, fertilizer and chemicals, low management experience, storage problem, and limited cash and market availability (Habte et al, 2011).

2.1.5 Comparison between seed systems

Formal seed system is knowledge and technology intensive and has a high degree of specialization. This system undertakes breeding with intent of developing a distinct, uniform and stable variety. Unlike the informal seed system this system takes advantage of *Heterosis*[2] and increase the size, growth rate, fertility, and yield of varieties (Kerstin et al., 2014). Seed from formal seed source reduce the risk of diseases transmission, guarantee a reliable germination,

[2] The increase in such characteristics as size, growth rate, fertility, and yield of a hybrid organism over those of its parents is called heterosis. Plant and animal breeders exploit heterosis by mating two different pure-bred lines that have certain desirable traits. The first-generation offspring generally show, in greater measure, the desired characteristics of both parents. This vigour decreases in the second generation and if the hybrids are mated together

seed purity and uniformity (FAO 2004; Kerstin et al, 2014). On the other hand seed from formal seed source are expensive and are not available in adequate amount (Loch and Boyce 2003). Smallholder farmers who are using informal seed system have few opportunities to benefit from decades of crop improvement that took place around the world in the formal seed system (Kerstin et al, 2014). Varieties which are being circulated in the informal seed source give low yield, mature late and are susceptible to moisture stress, drought, pests and disease (Meles et al, 2009; Beshir, 2011). In contrary to the formal seed source, the informal seed source offers a cheaper price, wider network of distribution and is reliable by smallholders (Meles et al, 2009). Farmer-based seed system is established to help smallholders by taking the advantages of the formal and informal seed system. The formal-seed system has good quality seed and the informal seed system has the ability to access smallholders and can easily avail seed in relatively cheaper price when the smallholders need it the most (Atilaw, 2010). Therefore farmer-based seed source circulates quality seed among smallholders using a network that can easily access farmers who are deprived by the formal sector. The decentralized structure of the system allows farmers to deliver seed to different places in the country by involving farmer's union, cooperatives, peasant association and NGOs. The price of seed from this source is cheaper compared to formal seed source because seed multipliers are supported by research organizations and NGOs.

2.2 Seed demand and supply

Seed supply is defined as the availability of quality seed that satisfies the farmer's interest at affordable price in sufficient amount at the right time (Loch and Boyce, 2003). The supply of common bean seed is limited partly because ESE, the main supplier of improved seed, has given less attention for legume crops including common beans. Currently, the NARS and ESE multiply

only three of the 21 different varieties introduced by CIAT and account for only 2 percent of the total common bean seed distribution in Ethiopia (Rubyogo et al., 2010). Among the East and Southern African countries receiving seed from PABRA, Ethiopia received the least amount (12 tons) in 2003-05 (Rubyogo et al., 2010) a proportion that shows how the country is not exploiting the opportunity provided by non-governmental organization. Overall the supply of common beans by the formal seed system in Ethiopia is poor.

From the demand side, it is evident that the higher the demand for common bean grain, the higher the demand for common bean seed. Figure 2.3 below shows an increase in common beans production over time in Ethiopia. The world demand for common bean is also increasing over time. For example, common bean importers increased their yearly import from 2.00 Mt in 1990 to 3.5Mt in 2003 (FAOSTAT 2014). Ethiopia is world's 6th and Africa's largest common bean exporter. With 73.39 percent of common beans being consumed within the country (CSA 2010) and an increasing population, home consumption of common beans is also important. These scenarios motivate producers to seek for improved seed to enable them to participate both in the export and local markets.

Evidence shows a mis-match between the demand and supply of certified seed. Ever since ESE was established, the demand for improved varieties of seed is growing. In 2007, the average seed demand was estimated to be around 400,000 tones, while the Ethiopian seed enterprise was able to provide only 20,000 tones (Marja et al., 2008). Similarly the largest ever supply of common bean seed by ESE is estimated at 22.38 tones country wide (Spielman et al., 2011). On average, it takes 12 kg to plant an acre of common beans field. The provided improved common bean seed can only cover 1865 acres of land. Recently several researchers proposed the promotion of

farmer-based seed multiplication in order to narrow the gap between the demand and supply of improved seed.

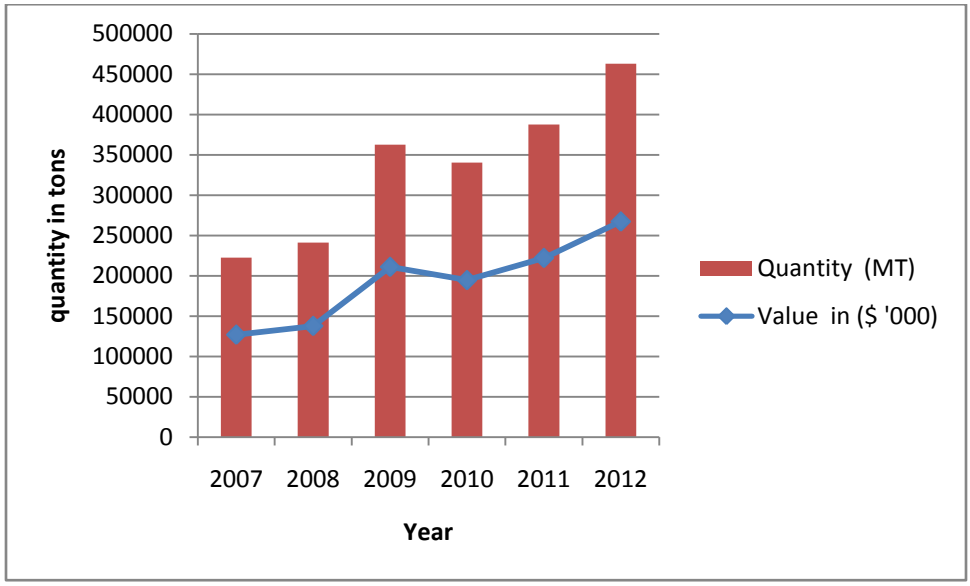

Fig. 2.3 common beans production trend in Ethiopia (Source faostat 2015)

2.3 Types of common bean in Southern rift valley

The scientific name *Phaseolus vulgaris* refers to Common bean or haricot bean by different scholars (Rubyogo, et al., 2007; Admasu et al., 2006; Frehiwot 2010; Ferris and Kaganzi, 2008). In Ethiopia, common bean has three different varieties namely *white*, *red* and *speckled* (ranger as the locals call it). Out of these three, the red and white are commercially demanded and are produced in large amount. About 56 percent of common bean production in Ethiopia takes place in the rift valley. White common bean production is mainly in the Southern rift valley, just North of Lake Zeway, while production of the red one is concentrated South of the lake (Frehiwot, 2010). The famous types of red common bean in the country are Melka, Welaita and Nasir; and for the white common bean it is Awash one, Awash Melka and Mexican 142. The principal producers of the white common bean in Ethiopia are smallholder farmers and most of their

production is for sale both in the local and export market but they consume much of the red type (NBE, 2008).

Fig 2.4 types of common bean (*Adopted from Frehiwot 2010*)

2.4 Economic importance of common bean

Common bean is produced in Ethiopia both for consumption and income generation. It is a key food item in Ethiopia, where it is used to make Ethiopian staple food "shiro wot" (stew). It can also be boiled and eaten with other cereals in different parts of the country. According to recent statistics of the national survey by CSA (2010), common beans producing smallholders consume about 73.39 percent of their harvest, sell 13.29 percent and use the rest as seed (11.56 percent).

Besides consumption, common bean brings hard currency in to the country. It is the most exported legume among all the pulses exported by Ethiopia. Statistics indicate that export of common bean generated 138 million dollars in 2009/10 (NBE 2011). Oromia and SNNP regional states are the top two common beans producing regions in Ethiopia; producing 37.8% and 32% of the common beans in the country respectively (Ferris and Kaganzi, 2008).

In Ethiopia, more than 2 million households are engaged in common bean production. In total, about 244,012.88ha of land is allocated to common beans production every year which is estimated to be 362,890.3 tons (CSA, 2010). Common beans are fast maturing and can easily adapt to different types of agro-ecological zones, which makes it a preferable crop by farmers (National bean research project, 2011). The fast maturing characteristics of the crop enables farmers to use the revenue from the sales of common bean for different household needs (ibid).

2.5 Production system of common bean

In Ethiopia common bean is either cultivated in pure cropping or intercropping system. Most of the smallholders intercrop common bean with different crops, unless production is for export market (Frehiwot, 2010). There are two main production seasons in the country, Meher (Kiremt) which lasts for three months from July to September and Belg which also lasts for three months from March to May. In many cases, the rain of Belg is less reliable and this compels smallholders to mostly rely on the second season Meher (Ferris and Kaganzi, 2008). Beans production is highly constrained by environmental stress factors such as: drought, pests, diseases, and low input farming methods that are blamed for declining soil fertility and productivity. However for smallholder producers, the biggest challenge is the quality of seed, and other inputs such as pesticides and fertilizers (Rubyogo et al., 2011).

Different governmental and non-governmental organizations have been actively involved in breeding and creating different seed multiplication and delivery models in Ethiopia. It is argued that the low level of involvement of private sectors in distribution of agricultural inputs including improved seed limits their supply (Spielman et al., 2011). No doubt, the government of Ethiopia is failing to meet the required quality and quantity of seed for various key crops except maize and wheat. At the same time, the cost of government operations in seed distribution symbolizes inefficiency especially when compared to private operators.

Promotion of farmer-based seed multiplication is based on the need to address the inefficiency in common bean seed production and distribution in Ethiopia.

2.6 Measure of profitability

The wider meaning of Profitability is a return to the invested resource (Emery *et al*., 1987). Profitability is also defined as the reminder of gross revenue after all the costs and expenses are deducted (Kohls and Uhl; 2002; Hardesty and Leff, 2009). Therefore profit is a return given to an investor as a motivation for his/her investment and risk. The common methods of compute profitability are gross margin analysis (Katungi et al; 2011, Nkwasibwe, 2014) and partial measure to compute the return per unit of input (Kibet e*t al*; 2011). The limitation of the partial measure is not considering the diminishing return to scale of different inputs. The reason why scholars adopt the partial analysis is because illiterate farmers can easily interpret the output (Kibet e*t al*; 2011).

Gross margin analysis is computed as the difference between gross revenue and variable cost. Katungi (et al; 2011) used gross margin analysis to determine the profitability of common beans seed multiplication in Kenya. During her analysis land was excluded from the variable cost

because it was considered a fixed cost. Similarly, Nkwasibwe (2014) adopted gross margin analysis by assuming that all the fixed inputs were not treated as inputs. This shows that there is a trend of assuming land is fixed among farmers. The assumption undermines the scenario where farmers rent land for production and the rental price can be different.

2.7 Measure of participation and level of participation

A number of scholars use different models of analyzing factors affecting participation and level of participation. Zambrano and Muselli (2007) analyzed female labor force participation in by using a binary model of both logit and probit model. Others also used the same procedure to analyze participation in higher education. The studies didn't show interest to analyze the level or intensity of participation in both cases. Another alternative analysis is tobit model which considers both participation and level of participation used in many cases. Tobit model is adopted by most marketing studies to capture participation and volume of sales in a particular market (Bellemare and Barrett, 2006; Boniphace et al., 2014). This specification is however flawed because it can't reflect the fact that intensity depends on decision to participate, which justifies the need to control for the selection bias (Heckman 1979).

The alternative model to analyze participation and level of participation simultaneously is Heckman two stage model (Heckman 1979). The advantage this model has over the previous ones is it creates a selectivity term called inverse mills ratio or lambda (λ) which helps avoid sample selection bias in the model (Takele, 2010). Sebatta (et al., 2014) used Heckman two stage model to analyze farmers decision of participation and level of participation in potato market in Uganda. Whereas Wiredu (et al., 2012) measured participation on mini-sett technology by yam producers by the proportion of land they allocate in Ghana. Similarly participation of farming

activity can also be measured by the amount of land allocated by the household head (ibid). Other studies which use Heckman model are (Balagtas et al., 2007; Chirwa, 2012; Abafita et al., 2016).

2.8 Analysis of choice

Smallholders can make a mutually exclusive or simultaneous choice to maximize their utility (Athey and Imbens, 2007). Different studies have used various empirical methods to analyze the determinants of choice for different scenarios such as climate change adaptation strategy choice and market channels choice. Most commonly used analytical approaches include discrete choice regression models like the binary probit or logit (Acquah de Graft and Onumah, 2011; Fosu-Mensah *et al*., 2010) and multinomial probit or logit (Deressa *et al*., 2008; ACCCA, 2010; Aemro *et al*., 2012). A shortcoming of most of the previous studies on choice is that they do not consider the possible inter-relationships between the various strategies/choices (Haji and Sani, 2014). These studies mask the reality faced by decision makers who are often faced with alternatives that may be chosen simultaneously and/or sequentially as complements, substitutes or supplements (Haji and Sani, 2014).

Recent studies showed that farmers are faced with multiple combinations of choices to maximize their expected utility (Marenya and Barrett, 2007). Therefore the choice decision is inherently multivariate. Attempt to explore the relationship using univariate modeling can cause exclusion of useful information about the correlation among seed source choices which may be compliments and substitutes (Teklewoldet al., 2013, Haji and Sani, 2014).

CHAPTER THREE

METHODOLOGY

3.1 Description of the study area

Southern rift valley is located in Oromia region, Ethiopia. The central and rift valley province contributes more than 50% of the total common beans production in the country (Lemu 2016, Laike et al, 2006, Frehiwot 2010). The southern rift valley region has a total of 12 districts. The major three crops in the area are Maize, common beans and vegetables ordered by volume of production. This study covers three Districts in Southern rift valley namely; Boset, Adami tulu Jido Kombolcha, and Shalla District. Boset woreda is devided in to 8 *kebeles* and has a total of 34,888. Adami Tulu Jido Kombolcha district has a total of 9 *kebeles* with a total population of 26,582 whereas Shala district has 8 *kebeles* and 21,598 population size. The districts are important producers and suppliers of the three types of common bean; red, white and *ranger*. All the districts are located between 1500 and 2300 altitude. The annual average rainfall of the area ranges between 90 and 1990mm in the two rainy seasons, *meher* (the smallest) and *kiremt* (the largest). The dominant climate in the area falls between the two categories of tropical and sub-tropical agro-climate zones.

3.2 Sampling technique and sample size

A sample of 195 respondents (1.45 percent of the total households) was randomly selected using the probability sampling technique. First, three districts were randomly selected from the total of 12 districts of southern rift valley. Two *kebeles* (the smallest administrative unit in Ethiopia) were then randomly selected from each district making a total of 6 randomly selected *kebeles*. From each *kebele*, both seed multiplying and grain producing respondents were selected using

systematic random sampling and sampling weights that are proportional to the population size of each *kebele*. The procedure of selecting respondents from each *kebele* was done by taking the list of each *kebele's* household head and finding the interval by dividing the population size with the sample size. A randomly selected number within the interval was used to come up with all the sampled respondents from each *kebele*. The same procedure was carried out six times for each kebele. Based on this approach, one respondent represented 426 households. The detail of the sample is summarized in Table 3.1.

Table 3.1 Sample size and its distribution among the *kebeles*

Kebele	**No. of Households**	**n**	**Percentage**
Sara and areda	150	14	7.18
Kechachule	364	34	17.44
Horfallole	550	54	27.69
Ananoshisho	250	24	12.31
Awaragama	559	53	27.18
Tukalangano	161	16	8.21
Total	2034	195	100

3.3 Source of data and method of data collection

Primary and secondary data were collected and analyzed. Primary data such as demographic and seed source choice data were collected from the seed and grain producing farmers. Secondary data on genesis of seed system, population distribution and background information on the study area were collected from several secondary data source including Oromiya regional state official website, respective district offices, Ethiopian seed enterprise, Central Statistics Agency, MARC, CIAT and several journal articles.

A semi-structured questionnaire was used as the principal means of primary data collection. The questioner was pretested in the tree different districts to retain the relevant variables and drop the inapplicable ones. In order to compliment the primary data, secondary data were gathered from government organizations (e.g. EIAR, MARC) non-governmental organizations (e.g. CIAT) and

from different publications. Additionally Focus Group Discussions (FGD) and personal observation were used. Taking into consideration the limited literacy of the rural households, enumerators were trained and hired to help the respondents to fill the questionnaire. Data entry and cleaning was done using SPSS statistical software.

In each district one focus group discussion (FGD) was conducted making a total of three FGD. The number of participants in each district was ten, three female and seven male. The number of male participants is higher than the female ones because of the dominancy of men on common bean farming over women in the study area. In *Shalla* district the number of female participant was only two and was replace with another male participant. Participants were given the focus group discussion before hand and they participated willingly. Each discussion took 50 minutes on average. A standard FDG guide (Kitzinger, 1995) was used to guide the questions and the procedure during the discussion.

3.4 Method of data analysis

Data was analyzed using simple descriptive statistics such as mean, percentage and frequencies, in order to describe source of seed and its users, characterize seed producers based on their demographic, social, and technology specific feature. Comparisons were made based on t-test for continuous variables and chi-square test for discrete variables. Gross Margin analysis was used to calculate the profitability of seed production, which is essential in understanding whether farmer-based seed system can be promoted as a profitable and therefore sustainable business as well as its prospect for growth. Econometric analysis was then applied to provide insights into factors that influence choice of seed source, the decision to participate in seed multiplication, and the intensity of participation measure in the amount of land allocated for seed multiplication.

3.4.1Gross margin analysis

Gross margin analysis was used to analyze the profitability of farmer-based common bean seed multiplication. Average revenue and average cost of engaging in seed multiplication were determined. The average total revenue was computed by adding up two principal sources of revenue in seed multiplication business. These are the revenue from sales of seed and the revenue from common bean seed residue that is either used to feed animals or sold out, although this is done to small extent. In the scenario where any of these two products were not actually sold, the average market value was used.

The average variable cost was computed by adding up all the variable costs including rental cost of land. The variable costs include those for seed, fertilizer (UREA and/or DAP), labor (paid and/or unpaid), anti-pest, cost of storage, cost of transport and rental cost of land. The cost of the inputs was converted to USD equivalent. In the case of unpaid labor the average value of paid labor in the specific *kebele* was used. Finally the total variable cost was divided to the number of seed producers to come up with average variable cost. The average gross margin was then computed by taking the difference between the average total revenue and average variable cost (equation 1). The same procedure was applied to compute the profitability of common beans grain in the study area. Katungi (et al; 2011) used gross margin analysis to determine the profitability of common beans seed multiplication in Kenya.

$$AGM = ATR - AVC \quad \text{..... (1)}$$

Where

AGM = Average gross margin in USD

ATR = Average total revenue in USD

AVC = Average variable cost in USD

And

$$PM = \frac{AGM}{ATR} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2)$$

Where

PM = Profit Margin

AGM = Average gross margin

ATR = Average total revenue

Table 3.2 list of variable cost with their unit of measurement

Description of the cost	unit of measure
land	Hectare
seed	k.g
UREA	k.g
DAP	k.g
paid labor	Adult equivalent
unpaid labor	Adult equivalent
anti-pest	Litters
storage	USD
transport person	USD
transport crop	USD

3.4.2 Econometric analysis

The choice of the econometric approach was dictated by the nature of the dependent variables in the analysis. A two-step Heckman procedure was used to analyze the probability of participation in seed multiplication in the first step and intensity of participation in the second step. To examine factors affecting choice of seed source and the relationship between seed sources, a multivariate probit model was used. Data was entered in the template using SPSS statistical software. The same software was used to conduct descriptive analysis. All the econometric

analysis including multivariate probit and two-stage Heckman model were conducted using STATA.

There are different possibilities to analyze the decision by a household to participate in seed multiplication as well as the intensity of participation measured by size of land allocated. The easiest way is to separately analyze the data using binary model and censored model for participation and volume of participation, respectively. This specification is however flawed because it can't reflect the fact that intensity depends on decision to participate, which justifies the need to control for the selection bias (Heckman 1979). The appropriate model to overcome selection bias is Heckman two stage model (Ibid). This method assumes the decisions to participate in seed multiplication and size of land allocated for seed multiplication are made simultaneously (implying that the error terms of the two equations are correlated). The error terms, *u* and *e*, are assumed to be bivariate, normally distributed with correlation coefficient, ρ (Hellin et al, 2010). Sebatta (et al., 2014) used Heckman two stage model to analyze farmers decision of participation and level of participation in potato market in Uganda.

The Heckman two step model exclude respondents with zero land allocated to seed multiplication in its second-stage of the analysis. Once a household chooses to participate in seed multiplication, it is automatically assumed that he/she should allocate a proportion of land greater than zero (L) > 0, meaning that the data is truncated to eliminate households that are allocating zero land to seed multiplication.

Basically this model helps to capture factors that affect both the participation and size of land allocated to common bean seed multiplication. First a standard probit model is used to examine the factors affecting farmers' decision to participate in seed multiplication. The second-step

follows with the purpose of identifying factors affecting the size of land allocated to seed multiplication. Therefore, to identify factors affecting the proportion of land allocated to seed multiplication, ordinary least square (OLS) model is used by including an inverse Mill's ratio (λ) as an additional independent variable to estimate selection bias. Both of the steps are specified below:

First step

$y_1^* = x_1'\beta_1 + u_1$ ..... (3)

$y = 1\ if\ y^* > 0, 0$ otherwise

where

y_1^* = the decision to participate or not in farmers based seed production.

x_1' = is a vector of explanatory variables that determine the decision to participate

β_1 = is a vector of unknown parameters

u_1 = is the residuals which is $N(0, \delta)$

Second step

$y_2^* = x_2'\beta_2 + \alpha\lambda + u_2$ ..... (4)

Where

y_2^* = is the dependent variable which is the size of land allocated in 2012/13

x_2' = is a vector of explanatory variable that determine the size of land allocated in 2012/13

β = is a vector of unknown parameter

λ = Lambda, the inverse Mill's ratio

α = the coefficient of Lambda that shows the impact of participation on the proportion of land allocated for seed production.

u_2 = is the residuals which is $N(0, \delta)$

The inverse Mill's ratio (λ) is simply a ratio of the probability density function over the cumulative distribution function of a distribution. The reason why we are including the inverse Mills ratio (λ) is to make sure that the error term has zero expectation (Hellin. et al 2010). In this case y_2^* will be observed if and only if $y_1^* > 1$, otherwise it will be considered as unobserved variable.

Evidence from previous surveys indicates that farmers use different seed sources during the cropping season because of the risk associated with formal seed systems. Additionally, farmers in Ethiopia produce three different types of common bean; red, white and *ranger* types. A producer might get one type of seed from one seed source and the others from another source in one production season. If it was known that a farmer exclusively chooses only one of the three sources, it would have been possible to adopt the multinomial logistic mode. But there is no guarantee for a unique seed source choice but rather a portfolio of options. Farmers are likely to simultaneously choose more than one source shows that multivariate probi model allows the estimation of this situation.

The attempt to explore the relationship using univariate modeling can cause exclusion of useful information about the correlation among seed source choices which may be compliments and substitutes (Teklewold et al., 2013). The fact that farmers can choose one or more of the three available seed sources makes the multivariate probit model preferable over univariete modeling because the former helps to analyze correlation between choices (Teklewold et al., 2013).

In the model, the dependent variable is a household choice *h* of one or more of the seed sources *i* which includes formal (*frm*), informal(*infrm*) or farmer-based seed multiplication (*farmer*) system. The model is therefore presented as:

$$y_{hi}^{*} = x_{hi}^{'}\beta_i + u_{hi} \ldots\ldots \text{ i= } \textit{formal, informal and farmer-based} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(5)}$$

$.y_{hi} = 1 \; if y_{hi}^{*} > 0 \; or \; 0 \; otherwise$

Where

y_{hi} = the dependent variable which is the choice of seed source *i* of household *h*

$x_{hi}^{'}$ = a vector of explanatory variable that determine the choice of seed source

β_i = is a vector of unknown parameter

u_{hi} = is the residual

The error term takes a multivariate normal distribution (MVN) with mean zero and a variance normalized to unity (u_{frm}, u_{infrm}, u_{famer}) ~ MVN(0, Ω). The diagonal of the matrix for all the covariance of the error terms is unity (one). Whereas the off-diagonal elements draws attention, that represents the unobserved stochastic relationship between choices of seed sources.

3.5 Definitions of variables and their expected effect on seed source choice

The dependent and independent variables used under the multivariate probit model are explained in this section. The model is specified as:

$y_i = \alpha + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \beta_6x_6 + \beta_7x_7 + \beta_8x_8 + \beta_9x_9 + \beta_{10}x_{10} + \beta_{11}x_{11} + \beta_{12}x_{12} + \beta_{13}x_{13} + \mu$ ………………………………………………………………………………………… (6)

Where

Y = choice of seed source from the available three seed sources (formal, informal and farmer based)
X_1 = Sex of the household head
X_2 = Age of the the household head
X_3 = Formal education of the household head
X_4 = Family size
X_5 = Participation in seed multiplication
X_6 = Livestock holding of the household
X_7 = Farm size of the household
X_8 = Participation in farmers organizations
X_9 = Extension contact
X_{10} = Access to credit
X_{11} = Distance to district town
X_{12} = Off-farm income
X_{13} = Price

The dependent variable in this analysis is smallholders' choice of seed source. This variable is defined by the type of seed source the smallholder used in 2012/13 production period. Respondents are at liberty to choose one, two or three out of the available seed sources (formal, informal and farmers based).

Sex is a dummy variable taking 1 if male and zero otherwise. A study by Kerstin et al, (2014) found that informal seed system is mostly operated by women in developing countries. That means female headed smallholders are more likely to access seed from informal seed source.

Age is continuous variable measured in years. Older farmers have grater experience with the traditional farming practices including accessing the seed from informal seed source and thus age is expected to be directly correlated with use of informal seed source.

Formal education is a continuous variable measured in years within the range of 0-15 years, zero being uneducated and 15 years most educated (completed college). More

educated farmers are believed to have a better access to information (Hailemariam *et al.*, 2006) and the information is expected to give smallholders a robust understanding about the importance of using improved common beans seed to enhance productivity and return. Since improved seed is accessed through formal and farmer-based channels, education is expected to be positively related with the two seed sources.

Family size is a continuous variable computed by summing up the number of family members based on their adult equivalent. Because it is believed that seed multiplication demands a lot of labor, a household with a higher adult equivalent is more likely to participate in seed multiplication and therefore access beans seed for grain production from farmers based seed multiplication seed source.

Livestock units are measured by converting the entire livestock holding in to tropical livestock unit (TLU) and adding them up. It is believed that livestock is a source of income for households, which increase ability to acquire seed from formal seed source which is more costly but at the same time the more rewarding. Therefore households with more TLUs are more likely to access seed from formal seed source. Tahirou (et al., 2009) pointed out that the high price of formal seed source attracts the wealthier smallholders compared to the worse off. In another study Langyintuo and Mungoma (2006) discussed that smallholder farmers passes the opportunity of using better agricultural input because of lack of finance.

The land endowment of a household is continuous variable measured in hectares. Households with more land are more likely to participate in common bean seed multiplication (which takes land from production for household consumption) and therefore more likely access seed from same source (farmer-based seed source).

Participation of household head in organization is a dummy variable taking one if the household head is participating in organizations such as cooperatives and farmer union and zero otherwise. Cooperatives and farmer unions are the main distributers of seed from the farmer-based seed multiplication channel (Alemu et al, 2011). Therefore group members are expected to have higher likelihood of accessing seed from farmer-based seed sources in the form of unions and cooperatives.

Extension visit to households is a dummy variable taking one if a household received extension visit in the year 2012/13 or zero otherwise. If farmers are visited by extension workers they tend to understand and appreciate the importance of using quality seed and thus they are more likely to access seed either from formal or farmer-based seed source or both.

Access to credit is a dummy variable equal to one if the respondent had access to credit from different financial sources including NGOs and credit institutions and zero otherwise. Additional financial sources enable farmers to access formal seed source, which is mostly located far and is more costly. Therefore access to credit increases the probability of using formal seed source. Reyes (et al., 2012) discussed that access to credit increase crop productivity by enhancing the capacity to access agricultural input including improved seed.

Distance of the household to the district town is a continuous variable measures the distance between household's home and the district town of that specific *kebele*. Because most of formal seed sources are located in big towns and cities, it is expected that the nearer a household is to the district town, the more likely it is for that household to use formal seed source. A study by Kamara (2004) showed closer distance to township increases access to market which further increases productivity and intensification.

Price is a continuous variable measuring the price charged by seed sellers. Price is a very sensitive factor which can cause change in farmer's choice of source of seed. Thus lower price seed sources are more likely to be chosen than higher- price sources by smallholder farmers. Recent studies showed that improved agricultural inputs including seed are becoming expensive (Bunde et al., 2014).

3.6 definitions of variables and their effect on participation and level of participation in seed multiplication

The dependent and independent variables used in Heckman two stages model are discussed below. The imperial model is specified as:

$$Y_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \beta_{14} x_{14} + \mu \quad (7)$$

Where:

y = participation and level of participation in seed multiplication
x_1 = sex of the household head
x_2 = age of the household head
x_3 = formal education of the household head
x_4 = family size
x_5 = farm size of the household
x_6 = livestock holding of the household
x_7 = extension contact
x_8 = agricultural equipment
x_9 = participation in farmers organizations
x_{10} = credit access
x_{11} = off-farm income
x_{12} = distance to district town
x_{13} = agricultural input use

x_{14} = distance to tarmac road

In the first stage the dependent variable is a dummy variable of whether or not the household participated in seed multiplication; taking on a value of one if participating and zero otherwise. In the second stage the dependent variable is a continuous variable measured in terms of the volume of land allocated to common bean seed multiplication. The independent variables are discussed as follows. The same variables are used both in the first and second stage except extension contact which was used only in the first stage. The reason why extension visit is dropped from the amount of land allocated to seed multiplication second-stage model specification is that extension visit may to a large extent increase the much required level of awareness, whose effect is on influencing the question of whether or not to participate in seed multiplication than is the case with the question of how much land to allocate to seed multiplication.

Sex is a dummy variable taking on a value of one if the household head is male and zero otherwise. Male headed households are expected to participate more in seed multiplication than female headed ones because male household heads have better information access and resource endowment than their female counter parts which likely affects participation in seed multiplication. A study in Ghana showed that women participated in new technologies because of limited access to land and production input (Morris and Doss 1999).

Age of the household head is continuous variable. With age comes experience and exposure to different trainings and even learning from others. All this exposure is expected to create awareness about the importance of farmer-based seed multiplication or lack of it which in turn affects the likelihood of participation and land allocation to seed multiplication.

Level of Formal education of the household is continuous variable ranging from zero to fifteen, zero being uneducated and fifteen being college. Since education make household heads more assertive and dynamic in the way they conduct their economic activities (Salim 1986), more educated farmers will have the ability to analyze the profitability of farmer based common bean seed multiplication, which affects participation and land allocation to bean seed multiplication.

Family size is a continuous variable measuring household labor endowment estimator by converting each household member in to adult equivalent and adding them up together. Common bean seed multiplication is labor demanding activity; therefore it is more likely for a household with larger family size to participate in common bean seed multiplication and allocate more land to it. Aymone (2009) discussed that larger family size is likely to take up labor intensive technologies.

Livestock holding is continuous variable which measures the number of total livestock owned by the household converting into tropical livestock unit (TLU). Livestock is both a source of income and draught power which is the basic inputs of common bean seed multiplication. As a result, households with a large number of livestock are more likely to participate in common bean seed multiplication and allocate more of land.

The total number of agricultural equipments is a continuous variable computed by adding the quantity of six different farming equipments which are believed to be common in every household of the study area. These equipments are wheal cart, sickle, axe, hoe, knapsack sprayer and water carrier. Agricultural equipments reflect the ability of farmers to undertake and complete agricultural activities. Therefore smallholders with larger number of agricultural equipments are more likely to participate in seed multiplication and allocate more land to the activity.

This is a continuous variable measuring the total size of land holding by household. Farmers with more land have a higher ability to try out new activities such as seed multiplication with limited risk (Shiyani et al., 2000). Therefore it is hypothesized that farmers with large size of land are more likely to participate in common bean seed multiplication and allocate more land.

Participation in organizations is a dummy variable taking a value of one if the household head participates in local organizations such as cooperatives, seed multiplication group, farmer associations; and zero otherwise. Participation in organizations generates knowhow about seed multiplication, improves access to inputs and to the marketing chain. Therefore household heads participating in organization are more likely to participate in common bean seed multiplication and allocate more land to this activity.

Extension visit to households is a dummy variable taking a value of one if a household was visited by extension worker and zero otherwise. One of the main mandates of agricultural extension is to introduce new technologies and practices to smallholder farmers. Since farmer-based seed multiplication is a newly introduced approach aimed at increasing seed access to smallholders, extension workers are more likely to promote it among smallholders. Therefore visits by extension workers likely encourage participation in common bean seed multiplication. Extension visit is not included in the second stage of Heckman model because it is believed that the extension workers will only motivate farmers to participate but the amount of land allocated for seed multiplication will depend on other factors.

Access to credit is a dummy variable taking a value of one if there is access to credit by the household and zero otherwise. Because some of the inputs into common bean seed multiplication especially land and labor require some large amount of cash, access to credit likely encourages

households to participate in seed multiplication and allocate more land to common bean seed multiplication.

Off-farm income is a dummy variable taking a value of one if a household head participates in off-farm activity and zero otherwise. Having off-farm income has ambiguous effects on seed multiplication. A household head who is involved in off-farm income is going to be occupied by the activities and won't have time to allocate to seed multiplication. The other reason is that the same household is probably generating significant amount of money from the off-farm activity and he/she might not be interested in seed multiplication business. On the other hand, a farmer who is participating in off-farm activity might decide to invest the income from the off-farm activity into seed multiplication and might end up participating in seed multiplication and allocate more land to it. Therefore the effect of off-farm income towards participation in seed multiplication and amount of land allocated for it can either be positive or negative.

Distance of the household to the district town is a continuous variable measuring the distance between household's home and the district town. Most of agricultural input dealers are located in townships including the two sources of foundation seed (Melkasa agricultural research center and Catholic missionary church). Therefore smallholders who are located close to district towns are more likely to access the inputs relatively easily and participate in seed multiplication and allocate more land.

Distance of the household to the nearest tarmac road is a continuous variable measuring the distance between household's home and the nearest tarmac road. The rental cost of land increases as land gets closer to road side; making it more expensive to rent such land for seed multiplication. Additionally those smallholders who own land around tarmac road might chose to rent out their land for other commercial activities than use it to seed multiplication. Therefore

distance to tarmac road is expected to have a positive correlation with participation and level of participation in seed multiplication. Jacoby (2000) discussed the importance of access to road for smallholders to access improved seed and sell their products.

CHAPTER FOUR

RESULTS AND DISCUSSION

This section presents results from descriptive and econometric analysis conducted in this study. The first part of the chapter presents results of descriptive statistics of all the variables of interest in the data analysis and findings from Focus Group Discussion (FGD). The second part of the chapter discusses findings of level of profitability of common bean seed multiplication in relation to bean grain production. The third part of the chapter discusses factors affecting the decision to participate in seed multiplication and size of land allocated to seed multiplication. The fourth part presents econometric results of the determinants of the choice of seed source among all common bean producers.

4.1 Socio-economic characteristics of seed multipliers in comparison with grain producers

In this section the continuous variables are analyzed using a student t-test and the categorical variables are analyzed using chi-square test. The study is based on a total sample of 195 respondents. Out of which, 50 (25.64%) are common bean seed multipliers while the rest (145 (74.36%)) are beans grain producers. The average age for the entire sample is 38.37 years, but seed multipliers are significantly older than grain producers. The mean education level for all the respondents is 4.64 years and there is no evidence of significant difference between seed and grainproducers. The average family size in adult equivalent is 3.19, but the seed multipliers have a significantly higher family size than grain producers. The possible explanation is higher number of family size attracts participation in seed multiplication because of the abundant labor availability of the family.

About 97.43 percent of all respondents are engaged in farming, with the remaining proportion constituting a category of salaried employees in different organization. The major crops in the study area are maize (26.87%), common bean (23.83%), wheat (20.56), *teff* (15.13) and sorghum (13.60). The average endowment of livestock across farm households measured in tropical livestock unit (TLU) is 4.65. This TLU equivalent is computed based on FAO weights for sub-Saharan Africa Livestock species (Janhnke 1982).The mean TLUs owned by seed multipliers and grain producers are statistically different and estimated at 6.72 and 3.74TLU respectively. Large number of livestock holding benefits the household from draft power and source of finance which contributes for participating in seed multiplication positively. The average agricultural equipment holding is 10.94 for all the respondents. The mean endowment of agricultural equipment is found to be statistically and significantly different across seed multipliers and grain producers.

The measuring unit of land in the study area is "*qert*" which is equivalent to ¼ of a hectare. The average land holding of the respondents is 12.84 *qert* (3.21ha), but the seed multipliers have significantly larger average landholding than grain producers. Seed multipliers travel about smaller average distance to district town than grain producers and the mean difference is statistically significant. Similarly, the average distance to the nearest tarmac road for the entire sample is 9.19km and there is no evidence of significant difference between seed and grain producers on the average distance to the nearest tarmac road.

Production statistics in the study area also reveals that a total of 47,898.5kg of seed was multiplied in 2012/13 production season with each seed multiplier producing an average of 903.75kg seed. In the same line, the average total common bean grain production in the study area was 111,811.5kg, with the average production per grain producer estimated at 712.18kg.

While the average selling price of common beans seed and grain combined for the 2012/13 production year was $0.5, the average selling price of seed and grain in the same year was $0.58 and $0.48 respectively and the difference was statistically different.

Table 4.1 comparison of socio-economic characteristics of common beans seed multipliers and non-multipliers

Variable	Total sample (n=195)	Seed multipliers (n=50)	Grain producers (n=145)	t-value
Age (years)	38.4	41.1(1.5)	37.4(0.8)	-2.2**
Formal education (years)	4.6	5.0(0.4)	4.5(0.2)	-1.2
Family size (Adult equivalent)	3.2	3.7(0.2)	3.0(0.1)	-2.9***
Livestock (TLU)	4.7	6.7(1.3)	3.7(0.6)	-2.8***
Agricultural equipments	10.9	14.4(1.8)	9.7(0.5)	-3.6***
Land owned (Ha)	3.0	4.5(0.3)	2.5(0.2)	-6.2***
Distance to main district town (k.m)	28.6	19.2(2.9)	31.8(1.3)	4.4***
Distance to tarmac road (k.m)	9.2	2.8(0.6)	11.4(3.6)	1.4
Price (USD)	0.5	0.6(0.4)	0.5(0.4)	-3.2***

Numbers in parentheses are standard errors. The *, ** and *** are significant variables at 10, 5 and 1 percent level of significance respectively

There are 23 females (17 of them grain producers) and 172 male (129 of them grain producers) respondents in the sample. Out of the 195, about 175 respondents (42 of them seed multipliers) participate actively in organizations and social groups, including cooperatives and farmers unions. The level of participation in organizations is not significantly different between seed and grain multipliers. One third of the respondents (8 of them being seed multipliers) have access to off-farm income and this is significantly and statistically different between seed and grain producers.

Out of the entire sample, 59 households (30 seed multipliers) have access to credit and it differs significantly between seed and grain producers. The total number of households who use

agricultural inputs such as UREA, DAP and pesticides are 182. Of these, 48 respondents are seed multipliers, and the difference in use of agricultural inputs is not significant statistically.

From the total respondents 175 (48 of them seed multipliers) of them had access to service in the year 2012/13 and the difference is statistically significant between seed multipliers and grain producers.

Table 4.2 comparison of socio-economic characteristics of common beans seed multipliers and non-multipliers

	Total respondents (N=195)	Seed multipliers (50)	Grain producers (145)	Chi-square
Male headed household (%)	87.7	86.0	88.3	0.2
Household participating in organization (%)	86.7	84.0	87.6	0.4
Respondents with Access to credit (%)	47.7	60.0	43.5	4.1**
Households participating in Off-farm income (%)	0.3	0.2	0.4	9.1***
Households using Agri-input (%)	93.3	96.0	92.4	0.8
Households visited by Extension worker (%)	89.7	96.0	87.6	2.9*

The *, ** and *** are significant variables at 10, 5 and 1 percent level of significance respectively

4.2 profitability of common bean seed multiplication in comparison with common bean grain production

This section presents the study findings on the profitability of farmer-based seed multiplication. A comparison is made between seed multipliers and grain producing farmers in the study area in order to get a deeper understanding of the profitability of the seed and grain business. The revenue and costs are stated as average values per hectare of land operated. The difference between the revenue and the total costs is then computed as the net income.

4.2.1 Cost of common bean seed multiplication and grain production.

Details of variable costs incurred by farmers during seed and grain production are listed in Table 4.3. The total cost of seed and grain production incurred by the respondents in Southern rift valley are $608.38/ha and $334.94/ha respectively. Findings from the study analysis indicate that the two highest costs in both cases are the cost of land and the cost of unpaid labor. The sum of these two costs is more than 62 percent of the total cost for seed multipliers and more than 56 percent of the total cost for grain producers. For most of the respondents, these two factor costs are not paid in cash. This implies that the opportunity cost methodologies were adopted to compute these costs at the household level. In a recent study conducted in Kenya among seed multipliers, the cost of land was not included as a variable input cost in the analysis, following a consideration that land is a fixed input and does not directly cost those involved in the seed multiplication enterprise (Katungi et al., 2011). But in this study there are seed multipliers and grain producers who rent land for the purpose of production. That is why it is included in this analysis.

Labor was divided into two categories, namely paid and unpaid labor. Under each categories five types of activities were grouped; namely land preparation and planting, weed control, harvesting, threshing or shelling and sorting and grading. The paid labor for seed and grain producers are 14.24 and 14.40 percent of the total cost respectively. Cost of foundation seed for seed multipliers covers 10.97 percent of the total cost, but the Cost of seed for grain production is slightly higher than their seed multiplying counterpart (12.14). This is possibly because seed multipliers' access seed from research institution with fixed and subsidized price but grain producers face price volatility, involvement of middle men and increased transaction cost. Most of the respondents, both seed multipliers and grain producers, complain about the limited supply

of quality seed. On average seed multipliers use around 60k.g/ha of DAP and 3.83k.g/ha of UREA. Seed multipliers use slightly higher amount of pesticides (0.21 percent of the total cost) than grain producers because they are obligated to pay more attention to their crop because there investment is much higher than grain producers. Grain producers use 46.55k.g/ha of DAP and 4.11k.g/ha of UREA. The total cost of fertilizer to seed multipliers and grain producers are estimated at 11.74 and 15.13 percent of the total average cost respectively. Grain producers spent almost no money on pesticides (0.06 percent of the total cost). They instead used traditional pest control in order to minimize cost of production. None of the respondents used manure or organic fertilizer. The reason why they are not using manure is probably explained the wrong perception and belief that the high moisture content in the manure may attract worms and termites on the plot, whose negative effect can damage the crop.

The cost of transport was also estimated by different categories of people and crops. The transport cost for people is the cost that is incurred for the transport of the people responsible for the sale of seed. Cost of crop transportation is the cost paid for transportation of crop to point of sales. The total cost of transport for seed multipliers and grain multipliers are 0.54 and 1.84 percent of the total cost respectively. The reason why the cost of transport for seed multipliers is relatively smaller than that of grain producers is because of a relatively shorter marketing channel that is utilized. Most of the seed multipliers make the seed sales at the farm.

Majority of seed multipliers store their product in their own stores. The reason why smallholders do not store in a modern storage facility is because of limited access to storage facilities. Despite interventions made in the area to improve the production and marketing of common bean by different parties such as ECX (Ethiopian Commodity Exchange) and CIAT (Centro Internacional

de Agricultura Tropical), the availability of modern storage facility is still limited. The storage facilities built with the help of CIAT provide an important service at a cheaper price. In this analysis the average cost of storage both for seed multipliers and grain producers is only 0.01 percent of the total cost.

Table 4.3 Average cost per hectare of common bean seed multiplication and grain production.

	Seed multiplication (n=50)			Grain production (n=157)		
Description of the cost	Mean	Per ha equivalent	% of cost	Mean	Per Ha equivalent	% of cost
Total cost of land	175.8	200.4	32.9	112.1	127.8	38.2
Cost of seed	58.56	66.8	11.0	35.7	40.7	12.1
Total cost of UREA	3.36	3.8	0.6	3.6	4.1	1.2
Total cost of DAP	59.27	67.6	11.1	40.8	46.6	13.9
Total cost of paid labor	76.02	86.7	14.2	42.3	48.2	14.4
Total cost of unpaid labor	156.62	178.5	29.4	53.7	61.2	18.3
Total cost of anti-pest	1.11	1.3	0.2	0.2	0.2	0.1
Total cost of storage	0.06	0.1	0.0	0.0	0.0	0.0
Total cost of transport to individuals	0.09	0.1	0.0	0.2	0.2	0.1
Total cost of transport to crop	2.79	3.2	0.5	5.2	6.0	1.8
Valid N (list wise)						
Total	**533.68**	**608.4**	**100**	**293.8**	**335.0**	**100.00**

4.2.2 Revenue generated from common beans seed multiplication and grain production

There are two sources of revenue for farmers, namely: sales of seed (or grain) and crop residues. Out of the three types of common beans (red, white and ranger), farmers multiply only the red and white types. The possible explanation for this is that farmers in the study area do not produce much of the ranger type of beans, implying low levels of ranger type of seed and therefore low sales, when compared with seed for red and white bean type. The price of seed varies depending on the time of sale and buyer categories. Those who sell late during sowing period receive as

high as $0.9/kg compared to those who sell immediately after harvest for $0.3/kg. Also selling to organizations such as MARC and catholic missionary church pays better.

Revenue from common bean grain depends on both output and price. The price of red and white common bean varies from $0.2/kg to $0.5/kg depending on the selling period. But the ranger type has a higher price and lower volatility compared to the red and white. Despite the better price, only 6 respondents in the sample were found to produce ranger type.

The other source of income is sales of residues of common beans. Standard conversion factor was used to determine the equivalent residue obtained from each quintal of seed acquired. Literature shows that 120 percent of common bean output is residue (Funte et al, 2009). The average estimated price per kg of residues is found to be $ 0.025.

The total revenue from sale of combined crop and residue for seed multipliers and grain producers is $1400.76/ha and $998.81/ha respectively.

Table 4.4 Average revenue per hectare of common bean seed multipliers and grain producers

Source of revenue	Seed multipliers				Grain producers			
	N	Mean	Per Ha Equivalent	%	N	Mean	Per Ha Equivalent	%
Crop sales	53	1008.7	1310.91	93.59	157	652.99	936.23	93.74
Residue	53	78.821	89.86	6.41	157	54.89	62.57	6.26
Total		1087.521	1400.76	100		707.88	998.81	100.00

4.2.3 Profit derived from common bean seed multiplication and grain production

The difference between revenue and cost defines the profitability of both the seed multiplication and grain production. In this study's data analysis seed multiplication are found to make a profit of $792.38/ha, with a profit margin of 56.57%. This profit margin is much higher than what was found in Kenya in 2011 which was only 36% (Katungi et al, 2011). On the other hand grain producers make $663.87/ha as profit with a profit margin of 66.46%.

These findings reveal that the profit level from seed multiplication ($792.38/ha) is higher than that of grain production ($663.87/ha) by $128.51/ha. But the profit margin of seed producers is lower than that for grain producers by almost 10 percent. The possible explanation for a lesser profit margin is a combination of two factors. The first reason is that seed producers incur higher cost in seed multiplication in terms of land preparation, production, clearing and storage. The second reason is that seed producers sometimes sale their product as grain because of time factor. Besides, farmers in some cases show low interest in buying seed from seed multipliers because of high price. As a result, seed producers after incurring higher cost from production to preservation and storage may end up receiving the same price as their grain producing counter parts. If all the seed produced by farmers was sold at the premium price as seed, the profit margin would have been more than 68 percent ($ 1293.381). This makes seed multipliers better-off both in terms of profit and percentage of profit margin compared to grain producers.

4.3 Smallholders' participation in seed multiplication

This portion of the analysis deals with participation in seed multiplication and the amount of land allocated to seed multiplication. The Heckman two stage econometric model is used to investigate factors affecting participation and size of land allocated to seed multiplication. In the first stage the probit model estimates factors that affect participation in seed multiplication. This first stage helps create a selectivity term called inverse mills ratio or lambda (λ) which helps avoid sample selection bias in the model. The inverse mills ratio in this case is significant at 10 percent implying that selection bias would have been resulted if the level of participation had been estimated without taking into account the decision to participate (Takele, 2010).

In the second stage, size of land allocated to seed multiplication is estimated by OLS (Ordinary Least Square). The *rho* value of +1 shows that there is a high degree of correlation between participation and level of participation in seed multiplication; additionally the fact that the *rho* value is positive shows that the unobserved variables are having similar effect towards participation in seed multiplication and size of land allocated for seed multiplication.

Since the second-stage of Heckman two-stage model is OLS, it is important to test for any likely violations of the model assumptions. First, the presence of multicollinearity can be a serious problem in OLS estimation, and occurs when there is a linear relationship among all or some of the regressors (Gujarati, 2004). By rule of thumb, variance inflation factor (VIF) less than 10 in the output generated by stata statistical package is considered to be a tolerable spurious correlation, implying low levels of multicollinearity (Dawit, 2010). In this analysis, VIF was computed, and results indicate that the highest VIF value is 1.99 with average VIF value of 1.31. These results suggest that multicollinearity is not a serious problem in the data analysis.

The next test that was conducted aimed at assessing the problem of omitted variables in explaining proportion of land allocated to seed multiplication. The omitted variable (ovtest) test in stata gave the ramse RESET test result that suggests a limited or no negative effect of omitted variable. The p-value in our case is found to be 0.0002, thus accepting the null hypothesis that there is no omitted variable in the model. (*F (3, 31) = 9.01 and Prob> F = 0.0002*).

Heteroskedasticity is another problem in OLS and occurs when the variance of the error term differs across observations (Gujarati, 2004). Presence of heteroskedasticity can produce biased and misleading parameter estimates in a model (Richard 2015). Breusch-Pagan test is used to test for presence of heteroskedasticity and the null hypothesis, which says variance of the error term is constant (Homoskedastic), is accepted.

4.3.1 Factors affecting decision to participate in seed multiplication

Table 4.5 factors affecting participation in seed multiplication

Participation in seed multiplication	Coefficient	Standard error	dy/dx	95% conf interval	
Sex (1=male; 0=otherwise)	-0.540	(0.440)	-0.122	-1.401	0.322
Age(years)	0.011	(0.018)	0.001	-0.025	0.047
Formal education (years)	0.084*	(0.051)	0.015	-0.015	0.183
Family size (Adult equivalent)	-0.009	(0.117)	0.003	-0.238	0.220
Farm size (Hectares)	0.308***	(0.070)	0.066	0.172	0.445
Livestock (TLU)	0.015	(0.018)	0.008	-0.020	0.050
Extension contact (1=contacted; 0=otherwise)	1.598***	(0.607)	0.466	0.409	2.788
Agricultural equipments	0.046*	(0.024)	0.007	-0.001	0.092
Participation in organizations (1=participate; 0=otherwise)	-1.689***	(0.536)	-0.524	-2.739	-0.639
Credit access (1=access; 0=otherwise)	0.103	(0.258)	0.051	-0.401	0.608
Off-farm income (1=participate; 0=otherwise)	-0.580*	(0.319)	-0.108	-1.206	0.046
Distance to district town (k.m)	-0.020***	(0.008)	-0.005	-0.035	-0.005
Agricultural input use (1=use; 0=otherwise)	0.741	(0.651)	0.134	-0.535	2.017
Distance to tarmac road (k.m)	-0.066	(0.026)	0	-0.116	-0.016
Cons	-2.537**	(1.043)		-4.581	-0.493

The *, ** and *** are significant variables at 10, 5 and 1 percent level of significance respectively.

Formal education is one of the variables that significantly affect the decision of the farm household to participate in seed multiplication positively. One additional year of formal education increases the likelihood of participating in seed multiplication by 1.5 percentage point. The possible explanation is that since education makes household heads more assertive and dynamic in conducting their economic activities (Salim, 1986),more educated farmers are expected to have the ability to analyze and discern the economic benefits of farmers based common bean seed multiplication and therefore choose to participate in this type of enterprise.

Land is the basic input in production, and it's found to have a strong and statistically significant relation with the decision to participate in seed multiplication. Possession of one additional hectare of land increases participation in seed multiplication by 6.6 percentage point. Seed multiplication requires relatively larger amount of land. This explains why farmers with large

size of land also have a high ability to participate in seed multiplication. It was observed during data collection that farmers with small size of land find it hard to rent land due to high land rental rate from land owners. Feder (1980) discussed that having large amount of land facilitates participation in new agricultural technologies with minimum risk.

Access to extension service is found to be significantly associated with the decision to participate in seed multiplication**.** Those who were visited by extension workers were 46.6 percentage points more likely to participate in seed multiplication than those who were not visited. Extension service helps to communicate new innovations and enterprises to smallholders that increase smallholder's level of awareness on the importance and likely high levels of profitability of farmer-based seed multiplication. Thus, the likelihood to participate in seed multiplication increases with access to extension service. Tahirou (et al., 2009) discovered that lack of extension service results in limited promotion of newly developed seed delivery mechanizems in Bénin and Nigeria.

Having and probably using agricultural equipment has a significant and positive effect on the decision to participate in seed multiplication. A one unit increase in the endowment of agricultural equipment increases the likelihood of participation by 0.7 percentage point. This could be due to the fact that seed multiplication requires significant investment in equipment, which makes it a preserve of relatively well-off stallholders. A study in western Africa showed that limited capital affects participation in seed production (Tahirou et al., 2009).

This study found that participation in organizations such as cooperatives decreases the likelihood of participation in seed multiplication by 52.4 percentage point. This outcome contradicts the hypothesis presented earlier in chapter 3. One of the objectives of participation in seed multiplication is securing seed access for own use. As shown by results of the multivariate probit

model on page 67, smallholders in cooperatives access seed from farmer-based seed source. Therefore because of being more seed secured, smallholders in organizations are not highly motivated to participate in seed multiplication.

Access to off-farm income reduces the likelihood of participation in seed multiplication by more than 10 percentage point. This is because participating in off-farm income generating activities reduces time available and likely incentives to participate in seed multiplication. Van den Berg (2013) argued that farmers who have off-farm income are less likely to participate in improved agricultural practices because they already have enough motivation from the of-farm income.

This study discovered that the further a smallholder is from the district town the less likely s/he is to participate in seed multiplication. If a smallholder is one kilometer further away from the district town, the likelihood of participation decreases by 0.5 percentage point. Proximity to district town has several advantages such as access to agricultural inputs including foundation seed and access to market. Jacoby (2000) discussed the importance of access to central market for smallholders to access improved agricultural input.

4.3.2 Factors affecting size of land allocated to seed multiplication

Table 4.6 factors affecting size of land allocated to seed multiplication.

l_land for seed multiplication	Coefficient	Standard error	95% conf	interval
Sex (1=male; 0=otherwise)	-0.601	(-0.365)	-1.315	0.114
Age (years)	0.024	(-0.015)	-0.005	0.053
Formal education (years)	0.026	(-0.047)	-0.065	0.117
Family size (adult equivalent)	-0.048	(-0.09)	-0.224	0.128
Farm size (Hectares)	0.180**	(-0.09)	0.004	0.355
Livestock (TLU)	0.027*	(-0.015)	-0.003	0.057
Agricultural equipments	0.026**	(-0.012)	0.003	0.049
Participation in organizations (1=participate; 0=otherwise)	-0.069	(-0.484)	-1.018	0.880
Credit access (1=access; 0=otherwise)	0.208	(-0.227)	-0.238	0.654
Off-farm income (1=participate; 0=otherwise)	-0.562*	(-0.319)	-1.186	0.063
Distance to district town (k.m)	-0.018*	(-0.009)	-0.035	0.000
Agricultural input use	0.261	(-0.566)	-0.848	1.369
Distance to tarmac road (k.m)	-0.001	(-0.03)	-0.059	0.058
_cons	-2.703***	(-0.941)	-4.548	-0.858
mills lambda	0.84*(0.47)			
Rho	1.00			
Sigma	0.841			
Number of observations	195			
Censored observations	145			
Uncensored observations	50			
Wald chi2(13)	30.82			
Prob > chi2	0.0036			
Breusch-Pagan test for heteroskedasticity Prob > chi2	0.000			
Vif	1.31			

The *, ** and *** are significant variables at 10, 5 and 1 % level of significance respectively.

The farm size owned is strongly correlated with land allocated to seed multiplication. This is probably explained by the fact that land holding has a direct relationship with size of land allocated for seed multiplication. Households with larger size of land have unique ability to allocate larger size of land to seed multiplication. To the extent that land access is limited in the study area, some smallholders may choose not to engage in seed multiplication. Land access through renting-in is becoming increasingly difficult and expensive. Feder (1980) discussed that

households with large amount of land can easily allocate larger amount of land for new activities without putting the household at risk of losing crop returns. Ghimire (et al., 2015) also discovered that farers with larger land size can easily adopt new variety of rice in central Nepal.

Livestock holding has a positive relationship with size of land allocated to seed multiplication. This is because having more livestock means more draft power which enable the cultivation of more land ceteris paribus. Ghimire (et al., 2015) argued that ownership of oxen facilitates farm operation when smallholders can not apply tractors. Additionally, livestock sales enable farmers to access agricultural inputs such as rental land.

Agricultural equipment variable measures both the wealth of the household as well as ability of smallholders to participate in agriculture. This study shows that farmers with higher amount of agricultural equipment are more likely to allocate larger size of land to seed multiplication. Randrianarisoa and Minten (2005) discovered that in Madagascar, limited access to agricultural equipments is the first constraint towards agricultural productivity.

Off-farm income is negatively associated with participation in seed multiplication and even when farmers participate, they allocate limited amount of land to seed multiplication. As explained above, smallholders participating in off-farm income generating activities are occupied by other activities and are thus expected not to have enough time to invest in seed multiplication.

Distance to district town is one of the variables hypothesized to affect both participation and level of participation in seed multiplication. Findings from this study show that seed multipliers who are far from district towns participate less in seed multiplication and allocate small amount of land than those closer to towns. Being close to the district town comes with the advantage of easy access to markets for the output. proxy to district towns helps seed multipliers to have better

access to NGOs sensitization services, agro dealers, middlemen, and small-scale buyers which motivates them to allocate more land to seed multiplication. Buckmaster (2012) discovered that as distance to market increases, the probability of crop production for consumption increases and the probability of crop production for sale at market decreases.

4.4 Seed source choice and the related challenges

This section presents the farmers' choice of seed source and key determinants of choice of seed source. Farmers have three possible seed sources, namely: formal, informal, and farmer-based. The formal seed source includes such seed sources as Seed Company, NGOs/government, farmer groups and research institution. The informal seed sources include saved seed, gift from family/neighbors, farmer to farmer seed exchange, and local traders. Whereas the third type of seed source denotes the category of seed that is multiplied by farmers in order to bring improved seed closer to smallholders. Faced with all these three options, smallholders are at liberty to choose any one or a combination of the three options.

Table 4.7 seed source choice of sampled households

	Seed multipliers		Grain producers		Combined	
Source of seed	Frequency	Percentage	Frequency	percentage	Frequency	percentage
Formal	16	32	1	0.69	17	8.72
Informal	0	0	11	7.59	11	5.64
Farmer-based	3	6	9	6.21	12	6.15
Formal and informal	2	4	33	22.76	35	17.95
Formal and farmer-based	23	46	28	19.31	51	26.15
Informal and farmers based	3	6	46	31.72	49	25.13
Formal, informal and farmer-based	3	6	17	11.72	20	10.26
Total	50	100.00	145	100.00	195	100.00

Among the sampled seed multipliers in the study area, about 32 percent of them access seed exclusively form formal seed source. Less than a percent of grain producers use formal seed

source as their sole seed source. No seed multiplier is found using informal seed source as their only seed source. More than 7 percent of grain producers exclusively use informal seed source. Nearly half of seed multipliers (46 percent) combine formal and farmer-based seed as their seed source. In the case of grain produces the largest combination of seed source is formal and farmer-based that constitutes about 31.72 percent. Almost 12 percent of grain producers and 6 percent of seed multipliers make use of all the three seed sources.

Since farmers' based seed multiplication is the most recently introduced seed source, it is expected to face various constraints. One of these is the limited number of distribution channels. Areas such as *Tuka Langano* has a large amount of seed multiplied by farmers but places like *Sara Ena Areda* and *Kechachule* are suffering from limited supply of improved seed. in the face of this contrast, smallholders now are asking if it is possible to have seed multipliers in every sub *Kebele* or *Gere* representing the community. The other constriant with this system is related to quality assurance. Some farmers accuse seed multipliers of selling seed that is mixing with ordinary common bean grain. This, as the farmers reported makes them feel betrayed and to have low confidence in farmer-based seed source. The fact that the Agricultural Inputs Quality Control Department of MoARD has its headquarters in the capital city with the other 10 smaller units around the country not being anywhere near to study area has made it difficult to certify seed multipliers in the study area (Thijssen et al, 2008).

4.4.1 Factors affecting seed source choice

A multivariate probit (MVP) model is estimated using Simulated Maximum Likelihood with a total of 195 observations. The likelihood ratio test of the null hypothesis which implies that there is no correlation between the covariance of the error terms across seed choice equations was

rejected (chi2 (3) = 42.563Prob> chi2 = 0.0000). The test result suggests that the options of seed sources are not mutually exclusive and therefore justifies the need to use the multivariate probit model for the analysis. Use of the MVP model helps one to understand the embedded relationship among the alternative seed choices. Results of this analysis are summarized in Table 4.6, and they indicate that formal and "informal seed systems", "formal and farmer-based seed source", and "informal and farmer-based seed sources" are substitutes, which imply that they are significantly and negatively related to each other at least at 5 percent level of significance. Results in Table 4.6 further shows the wald test of the null hypothesis rejected the null hypothesis, implying that all regression coefficients in each equation are not jointly equal to zero.

The correlation between formal and informal seed source is estimated at 37.4 percent. During informal discussion with respondents, it was discovered that they always keep some amount of grain from the last harvest for seed as backup in case they fail to get seed from the formal source. Even if they get some seed from the formal source it might not be enough, which compels them to use both seed source. The correlation between formal seed source and farmer-based seed source is 40.9 percent. This is probably because farmers who are engaged in seed multiplication have access to both formal seed source and farmer-based seed multiplication source. They can also use the two sources alternatively. The last correlation is between Informal and farmer-based multipliers seed source estimated at 40.8 percent. This correlation can be explained by the fact that marginalized farmers who can't access formal seed source revert to the farmer-based seed multipliers as their best choice, but if they can't get that either, the last resort is always the informal seed source.

Table 4.8: factors affecting seed source choice of the sampled respondents

	Formal	Informal	Farmer-based
Sex (1=male; 0=otherwise)	0.405(0.362)	0.021(0.363)	0.236(0.335)
Age (years)	-0.025*(0.015)	0.028*(0.015)	0.015(0.015)
Formal education (years)	-0.024(0.031)	0.027(0.032)	-0.042(0.032)
Family size (Adult equivalent)	0.059(0.089)	0.027(0.088)	-0.022(0.083)
Seed multipliers (1=multiply; 0=otherwise)	0.793**(0.309)	-1.477***(0.284)	-0.353(0.272)
Livestock holding (TLU)	-0.004(0.016)	0.015(0.015)	-0.009(0.014)
Farm size (Hectares)	0.116*(0.059)	-0.182***(0.061)	0.058(0.061)
Participation in organization (1=participate; 0=otherwise)	-0.014(0.317)	-0.494(0.389)	1.669***(0.344)
Extension contact (1=contacted; 0=otherwise)	-0.005(0.008)	-0.006(0.008)	0.0130.008)
Access to credit (1=access;0=otherwise)	-0.121(0.223)	-0.012(0.227)	0.078(0.217)
Distance to district town (k.m)	-0.024***0.007)	0.002(0.007)	0.009(0.007)
Off-farm income (1=participate; 0=otherwise)	0.249(0.211)	0.06(0.22)	-0.001(0.214)
Price (USD)	0.04(0.027)	-0.023)(0.027)	-0.015(0.026)
_cons	0.782(0.642)	0.454(0.679)	-1.797***(0.672)
rho21	-0.374***		
rho31	-0.409***		
rho32	-0.408**		
Number of observations	195		
Wald chi2(39)	116.83		
Prob > chi2	0.000		
Log likelihood	-299.83604		

Likelihood ratio test of rho21 = rho31 = rho32 = 0:
chi2(3) = 42.563 Prob > chi2 = 0.0000

The *, ** and *** are significant variables at 10, 5 and 1 percent level of significance respectively. Results in parenthesis are standard errors.

Age of the household head is found to be significantly associated with seed source choice. It affects formal seed source choice negatively and informal seed source positively. The significant correlation between age and choice shows that old farmers are more attracted to informal seed source than their younger cohorts. The older the farmers, the less likely they are to use new seed sources as they place confidence in their old ways and methods. Younger farmers have been found to be more knowledgeable about new practices and may be more willing to bear risk and

use new delivery system such as farmer-based seed source. Ali (et al., 2015) discovered that the younger the farmers the higher the probability of them using certified wheat seed in Pakistan.

Participation in seed multiplication strongly influences the sourcing of seed from formal and informal options. In this case, respondents who participate in seed multiplication are more likely to source seed from the formal sector whereas grain producers are more likely to source seed from the informal alternative. This scenario can be explained by the higher exposure of seed multipliers to formal seed sources such as MARC and catholic missionary church. Compared to seed multipliers, grain producers have limited access to formal seed source and as a result end up using seed from the informal seed source.

Households with large land holdings are more likely to use formal seed source. The possible explanation for this scenario is farmers with relatively large size of land can easily raise money by renting out land which enables them to purchase seed from the formal seed and pay for the transaction costs. On the rivers, smallholder farmers with limited land are less likely to have enough money to buy seed from formal source instead they save and/or borrow from neighboring farmers for their seed requirements. This is a vicious circle that keeps smallholders from accessing improved input including seed, a result that is consistent with the findings of Elizabeth Cromwell (1995).

Participation in organization captures any involvement in social and economic unions such as cooperatives, self-help organizations, farmers' association and many others. In this study, households that participate in organizations were found to be more likely to use farmer-based seed. As mentioned earlier, farmer-based seed multiplication is a newly introduced mechanism to address seed shortage among smallholders. Therefore participation in organizations serves as information hub creating knowledge about the whereabouts of farmer-based seed. As a result

households with this information source their seed from farmer-based seed multipliers. Alemu (2011) discussed that organizations such as agricultural marketing cooperatives, seed cooperatives and local seed business cooperatives increased accessibility of farmer based seed system by smallholders in Ethiopia.

Distance of households to the main district town is found to be relevant to seed source choice. The variable is negatively related to formal seed source choice indicating farmers who are far from the district town face high transaction costs of accessing formal seed and therefore less likely to use formal seed source. Keeping in mind that most agro-dealers including Ethiopian seed enterprise are located in main towns, farmers who are far from district towns incur higher transport and transaction costs to access formal seed sources compared to the ones close to district towns; which discourages the use of formal seed source by remote farmers.

4.5 Findings from Focus Group Discussions

In addition to the variables included in the models, findings from FGDs provide more insights concerning the multiplication of common beans seeds and the underlying level of profitability. The issue of climate change appears to be a serious challenge faced by seed multipliers, especially in areas of *Anano and Shisho*. For instance, during the production period of 2011/12, there was excessive rainfall in the area that caused significant loss of the seed product. In the following year, things were different. The area received rain long after planting period and this affected productivity due to failure of timely rainfall. In response to these two consecutive events, seed multipliers decided to either quit the business altogether or to switch to grain production. The effect of climate change is becoming a serious issue for both for seed and grain producers in the study area. The negative effect of climate change is likely to be more felt by

seed multipliers than is the case with grain producers because of the relatively high level of investment they made.

In this same informal discussion, farmers indicated their determination to continue initiating and developing the seed multiplication business. Responses from FGDs further indicate that: most farmers choose to start the business of seed multiplication after seeing their fellow family members and neighbors in the same business, but more importantly when successful at making more money from seed multiplication. They also get the understanding that engaging in seed multiplication not only brings in money, but also provides security for seed availability to neighbors and family members in the community. Other sources of motivation for farmers to engage in seed multiplication include the inspiration received from development workers, who take them through relevant business plans and the required best practices for one to succeed. Seed multipliers in each *district* have their own group and independent management. The chair person of each group plays a great role in motivating members to participate in seed multiplication. The contribution of MARC, CIAT and Catholic missionary church is also commended for introducing seed multiplication and providing free foundation seed that helped farmers start seed multiplication from the very beginning.

4.6 Limitation of the study

The study is conducted in Southern rift valley because of the high production of common beans. But the central rift valley and western Harergy are also significant common beans producers. Due to shortage of budget the study was forced to focus only in southern rift valley. Data collection was done by mid 2014. There was heavy rain which destroys crops in the study area and created a huge crop lose. In 2014 also, there was a delay in rain fail in the region. A

combination of the two effects made farmers fear the risk of joining common bean seed multiplication. Even though the study discovers about the scenario during FGD, the effect of climate change was not included in the econometric analysis of participation in seed multiplication.

Cooperative unions and farmers' organizations play vital role in distributing agricultural inputs including improved. But because of budget constraint the study did not include them in the survey. Respondents in the study area are used to incentives when they participate on a survey. To avoid respondents' bias, this study did not provide any incentive. Respondents were not fully complying to participate in the survey which made the process long and time taking to convince the respondents.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

5.1 Summary and conclusions

The demand for food is growing steadily due to an increase in population, thus the need to increase the level of food crop production. Seed is basic and indispensable input of crop production. The quality and quantity of seed a farmer uses determines the quality and quantity of grain s/he produces. There is need to ensure that farmers access and use only the type of seed that is of high quality and affordable. Smallholder farmers in developing countries still face the challenge of accessing improved seed from the formal seed sector. Since the majority of food crop producers in Sub-Saharan Africa are smallholders, the food security of the world may be endangered because of limited supply of improved seed. Common bean producers are among the victims of the ill functioning seed system, especially in Ethiopia because of limited supply of improved seed. A number of remedies are being promoted in Ethiopia as part of interventions to address the problem of limited access to seed among marginalized smallholder common bean producers. One of the programs developed as a result of the above mentioned problem in Ethiopia is the farmer-based seed multiplication. Uncertainty of profitability, availability, accessibility and affordability of the farmers' based seed multiplication motivated this sturdy.

The study provides interesting findings on: the profitability of common bean production among seed multipliers and grain producers; key determinants of participation in seed multiplication and size of land allocated to seed multiplication; and finally key determinants of farmers' choice of seed source and the underlying correlation among different types of seed source. The study involved a survey of 195 randomly selected common bean producing household farmers from 6 *kebeles of Southern Rift Valley, Ethiopia*.

The findings of the gross margin analysis show that both seed and grain production are profitable. Seed multipliers, however, get more profit per hectare of land than their counterpart grain producers, although the profit margin of the later is greater than the former by 10 percent. The possible explanation for the lower profit margin received by seed multipliers can be attributed to the higher cost they incur during production, clearing, and grading. Additionally there is a problem of selling seed at the price of grain depending on the time demanding factors. The seed multiplication enterprise is a lucrative business and smallholder farmers should participate to rip a higher return on their investment. *Ranger* type of common bean has a grater profit margin but there are few smallholders who producing it.

The study shows that several smallholders use all three sources in varying combination. About one fifth (21 percent) of the respondents use only one seed source, while the majority (nearly 70 percent) of the respondents use a combination of two seed sources. The rest of the respondents combine all the three seed sources to meet their seed requirements. The study shows that all the seed sources have a substitute type of correlation. For instance, the formal seed source substitutes both the informal and farmers based seed source, which implies that for a farmer looking for a formal seed source might as well go for farmer-based seed source or even the informal seed source depending on the convenience and prospects of formal seed source in the area. The same is true with the other two seed sources. Smallholders sourcing seed from farmers' seed multipliers tend to complain about limited seed supply and seed scarcity during the planting time, but also the undesirable mix of bean grain with bean seed. The fact that Melkasa Agricultural Research Center (MARC) is always late to avail seed for production pushes farmers to opt for informal and/or farmers based seed multipliers as their second best option.

Results of econometric analysis show evidence of various economic and social factors affecting choice of seed source by farmers. While the choice of formal seed source is positively related with farm size and participation in seed multiplication, it is negatively influenced by distance to district town and age of household head. Use of informal seed source is influenced positively by age and negatively by farm size and participation in seed multiplication. Sourcing seed from farmers based seed multipliers is positively influenced by participation in organizations such as cooperatives. In conclusion, it was observed that participating in cooperatives increases access to farmers based seed source. The formal seed source seemed to be reached by farmers who are well off and near the district town.

The two-stage Heckman model analyzed the factors affecting participation in seed multiplication in the first-stage and the volume of land allocated to seed multiplication in the second-stage. Formal education, landholding, extension contact, and agricultural equipment owned were found to contribute positively for participation in seed multiplication. In addition participation in cooperatives, access to off-farm income and distance to district town is negatively associated with participation in seed multiplication. On the other hand, number of livestock owned, farm and agricultural equipment are positively associated with the amount of land allocated to seed multiplication, while participation in off-farm income and being far from district towns is negatively associated with amount of land allocated to seed multiplication. Seed multipliers also outlined various constraints they face such as absence of modern storage facility, low and reducing of demand for improved seed among others.

5.2 Recommendations

There is need to consolidate the positive impact created by the seed multiplication in availing improved bean seed for smallholders in southern rift valley. This can be achieved by mainly focusing on addressing the constraints raised by this study. Based on the robust evidence generated by results of estimated models, focus group discussion, and personal observations the following recommendations are hereby suggested.

- Some seed multipliers sell their product immediately after harvest because of lack of modern storage facility and need for cash. Seed multipliers should keep their products until planting season and sell their product at a premium price.
- Since participation in organizations such as cooperatives (social capital) show a positive relationship with sourcing seed from farmer-based seed multiplication, the office of agriculture in respective *kebeles* should promote the work of organized farm groups and farmer cooperatives in their effort to increase awareness about the availability and importance of farmer-based seed source. Additionally, the participation of cooperatives in distribution of multiplied seed from areas of surplus to areas of scarcity can help distribute seed evenly and encourage seed producers and farmers to use improved seed.
- District officials should attract formal seed producers including ESE to open branches at least in *district* or *kebele* level to decrease the distance (bring services nearer) farmers' travel to access improved seed. The district officials should provide evidence on the high production of common bean in the area which further leads to high demand of quality seed.

- It was observed that smallholders participating in seed multiplication are better endowed in terms of land, livestock and agricultural equipment; which suggests that more needs to be done to innovate a pro-poor seed system that does not ignore poor smallholders.
- Since both seed multipliers and grain producers are complaining about limited supply of foundation and improved seed respectively, Research institutions including MARC should increase their capacity to address the demand of both improved and foundation seed.
- MARC together with extension and development workers must take part in promoting ranger type of common bean. Its high price will make farmers more profitable.
- Increased number of NARS agricultural input certification units close to seed multipliers and agricultural research centers can be used to boost the confidence of farmers using seed from seed multipliers and it will also prevent seed multipliers from behaving opportunistically by mixing grain with seed.
- Seed multiplying individuals must keep their product until planting season so that they can sell their product as seed and enjoy the premium price.

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APPENDICES

1.1 Questionnaire

Household questionnaire

This questionnaire will be conducted in order to examine participation in farmers based seed production in the specified study area and its profitability. All the information you are giving will be confidential and will be used only to this study. Result and finding of the study will be communicated back to you once the study is finished. We thank you for your cooperation.

(a) Woreda _____ (b) Kebele _____
(c) Date of interview_____ (d) Name of enumerator _____
(e) Cell phone number _____

Part one: Household socio-demographic character

1.1Household head characters

No	Question	Response Choices	Response
1.1.1	Name		
1.1.2	Sex	1=Male 0=Female	
1.1.3	Age		
1.1.4	Marital status	1=Single 2=Married 3=divorced 4=widow	
1.1.5	Educational status	1=illiterate 2=read and write 3=formal 4=other (please specify)	
1.1.6	Number of years in formal school		
1.1.7	Years of experience in farming		
1.1.8	For how long did you cultivate common beans (in years)		

1.2 Household members' characteristics

No.	Name of household member (1.2.1)	Age (1.2.2)	Sex (1.2.3) Code A	Marital status (1.2.4) code B	Educational status (1.2.5) code C	Relationship to the HH (1.2.6) Code D
1						
2						
3						
4						

5						
6						
7						
8						

Codes A	Codes B	Codes C	Codes D
0. Female 1. Male	1. Married living with spouse 2. Married but spouse away 3. Divorced 4. Widow/widower 5. Never married 6. NA 7. Other, specify…….	1=None/Illiterate 2=Adult education 3=Religious education * *Give other education in years*	1. Spouse 2. Son/daughter 3. Parent 4. Son/daughter in-law 5. Grand child 6. Other relative

Part two: Household assets and housing

No.	Name of asset	Number owned
2.1	Oxen	
2.2	Cows	
2.3	Heifers	
2.4	Bulls	
2.5	Calves	
2.6	Donkeys	
2.7	Horses	
2.8	Mules	
2.9	Small ruminants (sheep and goat)	
2.10	Chicken	
2.11	Cart	
2.12	Sickle	
2.13	Axe	
2.14	Hoe	
2.15	Knapsack sprayer	
2.16	Water carrier (specify type)	
2.17	Stone grain mill	
2.18	Motorized grain mill	
2.19	Water mill	
2.21	Radio, cassette or CD player	
2.22	Mobile phone	
2.23	TV	
2.30	Bed (leather, wooden or metal)	
2.31	Chairs/sofa	
2.32	Table	
2.33	Gun	
2.34	Grass roofed house	
2.35	Corrugated iron sheet house	
2.36	Other (specify)	

Part three: farm characteristics and crop portfolio

Farm character

No.	Question	Response
3.1	**How much is the total land owned by the household in hectares in 2012/13? (2005 e.c)**	
3.2	Land Utilization 2012/13 (2005 e.c)	
	(a) Total cultivated land	
	(b) Land under fallow	
	Grazing land	
	Homestead Area	
	Rent out	
	Forest Land	

3.3 types of crop produced

No.	Crop	2012/13		
		Ha	Quintal	Purpose
1				
2				
3				
4				
5				
6				
7				
8				

Part four: seed multiplication and distribution

No	Question	Options	Response
4.1	Do u participate in common beans seed multiplication activity?	1=yes 0= no	
4.2	Do you sale seed for other farmers?	1=yes 0= no	
4.3	What kind of common beans seed do you multiply?	1=red 2= white 3=both	
4.4	How much Ha of land did you use for seed multiplication in 2012/13?		
4.5	How much Ha of land did you use for all type of crop production in 2012/13?		
4.6	How much kilo gram of seed did you produce in 2012/13?		
4.16	What is your source of input (foundation) seed for seed multiplication?	1=Research institution (Melkasa research institution)	

		2=Ministry of agriculture 3=Private foundation seed stores 4=Saved from previous season 5=Farmer seed producer 6=Other (please specify)	
4.17	How far is your location from the source		_____Min _____ K.M
4.18	If from saved from previous season, where does the original seed came from?	***Use the list from 4.13***	
4.19	How much foundation seed did you access from your source in 2013?		
4.20	How far is the nearest market from your location?		_____Min _____ K.M

Part Five: Cost related to common beans multiplication

Please tell us about the inputs used, costs per input and the source of inputs. Please fill in the following information as per the standard.

5.1 Cost of common beans production

Input		Quantity used	Cost of input per unit in birr	Total cost	Source of input
Land					
Seed	red				
	White				
Fertilizer	UREA				
	DAP				
Manure					
Labor					
Water (irrigation or bought from other source)					
Anti-pest					

5.2 Common beans storage cost

This is the cost incurred to storage of seed between seed is produced and sold out

Type of seed 1=red 2=white	Means of storage Code A	Quantity of seed in store (in K.G)	Period of storage in days	Cost incurred per K.G per day	Total cost of storage

Code A1= ECX store 2=own store 3. Cooperative store

5.3 Common beans marketing

Transaction {5.3.1} 1=red 2=white	Is there a market in your village? {5.3.2} [1] Yes [0] No	Distance to the village market from your residence {5.3.3} (*Report both if possible*)		What is the main means of transportation you use to get to this local market? {5.3.4} Code A	Distance from the village centre to main tarmac road KM {5.3.5}	Distance from the village to main district town KM {5.3.6}
		KM	Minutes walking			

Code A1= walking 2= horse 3=donkey 4=cart 5=taxi 6=own vehicle 7= cart

Transaction ID 1 red 2 white	Market where this transaction too place {5.3.7} Code B	Month when sale took place [1-12] {5.3.8}	Quantity sold in this transaction KG {5.3.9}	Person responsible for this sale Code C {5.3.10}	Price received (birr per kg) {5.3.11}	Who was the buyer? Codes D {5.3.12}	Relation to buyer Codes E {5.3.13}	Time taken to get to the market (Minutes) {5.3.14}	Person transport cost (birr/ person) {5.3.15}	Crop transport cost (total) (birr) {5.3.16}

Code B 1=village market 2=cooperative 3=local market 4=central market (main town or city) 5=farm gate
Code C1=household head 2=spouse 3=child 4=relatives 5=Sales representative
Code D 1=neighboring farmers 2= a random farmer 3=cooperatives 4=traders 5=distributers
Code E 1=relative 2=neighbour 3=cooperative union mate 4= trader customer
Code F 1= walking 2= horse 3=donkey 4=cart 5=taxi 6=own vehicle

5.4 Buyers' information

No.	Question	Options	Response
5.4.1	Are your buyers members of any cooperative?	1=Yes 0=No	
5.4.2	For what purpose are they buying it?	1=For production purpose 2=For resale purpose 3=For exporting purpose 4=For distribution purpose	
5.4.3	How do you characterise your buyer as far as wealth is concerned?	1=Poor 2=Medium 3=Well-oof	
5.4.4	How do you categorize your buyers as poor, medium or well off?		
5.4.5	What size of pack do buyers prefer?		_____K.G pack
5.4.6	How much k.g of seed a buyer buys at one purchase?		_____K.G

5.4.4_____

Part six common beans seed source

6.1 Do you take common beans production as part of your portfolio?
1. Yes 0. No

6.2 do you have the interest of producing more common beans seed than what you are producing?
1=yes 0= no

6.3 If yes for 6.2, what is the major problem?

6.4 Are you still producing common beans seed?
1. Yes 0. No

6.5 If no for 6.4 what is the reason?

_____

6.6 What initiated you to work on common beans seed production?

_____

For grain producers

6.2 Do you take common beans production as part of your portfolio?
1. Yes 0. No

6.2 do you have the interest of producing common beans seed?
1=yes 0= no

6.5 if yes for 6.2, why can't you produce?

6.6 if you have been producing why did you quite?

_____

If yes for 6.1 please proceed to the table if not please go to the next section.

V6.1.1	V6.1.2	V6.1.3	V6.1.4	V6.1.5	V6.1.6	V6.1.7	V6.1.8	V6.1.9	V6.1.10	V6.1.11	V6.1.12	V6.1.13
Variety 1=red 2=white	Choice of seed distribution channel (chose one or more) Code A	If informal which exactly? Code B	If saved how long will it take you to change it to new variety?	If formal which one exactly? Code C	If farmers based which one exactly Code D	seed source with short germination period Code A (if 1, c) or (if 3, D)	seed source with drought tolerance Code A (if 1, c) or (if 3, D)	seed source with high purity Code A (if 1, c) or (if 3, D)	Seed source with timely distribution Code A (if 1, c) or (if 3, D)	Seed source with affordable price Code A (if 1, c) or (if 3, D)	Seed source with high quality Code A (if 1, c) or (if 3, D)	Seed source with easy accessible Code A (if 1, c) or (if 3, D)

Code A 1. Formal seed producer 2. informal seed producers 3.farmers based seed production
Code B 1. Own saved 2. Gift from family/neighbours 3. Farmer to farmer seed exchange 4. Local traders
Code C 1. Agro dealers/agrovets 2. Bought from seed company 3. Provided free by NGOs/Govt 4. Farmer Groups 5. Research institution 6. Others (Please specify)
Code D 1. From own farm production 2. Extension Demo plots 3. Accessed from neighbouring seed producers 4. Cooperatives 5. Others (please specify)

6.5 What is the reason you are not able to use your preference source?

_____

No	Question	Options	Response
6.2	How long have you used the seed source you are using now?		_____ year(s)
6.3	Is the source you are using your preferred one?	1. Yes 0. No	
6.4	If No which source is your preference?	1. Formal seed producer 2. Informal seed producers 3. Farmers based seed production 4. Other (please state)	

Part Eight: Labor requirement for common beans Seed and grain production

8.1 Labor requirement and utilization for seed multiplication

Plot number	Total **unpaid labour** use in person days *															Total **hired labour** use in person days *									
	Land preparation & planting			Weed control (sum up all weeding times)			Harvesting			Threshing			Sorting & grading			Land preparation & planting		Weed control (sum up all weeding times)		Harvesting		Threshing or shelling		Sorting & grading	
	Male	Female	Children	Male	Female	Children	Male	Female	Children	Male	Female	Children	Male	Female	Children	Male	Female	Male	Female	Male	Female	Male	Female	Male	female
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**				**14**	**15**	**16**	**17**	**18**	**20**	**21**	**22**		
Meher 2012/13																									
1																									
2																									
3																									
4																									
5																									
……For the labour that was hired, what was the unit cost paid																									
Total																									

In this section the labor information must be for the plot size mentioned in section 5.1. Consider all the labour applied in one field even when the field is intercropped, i.e. you will have one row per field even if multiple crops.

*Person days= Numbers people worked X number of days worked: * Children are below 15 years of age*

No.	Question	Options	Response
8.2	Do you face labor shortage?	1. Yes 0. No	
8.3	If yes, for which activities?	1. Crop production 2. Livestock production 3. seed multiplication 4. other (please specify)	
8.4	If yes to 8.2, how do you usually solve it	1. Hiring labor 2. Use communal labor 3. share cropping 4. Other (Specify)	
8.5	If labor is hired, what type of labor do you hire?	1. Permanent 2. Casual 3. Both	
8.6	If permanent, how much do you pay per annum?		_____ Birr
8.7	If casual, how much do you pay per day?		_____ Birr

Part nine: Participation in organization

9.1 do you participate in any organization, association or group?

1. Yes 0. No

If yes please fill in the following information, otherwise go to part ten

Household member	organization / association/ groups you are member of: (codes A)	Group functions for the association/organization (codes B)	Length of membership (in years) *[for the association/organization*	Role in the group (codes C)	Still a member now? [1=Yes; 0=N]	If No in column 6, main reason/s for leaving the group (codes E)
1	2	3	4	5	6	7
HHhead						
Spouse						

Codes A		Codes B		Codes C	Codes E
1. seed multipliers group	9. Saving and credit group	1. Product marketing	8. Soil & water conservation	1. Official	1. Left because organization was not useful/profitable
2.Input supply/farmer coops/union	10. Funeral association	2. Input access/marketing	9. Church group/congregation	2. former official	2. Left because of poor management
3. Crop/seed producer and marketing group/coops	11. Government team	3. Seed production	10. Input credit	3. Ordinary member	3. Unable to pay regular membership fee
5. Farmers' Association	12. Water User's Association 13. Equb 14.Other,	4. Farmer research group 5. Savings and credit	11. Other, specify……	4. Other specify……	4. Group ceased to exist 5. Other, specify……

6. Women's Association 7. Youth Association	specify…… ….	6. Funeral group 7. Tree planting and nurseries

9.10 if yes for 9.9 how?

Part Ten: Extension visit and Technology utilization

No.	Question	Options	Response
10.1	Did you make contact with extension agents in 2012/13 E.C?	1=Yes 0=No	
10.2	If Yes to 10.1, how frequently do you usually discuss agricultural matters with the Extension agents?	1=Weekly 2=Monthly 3=Quarterly 4=Arranged on discussion	
10.6	Do you have access for irrigation water?	1= Yes 0=No	
10.9	How often do you access irrigation water in a week?	1. Every day 2. Two days a week 3. Three days a week 4. Four days a week 5. Once in a week	
10.11	Do you have access to credit?	1= Yes 0=No	
10.12	If yes for 10.11, How much did access in 2012/13?		
10.13	Do you think you can get credit access anytime you want?	1= Yes 0=No	
10.14	Do you have bank account?	1= Yes 0=No	
10.16	Do you use agricultural inputs such as fertilizer and chemicals to Improve your farm productivity in 2012/2013?	1= Yes 0=No	

If yes to 10.15, give details of the types you use, amount and source technologies

No.	Type of technology	Quantity (K.G)
	UREA	
	DAP	
	Pesticides	
	Herbicides	
	Fungicides	

1.2 Conversion rates

The conversion factor of common bean residue is 1 crop to 1.2 residue (1K.G crop = 1.2 K.G residue of common bean) (Funte et al; 2009)

Tropical Livestock Unit (TLU) Conversion factor is Oxen= 0.5, Cows= 0.5, Donkeys= 0.5, Horses= 0.8, Mules= 0.5, Small ruminants (sheep and goat) = 0.1, Chicken= 0.01.

1.3 Administrative hierarchy of the Ethiopian government

The country is divided in to 9 regions and 2 temporary federal cities. The nine regions are again divided into different "*zones*". Each zone has different "*districts*" and the smallest unit of administrative unit in the country is the sub division of "*district"* called "*kebele*". There are other units bellow "*kebele*", sometimes they are called "*gere*" or "*ketena*" but they are not formally know in the administrative hierarchy.