DETERMINANTS AND ROLE OF FARMERS' SEED AND SEEDLING MULTIPLICATION IN THE SNNP REGION SEED SYSTEM

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DEDICATION

I dedicated this thesis manuscript to my late wife Serkalem Chalachew whom I lost during my stay here for MSc. course and my beloved children Ruth and Tewodrose Gezahagn

STATEMENT OF AUTHOR

First, I declare that this thesis is the result of my own work and that all sources or materials used for this thesis have been duly acknowledged. This thesis is submitted in partial fulfillment of the requirements for MSc. degree at Haramaya University and to be made available at the University's Library under the rules of the Library. I confidently declare that this thesis has not been submitted to any other institutions anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHY

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ABBREVIATIONS AND ACRONYMS

ADLI	Agricultural Development Lead Industrialization
AISCO	Agricultural Input Supply Corporation
ARDO	Agricultural and Rural Development Office
BoARD	Bureau of Agriculture and Rural Development
BoFED	Bureau of Finance and Economic Development
CADU	Chilalo Agricultural Development Unit
CC	Contingency coefficient
CSA	Central Statistics Authority
CTA	Technical center for Agriculture and Rural cooperation
DA	Development Agent
EARI	Ethiopian Agricultural Research institute
ESE	Ethiopian Seed Enterprise
ESIA	Ethiopian Seed Industry Agency
FAO	Food and Agricultural Organization
FBSPMS	Farmers Based Seed Production and Marketing Scheme
FSE	Farmers Seed Enterprise
GNP	Gross National Product
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IDA	International Development Agency
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Institute
ILRI	International Livestock Research Institute
Masl	meter above sea level
MoA	Ministry of Agriculture
MV	Modern Variety

ABBREVIATIONS AND ACRONYMS (Continued)

PASDEP	A Plan For Accelerated and Sustained Development to End Poverty
RCA	Regional Cooperative Agency
SARI	Southern Agricultural Research institute
SMIP	Sorghum and Millet Development Program
SNNPR	Southern Nations Nationalities and Peoples' Regional State
SSA	Sub Saharan Africa
VOCA	Volunteers Overseas Cooperative Assistance
USAID	United State Agency for International Development
WARDO	Woreda Agriculture and Rural Development Office
WBG	World Bank Group
WTC	Wondo Trading Company
WVE	World Vision Ethiopia

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DETERMINANTS AND ROLE OF FARMERS' SEED AND SEEDLING MULTIPLICATION IN THE SNNP REGION SEED SYSTEM

ABSTRACT

Increasing the production and productivity of the crop sub sector is one of the measures taken in Ethiopia to assure food security of more than 70 million people and escape from long-lived poverty persisted in the country. This improvement can only be realized if modern technologies are utilized from which seed take the first priority due to its nature. However, the low capacity of Government Company, sluggish growth of the private sector in the seed industry and the nature of the demand of subsistent farmers obliged to seek for another alternative seed source. Farmers' based seed multiplication is the main alternative. Even though farmers' based seed multiplication contributes to livelihood of farmers besides improving seed supply like any other technology, the participation of farmers in the multiplication is constrained by different farm characteristics, socio-economic and institutional factors. Hence to evaluate the contribution and identify most influencing factors of farmers based seed multiplication in SNNP region four types of seed multiplication (coffee, wheat, apple and potato)were considered for the fact that farmers commonly multiply in their respective Woredas in the region (Dale, Angacha, Chencha and Hula Woredas). Primary and secondary data were employed in this research mainly primary data were used from interview result of 60 randomly selected farmers from 2Kebeles of each indicated Woreda and totally 240 sample farmers.

In order to describe and compare different categories of the sample units with respect to the desired characteristics, mean, standard deviation and percentage were computed. Further more t-test and chi-square test were used to supplement or testify significance of results obtained. A Tobit model was employed to identify the determinants variable to farmers' involvement in seed multiplication activity and intensity of multiplication. In order to analyze the contribution of involvement in seed/seedling multiplication and evaluate the performance of seed market in the region gross margin analysis and Gross Marketing Margin analysis were employed besides qualitative description of the situation.

The Tobit analysis result reveals that, access to credit, distance from market and main road, farm land size, ownership of farm oxen and radio, training, family size and availability of extension service significantly influence both the probability of participation and intensity of seed multiplication. The seed quality control and certification system in the region was not well organized to assist seed producer farmers.' Moreover poor technical, manpower and infrastructure capacity of the farmers' cooperatives found to have drawback on farmers based seed multiplication. Uncoordinated support and unreliable intervention both from governmental organizations and non governmental organizations' also considered to affect farmers seed multiplication and the overall seed system. Nevertheless, there is difference among crop type, the gross margin analysis approves that seed/seedling multiplication business in those sample Woredas increase the gross return of farmers that they would get from the same size of land on which they have been producing other common crop type, besides its contribution in gap filling. So, responsible government organizations need to give attention to the capacity building of rural financial institutions and cooperatives, improving the extension service delivery and seed quality control and certification system.

1. INTRODUCTION

1.1. Background

Ethiopia presents one of the most important global challenges in agricultural development. It is among the poorest countries in the world, and its agricultural sector accounts for about 40 percent of national GDP, 90 percent of exports, 85 percent of employment, and 90 percent of the poor. Rural poverty is further compounded by extreme land shortages in the highlands—per capita land area has fallen from 0.5 ha in the 1960s to only 0.2 ha by 2005—and by a marginal productivity of labor that is estimated at close to zero (World Bank ,2005 as cited in Byerlee *et al*.,2007).

The agricultural sector in Ethiopia is not yet adequately commercialized to bring about rapid change in production inline with increasing population pressure. Food production and productivity do not keep pace with the ever-increasing population, which is 3.3% per annum and characterized by the prevalence of poverty and food insecurity (Yeshi, 2002 as cited in Yenealem, 2006).

The problem is not that Ethiopia is poorly endowed with agricultural resource, Ethiopian land is generally considered to be among the most fertile soils in Africa, and it has been estimated that over 70% of the land is suitable for agriculture; instead the problem is that new technologies have not been permitted to make any inroads into Ethiopian agriculture (Kidane and Alber, 1994). Agriculture in Ethiopia is caught in a low input-low output trap, due in part to low levels of investment, low technology application, and low capacity. The solution needs to involve a structural change, for which major capacity development is needed, including a quantum change in human capacity, input supply, technology adoption, and provision of infrastructure (PASDEP, 2005). Specially, in order to increase the production and productivity of agricultural output, the use of modern agricultural technologies are vital, out of which fertilizer and high yielding variety of crops are the most important technologies to increase the level of crop production (Mesfin, 2005).

One of the most important inputs in agriculture is seed. Seeds form the foundation of all agriculture. Without seeds there is no next season's crop. The genetic traits embodied within seeds reflect and determine the nature of farming systems dependent on them. The genetic and physical characteristics of seed determine the productivity in line with the use of other agricultural inputs and improved cultural practices within the farming system. Improving the genetic and physical properties of seed can trigger yield increase and lead to improvement in the agricultural production and food security. In order for seed to act as a catalyst in agricultural transformation, however improved seed has to be made available to a broad base of farmers on continuing base. Most farmers still do not have access to commercially processed seed at a nearby retail outlet. Many released varieties have never been widely disseminated (Rohrbach *et al.,* 2002).

Variety improvement for cereals, pulses, and oil seed crops has long history in Ethiopia that started when the then Alemaya College of Agriculture was established in the 1950s and the Ethiopian Agricultural Research institute (EARI) the then institute of agricultural research (IAR) in the late 1960s. Varieties from these institutions were first introduced to farmers in 1967 under Swedish-assisted Minimum Package Program at Chilalo Awaraga in Arsi Area. The Chilalo Agricultural Development Unit (CADU) supplied farmers with a package of inputs and services, which included improved seed, fertilizer, pesticide, credit, and extension advice. The success of CADU encouraged similar minimum package program in other regions by international agencies including IDA, USAID, and FAO in collaboration with the extension service of the Ministry of Agriculture.

However, crop improvement is a key area of agricultural research, which involves selective breeding to identify and develop crop varieties, promoting these varieties and associated management strategies through extension, and providing seed (and other inputs) through supply systems. The absence of effective formal seed system greatly reduces the impact of publicly funded plant breeding program. This failure of seed multiplication and distribution translated into negative rate of return to research investment (Tripp, 2001).

A core goal of the Government of Ethiopia , ADLI strategy was to raise cereal yields through a centralized and aggressive extension-based push focusing on technological packages that combined credit, fertilizers, improved seeds and better management practices(Byerlee *et al*.,2007).This government strategy resulted tremendous input demand especially for improved seed and fertilizer . How ever the supply side did not show significant improvement.

Even though , the Ethiopian Seed Enterprise which has remarkable place to innovate, produce and distribute improved seed with different variety being the sole owner of the market before liberalization. Later with the emergence of private seed company like Pioneer Ethiopia that supplies hybrid maize seed, also some vegetable seed dealers and retailers created significant change in seed availability though the gap between demand and supply still remain unchanged.

For instance, as the census of 2004/05 shows the total area covered by cereals in the same production year was 7,637,524 hectares but from this only 346,000 hectares (4.5% of the total cultivated area) was covered with improved seed. This figure was reported to have significant difference from the total area applied with fertilizer which was nearly 3 million hectares (CSA, 2004/05) for the same period. So unless alternative mechanisms are designed and executed it is difficult to be successful in the sector.

In recent years' research, extension and development programs have adopted community-based participatory approaches that unify the efforts of various stakeholders concerned with agricultural development with the aim of overcoming formal research-extension linkage weaknesses and improve localized seed availability on a sustainable basis. One of these approaches has been community-based secondary seed multiplication schemes whereby farmers, roles are shifted from passive recipients to that of active seed producers and eventually serve as secondary seed sources and disseminators. Reportedly such efforts are found to increase access of many farmers within the shortest time and at low cost for they are essentially grafted on to the local social networks and farmers-to-farmers extension approaches (Abera *et al.*, 2001).

Southern Nation Nationality and Peoples Region has also designed and implementing program that is expected to increase improved seed supply. The major component is the farmers' seed multiplication and distribution scheme. This scheme was started by the then Ethiopian Seed Industry Agency, which targeted transforming the informal seed sector to modern seed source. Currently based on the experience gained during the project life (Farmers Seed Multiplication and Distribution Scheme), and the intervention of different NGO s' farmers are producing seed of cereal crops and different fruits seedling for market.

For the success of this farmers based seed multiplication different actors have been involved in the regional seed system including Southern Nation Nationalities and peoples Region Agriculture and Rural Development Bureau(BoARD), Southern Nation Nationalities and Peoples Region Research Institute(SARI) ,Cooperatives and NGOs'. Those organization support seed producer farmers in availing basic seeds and complimentary inputs, training, help seed producer farmers to get market for produced seed and on other related activities.

1.2. Statement of the Problem

Agricultural productivity increases from the adoption of new seeds derived from on-going genetic improvement, disease and insect resistance, drought tolerance and post harvest features. This increase can be substantial, especially if farmers continue to renew seed stock and adopt new varieties (Maredia *et al*., 1999).

There are two sources of seed in the SNNPR to renew the seed stock. The formal one, which is dominantly supplied by Ethiopian Seed Enterprise for cereals and different types crop seeds .Seedlings of different fruit and other perennial crops multiplied in government and NGOs' owned modern nursery sites. The informal seed sources that include a seed retained by the farmers from current harvest and obtained through farmers-to-farmers exchange. However, both have their own drawbacks. That is, the capacity of the formal sector is limited to supply the nations demand and the traditional one (informal system) is incapable of producing improved quality seed in the existing situation.

One of the alternative measures taken to improve seed supply sustainably in the region is farmers based seed multiplication. Involvement of farmers in seed/seedling multiplication has many benefits including increasing agricultural production through increments in productivity, increasing the income of small-scale farmers and improving agricultural seed and other input markets. In addition, it is possible to create changes that will improve the living standard of the rural population and promoting the transformation toward a sustainable commercial agricultural sector.

The farmers based seed multiplication comprises both informal and formal seed systems by its nature and actors involved. There are different stakeholders participating in the regional seed system for implementation of farmers based seed/seedling multiplication: the SNNPR Agricultural Research Institute (SARI), SNNPR Agricultural development Bureau (BoARD), cooperatives, ESE, NGO and the farmers themselves.

Currently, besides, direct government interventions through different programs to fulfill the seed demand of the region, farmers in the region are involved in different types of seed multiplication. That is replicating modern way of seed and seedling multiplication started by governmental and non governmental organization in their vicinity.

In Angacha Wereda, farmers have been multiplying cereal seed since the implementation of seed project financed by IFAD and implemented by ESIA in cooperation with regional agricultural bureaus. The farmers involved in this scheme to produce seed with contractual agreement to ESE. Out of the contractual agreement cooperative union are currently the main marketing bodies for seed produced by farmers' .Even though there is not sufficient supply farmers get both basic and certified seed to multiply, directly from ESE or through WARDO.

Chencha Woreda has been one of the potential apple fruit source and the main apple seedling supplier to the country. This fruit was introduced by church organization known as Kalehiwote Church found in Chencha Woreda in 1970 (Hailemariam *et al*.,2004). Nowadays farmers in Chencha Woreda have been producing apple seeding mainly for the market, using parent material including skill initiated from the indicated church.

Coffee, as one of endogenous and the major export crop, seed selection and seedling multiplication by farmers in the potential areas of the region has a long history as one means to expand the production. But the establishment of Ethiopian Coffee Board in 1957 and successive programs and projects implemented changed this traditional way of seedling production. Those governmental activities which focused on dissemination of improved variety and distribution of seedling produced on government run nursery sites, contributed to introduction of modern seedling production technology to the farmers. Currently, many farmers in Dale Woreda of Sidama zone are producing seedling both for their consumption and market.

This trend is believed that it contribute to the overall realization of agricultural development objective of the region, by increasing the supply of seed/seedling of different crops. However the growth in participation of farmers and amount of seed produced and supplied by seed producers farmers was below the level it can satisfy the seed demand of the region.

Seed or seedling multiplications of improved variety require modern agricultural practice and application of recommended inputs. So as any other new technology adoption, the participation of farmers in seed/seedling multiplication could be influenced by different socio economic and institutional factors which are location specific. A study made (Maredia, *et al*., 1999) also shows that, due to weak linkage and integration among the stakeholders and especially poor marketing system, seed multiplication schemes may fail to give the intended service to the farmers. Thus, for developing a sustainable seed system there is a need to have greater integration among the different stakeholders, broader participation and decentralization.

Even if farmers based seed/seedling multiplication is performed for a lengthy period of time in the region, there has been no study undertaken in the area of identifying the factors that determine the participation of farmers in the seed/seedling multiplication activities and its contribution. Therefore, this study was initiated to identify factors determines farmers' participation decision in seed/seedling multiplication in the region and to evaluate the contribution of farmers' involvement in seed/seedling multiplication both for the producer farmers and the region as a whole.

1.3. Objectives of the Study

The supply of improved seed with required quality, alternatives, time and fair price is determined solely by the overall effectiveness and efficiency of seed system. So the general objective of this study is to evaluate or measure adequacy and effectiveness of the regional seed system with respect to seed multiplied by the farmers and contribution of involving farmers in multiplication of seed/seedling of different crops. The specific objectives are:

1. to identify factors that contributes to farmers' participation in improved seed multiplication activity
2. to analyze regional seed market performance for seed multiplied by the farmers
3. to evaluate the role of farmers based seed multiplication

1.4. Significance of the Study

Quality seed is vital to the success of our country's agricultural development. In the existing condition, one of the main sources of this quality seed is farmers based seed multiplication. So, this study along with the analysis of the situation of seed supply, has policy implication for the regional policy makers with regard to creating conducive environment for farmers based seed multiplication and in general formulating policies and strategies for the development of the seed sector. Besides, it would be a useful reference for researchers and other personnel interested in the area of study.

1.5. Scope and Limitation of the Study

This study mainly emphasizes on farmers based seed/seedling multiplication, that is farmers seed multiplication through contractual agreement with ESE and regional government assisted or recognized multiplication and distribution scheme. Based on this idea wheat seed, apple and coffee seedling and potato seed (bulb) were selected that are commonly multiplied by farmers in the region. Due to time and financial constraint, this research has been limited to only 4 Weredas and 8 *Kebeles* also only 4 seed and seedling types which taken from different type of seed/seedling commonly multiplied by farmers in the region.

2. LITERATURE REVIEW

2.1. Definition of Concepts and the Theoretical Framework

2.1.1. Seed

The importance of seed as the carrier of most important characteristics for crop production has been recognized since the early days of agriculture. Starting from 10000 years ago, harvesting seed from preferred plants has been the basis of crop domestication and consequently of present day agriculture (Louwaars *and Gam*, 1999).

Seed is the most important agricultural input; it is the basic unit for distribution and maintenance of plant population. It carries the genetic potential of the crop plant. It thus dictate the ultimate productivity of other input such as fertilizer, pesticide irrigation water etc., which build the environments that enable the plant to perform (Mugonozza, 2001).

Seed and other planting materials are the farmers' most precious resources, especially for smallholders in Sub-Saharan Africa, where agriculture is characterized by much risk and uncertainty (WBG, 1999). Seed is generally considered to be the most affordable external input for farmers, and many of its benefits are assumed to be 'scale-neutral'. So investments in crop improvement potentially can reach a wide range of farmers. While many other areas are also important for agricultural development – such as markets, credit supply, support institutions, and policies –access to appropriate seed is clearly the first step (McGuire, 2005).

The use of good quality seed of adopted and improved varieties is widely recognized as fundamental to ensure increased crop production and productivity. This is even more important in SSA in the view of increasingly available land, declining soil fertility and ever growing population; those facts increase the importance of promotion and use of good quality seed as a means to intensify food production (FAO, 1999).

The potential benefits from the distribution of good quality seed of improved varieties are enormous, and the availability of quality seed of wide range of varieties and crops to the farmers is the key to achieve food security in SSA. Enhanced productivity, higher harvest index, reduced risks from pest and disease pressure, and higher incomes are some of the direct benefits potentially accrued to the farmers (FAO, 1999).

2.1.2.Seed system

Seed systems are composed of set of dynamic interaction between seed supply and demand, resulting in farm level utilization of seed and thus plant genetic resource. The seed system is essentially the economic and social mechanism by which farmers' demand for seed and various traits they provide met by various possible sources of supply (FAO, 2004).

The term seed system represents the entire complex organization, individual and institution associated with the development, multiplication, processing, storage, distribution and marketing of seed in any country. The seed system includes traditional (or informal) system and the non-traditional (or formal or commercial) systems. Legal institutions such as variety release procedures, intellectual property rights, certification programs, seed standards, contract laws, and law enforcement are also an important component of the seed system of any country. They help determine the quantity, quality, and cost of seeds passing through the seed system (Maredia, *et al.,* 1999).

Seed system participants may be relatively few or many, predominantly public or private depending upon the farmers that the system serves. In local systems of seed exchange, farmers often undertake most of the activities that define a seed system. As systems expand to national, regional, and international scales, participants will include the following: farmers, international agricultural research centers, private and public domestic seed enterprises, retailers and distributors, multinational seed companies, private research institutions, farmers associations and cooperatives, banks and credit institutions, trade associations, local governing bodies, donor agencies, national agencies and ministries, community groups (social, religious, etc.), agricultural universities, national agricultural research institutes and NGOs/PVOs. These participants may assume multiple roles in the process of seed provision, performing one or several activities (WBG,1999).

Seed systems, formal or informal, fulfill a series of functions that are basic prerequisites for expecting the best possible productivity from a crop in a specific situation. Healthy, viable seed of the preferred variety needs to be available at the right time, under reasonable conditions, so that farmers can use their land and labor resources with the best yield expectations. The wrong variety, sown at the wrong time with infected seed of poor germination potential, will seriously limit a farmer's expectation of production and productivity. Thus, any seed system has multiple functions to fulfill—for a range of farmers, farming conditions, and crops in a village, region, or country. A seed system can be assessed at any time according to how well it fulfills these functions. Conditions, situations, groups of farmers, or crops can be identified under which the specific system works well (Welfzien *et al.,* 2001).

Activities undertaken to supply seeds to farmers include research and development, multiplication, processing, distribution, and uptake. Other activities that may occur in conjunction with these include transport and storage, as well as quality control (such as seed certification). Seed provision to farmers also includes activities undertaken to influence the process, such as: pricing, financial and technical support, provision of inputs, communication and coordination, as well as market research and promotion. Finally, policy formulation underpins seed systems, defining the boundaries and opportunities for the conduct of all seed system activities (WBG, 1999).

2.1.3. Formal seed system

According to FAO (1999), formal seed system as a sector comprises all seed program components, namely; plant breeding, seed production, processing, marketing, extension, quality control and certification, that interact among themselves and usually regulated by law. The formal seed sector was set up and organized with the principal goal of diffusing quality seed of improved varieties developed by formal breeding programs. The principal sources of materials for formal breeding programs are the *ex situ* collections of gene banks. Gene banks contain materials that were originally collected from farmers' systems, that is—in the case of cultivated plants—materials that were developed and maintained by farmers.

The formal system has been relatively successful for well-endowed, high-potential areas, but much less successful in more variable, marginal areas. This is partly explained by the fact that improved varieties tend to be poorly adapted to farmers' preferences and production environments. In general, plant breeders have lacked understanding about what farmers in these areas need, developing only few, genetically uniform products for on-farm testing. Evaluation and selection of new materials was on-station, where conditions are different from those in the target environment (Almekinders, 2000).

The formal seed system can be characterized by a clear chain of activities. It usually starts with plant breeding and promotes materials for formal variety release and maintenance. Regulations exist in this system to maintain variety identity and purity as well as to guarantee physical, physiological and sanitary quality. Seed marketing takes place through officially recognized seed outlets, and by way of national agricultural research systems. In formal seed production, seed multiplication occurs through several generations rather than continually recycling the seed of one generation, to avoid building up physical or genetic contamination over time in the same lot of seed (Louwaars *et al*., 1999).

A major challenge for formal seed supply is to produce sufficient seed of all varieties needed, and deliver it to farmers in a timely manner. This requires considerable organization, time, and space, and incurs risks due to costs and production. To start with, significant area and effort is involved in seed production, though this varies by crop according to its multiplication rate (i.e. how much usable seed is produced per seed sown (McGuire, 2005).The study made by Baniya *et al* (2003) signify that, the formal system focuses more on the interests of the seed company, and has more access to biotechnology and plant breeding techniques, so this seed system generally neglects the indigenous knowledge. The market is dominated by a few suppliers with potentially serious implications for technology choice and price fixing.

2.1.4. Informal seed system

Informal or on-farm seed system, vary among country, region and crops. They rely on seed-saving practices, that is, keeping parts of the harvest for planting in the next season. The system usually plants local varieties of seed kept from the previous year's harvest, obtained from neighbors and/or the local market .This is the predominant system for food crops in subsistence agriculture .It is estimated that in developing countries, the informal seed system is responsible for more than 80% of the total area planted with subsistence crops .It is very resilient system, which is very active even with out the support of public or private institutions. On farm seed system are essential for improving food security for developing countries. They will likely to continue to be the main source of seed for subsistence crops in the world. This system is not market oriented; seeds are usually produced for consumption .Some surplus can be bartered with neighbors or sold to local grain dealers (FAO, 2004).

As a study made by GTZ (2000) clearly states, for small-scale farmers in developing countries, management of seed is of crucial importance and forms an integral part of their crop production systems. For many centuries, farmers have developed and maintained their own plant genetic resources, based on local means of seed production, selection and exchange. Introgressions, mutations and introductions from elsewhere are the common sources of new genetic material in a community. Newly introduced varieties are subject to farmers' experimentation, and when adopted they become part of the local gene pool. In many cases, this integration involves physical mixing of seeds and spontaneous crossing with other materials. The informal seed sector has strong local character, without necessarily being confined to a small geographical area.

2.2. The Potentials and Limitations of Farmers Based Seed Multiplication

In the mid 1970, different governments and donors recognized the critical role of seed in agricultural transformation and began to provide substantial support for seed system development across the developing countries. Most of those resources were used to establish large scale parastatal seed corporation, technical laboratories, processing plant and certification department. In Africa, these efforts achieved only limited success in a few crops such as hybrid maize and sorghum, leaving the majority of smallholders un-served. Parastatal seed system supplied only about 10% of the total seed planted each year, about 60-70% of seed used by African smallholder is saved on-farm, and the remaining 20-30 % is borrowed or purchased locally (Maredia *et al*., 1999).

Global agriculture has experienced considerable technological development during the last four decades that has been responsible for the expansion of the world food production. The innovation comes from fields of knowledge and well incorporated in to the agricultural activities. However, commercial agriculture have benefited more from this process than the small scale farmers involved in traditional agriculture due to the latter marginal access to the knowledge and technique. The breeding program of major crops and the diffusion of the high yield varieties that they release follow the same pattern (Gusti, 2004).

In addition, the national agricultural research institute plant breeding strategies often don't address the need and the demand of small farmers, more subsistence oriented farmers. Because the demand of subsistence oriented smallholder farmers are more interested in the characteristics such as storage quality, test, and resistance to pest (Maredia *et al*., 1999). Due to this small-scale farmers in developing countries rely largely on seed from their own farm or from other sources in the community. In some countries, commercial enterprises play a significant role in supplying seed for cross-pollinating crops and vegetables. The role of the public sector in supplying seed is of little significance for most small-scale farmers and crops. While the farmers' seed supply is far from ideal, the public seed sector faces financial and institutional constraints that limit its performance (Almekinders, 2000).

Due to the prevailing condition in the most SSA countries, farmers based seed multiplication systems appear to be the most appropriate strategy for developing effective seed supply system in the region (FAO, 1999). Decentralized farmers-based seed enterprises have several advantages over more formal centralized operation. Some of the advantages are seed production costs are low, seed is available to farmers at the right time, users can purchase the quality of seed desired and seed producers are well informed about the seed and variety characteristics valued by farmers (Maredia *et al*., 1999).

In addition, the benefit of small scale farmers from commercial seed activities include, increasing production through increment in productivity, increasing the income of the small farmers and improving agricultural seed and other input market, in addition it is possible to create changes that will improve the standard of living of the rural population, reducing poverty and improving food security and promoting the transformation toward a sustainable commercial agricultural sector (Gusti, 2004).

The implementation of such scheme towards improving the traditional agriculture by certain changes in the local seed system, it promotes an innovative process or technological change aimed at better insertion of seed system in to the market through improving the current local seed system. Such improvement entails transforming the small scale farmers group in to market oriented seed enterprise dedicated to the production of seed of improved varieties. Links between the informal and formal seed system are then established to develop a favorable environment for small scale farmers to get in to the seed business. The replacement of local seed with better quality seed produced by local farmers will make the benefit of improved seed varieties available to them (Gusti, 2004).

There are some specific limitations to the development of local seed system. There may be some economic limitation with horticultural crops, for instance, since the cost of producing those seeds in small-scale is usually not cost effective. Hybrid seed production require isolating seed production fields and there for unsuitable for small-scale farmers communities. Another limitation relates to the need for investment in infrastructure such as seed conditioning machinery, tractors and implements. There are how ever, seed market niches that can be occupied by organized groups of small-scale farmers. Those opportunities are usually neglected by the formal system because the market is not large enough to attract large-scale farmers or because they require hand labor. These market niches need to be identified and suitable condition developed in order that groups of small-scale farmers may explore them (Camargo *et al*., 2004).

Tripp (2001) stated that, local level seed project are subject to a number of problems, there is often confusion about goal and target participants and lack of clarity about whether the principal objective is to increase the incomes of the participant or to develop sustainable source of high quality seed. One of the major failing of most local seed projects has been to ignore the importance of transaction cost in process. The projects are often confused with the multiplication, seed provision, overlooking the fact that seed multiplication is only one aspect of the process.

The other concern is the potential risk posed to small-scale entrepreneur if seed stocks go unsold. Mechanisms for assessing the potential demand for seed and protecting the seed seller against the liability for unsold stocks need to be explored. The second issue involves the regulatory role of the government in an increasingly decentralized seed system. Key equations include; how will farmers be assured of the seed quality? How can seed enterprise and farmers be assured that their contract will be honored (Maredia *et al.*, 1999)?

2.3. Seed Development, Production and Distribution in Ethiopia

The Ethiopian seed industry is composed of formal and informal sectors as well as public and private organization. The formal sectors include federal and regional agricultural research establishments, universities, the regulatory organ in the MoARD, and private companies. The informal sectors encompass millions of farmers, who continue to practice seed selection and preservation, just as their ancestors did (Abdisa *et al*., 2001).

The formal system is concerned with the development and distribution of seeds of modern or improved varieties, while local cultivars or landrace varieties are handled by the informal system. The line between the formal and informal seed sectors can become somewhat blurred, as seeds of modern varieties can be saved by farmers and eventually become considered a “local variety” after some years. In addition, in Ethiopia there have been attempts made by the government and NGOs to promote quality seed production and distribution through market channels for landrace varieties, although until now the volume they represent is quite small (Lipper *et al*.,2005).

The bulk of seed supply in Ethiopia is provided through the informal system. According to data obtained from the NSIA in 2003, the total demand for food grain seeds in the country is approximately 1.4 million quintals per year. In 2005 the formal sector provides around 200,000 quintals or between 10-15 % of the total. The remainder is made up by supplies from the informal sector.

Formal breeding and seed multiplication activities were conducted on an ad-hoc basis until the 1970s. In 1976, the National Seed Council (NSC) was set up to formulate recommendations for seed production in the formal sector and the release of varieties from the national research programs (Byerlee *et al.,* 2007). From their recommendations the Ethiopian Seed Corporation was founded in 1979 as a state enterprise, run through the Ministry of State Farms, Coffee, and Tea Development (Dabi *et al.*, 1998). It was renamed the Ethiopian Seed Enterprise in 1993, and restructured to answer directly to the Prime Minister's Office, according to a Regulation of the Council of Ministers (No. 154/1993). For simplicity, this account uses ESE to refer to both Corporation and Enterprise (McGuire, 2005).

To create the right condition for the establishment of strong seed system for production and supply of good quality seed to the farming community, the government formulated the national seed industry policy, which was issued in October 1992. The policies is instrumental to developing a healthy national seed industry conserving and sustain genetic resource, reinforcing crop breeding research and supplying of high quality seed to the farmers to participate in germplasm conservation as well as in the seed production and supply system. It also has an objective of creating a functional and efficient institutional linkage among seed industry participants (Tsgedingil, 2003).

A Ministerial Regulation No. 16/1997, which was enacted to cover registration of varieties, seed producers, processors, distributors, quality control, seed trade (import-export), etc. has been replaced by Seed Proclamation No.206/2000. The latest Proclamation is more comprehensive and creates stronger legal framework for the protection and control of the interests of all players in the seed industry. Moreover, field and seed standards prepared for 74 crops are officially issued for implementation. NSIA has built the necessary capacity to implement and enforce the standards (Getnet *et al*., 2001).

Despite the crucial importance of improved seed in bettering the livelihoods of small-scale farmers, in Ethiopia access to this invaluable technology is still constrained by many factors. One important factor is the underdeveloped seed industry. Independent studies have estimated a large annual demand for seed, which is never met or (in the case of hybrid maize and sunflower) is met only through imports (Alemu *et al*., 1998).

Study made by Abera *et al*., (2001) signifies that the supply of seed is constrained by the inefficiency of public seed enterprises, poor seed promotion, poor transportation, and inappropriate agricultural and pricing policies. Moreover, because high-yielding varieties perform well with fertilizers, the limited availability of fertilizers constrains demand for improved seed. As a result, in the peasant sector most seed is still produced by farmers themselves.

An important impetus for reform of the seed system was provided through the Seed System Development Project (Cr. 2741 ET), which was implemented from 1997-2001 through financial support from the World Bank and IFAD. This project had two main components: seed enterprise development and capacity building. The former component was intended to improve the supply of quality seed of landrace and modern varieties by providing support to the ESE. In addition, support for the promotion of seed multiplication among farmers through the Farmers Based Seed Production and Marketing Scheme (FBSPMS) came under this component (Lipper *et al*., 2005).

The intention was that this scheme would double the total national production of Certified Seed, while making this seed more available to farmers by virtue of the decentralized approach, as the seed could be sold directly to district MoA offices, or reach neighboring farmers through informal exchange. With this widely-dispersed approach, the FBSPMS sought to be more effective in meeting local demand, and supply seed in a timely and affordable manner. A further goal of the scheme is to organize the most successful seed-producing farmers into producer groups, and support these groups in becoming small independent enterprises specializing in seed production (McGuire, 2005).

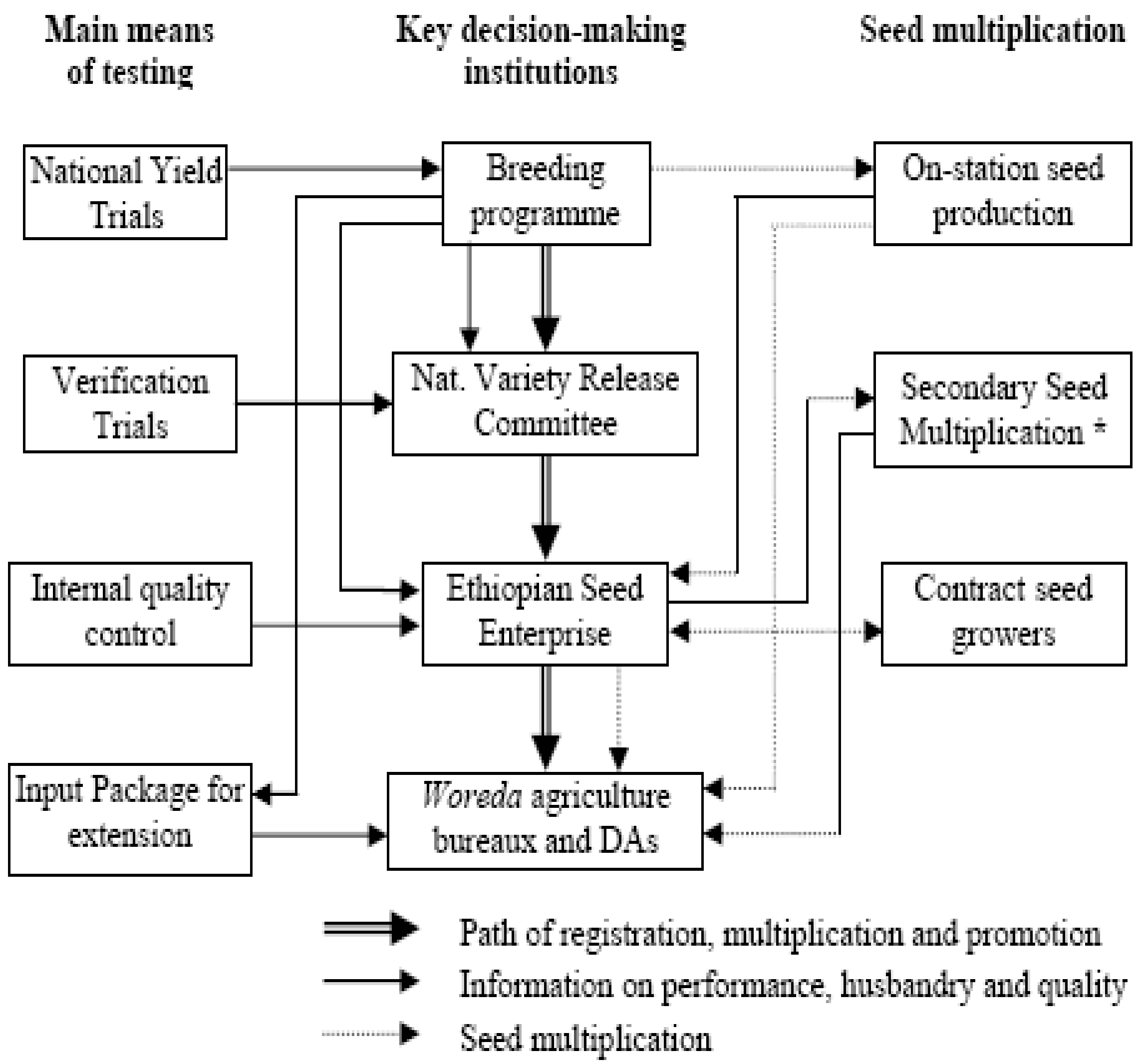

Figure 1 Different actor in the seed system of Ethiopia and their relations

(Adapted from Shawn McGuire, 2005)

2.4. Adoption of New Technologies

Adoption was defined as the degree of use of a new technology in long-run equilibrium when a farmer has all the information about the new technology and it's potential. Adoption refers to the decision to use a new technology, method, practice, etc. by a firm, farmer or consumer. Adoption of the farm level (individual adoption) reflects the farmer's decisions to incorporate a new technology into the production process. On the other hand, aggregate adoption is the process of spread or diffusion of a new technology within a region or population. Therefore, a distinction exists between adoption at the individual farm level and aggregate adoption, within a targeted region or within a given geographical area (Feder *et al*., 1985 as cited in Dereje, 2005)

Adoption of technological innovations in agriculture has attracted considerable attention among development economists because the majority of the population of less developed countries derives their livelihood from agricultural production and a new technology, which apparently offers opportunities to increase production and productivity (Feder *et al*., 1985as cited in Girmachew,2005).Agriculture progresses technologically as farmers adopt innovations. The extent to which farmers adopt available innovations and the speed by which they do so determines the impact of innovations in terms of productivity growth (Diederen *et al*., 2003).

Weir *et al*., (2000) emphasized that although farming methods in Ethiopia are still rather traditional, farmers in many areas do have the option of using new, higher-yielding crop varieties and some modern inputs, primarily chemical fertilizers. Rates of adoption of such innovations vary widely from one part of the country to another, allowing us to compare sites at different stages in the adoption and diffusion process.

According to Sunding *et al.(*2000), measures of adoption may indicate both the timing and extent of new technology utilization by individuals. Adoption behavior may be depicted by more than one variable. It may be depicted by a discrete choice, whether or not to utilize an innovation, or by a continuous variable that indicates to what extent a divisible innovation is used.

Adoption at the farm level describes the realization of a farmer's decision to implement a new technology. On the other hand, aggregate adoption is the process by which a new technology spreads or diffuses through a region. Therefore a distinction exists between adoption at the individual farm level and within a targeted region. If an innovation is modified periodically, however, the equilibrium level of adoption will not be achieved. This situation requires the use of econometric procedures that can capture both the rate and the process of adoption **(**Getahun *et al*., 2000).

Determinants of technology adoption encompass characteristics of the technology, features of the farming system, market and policy environment as well as the socioeconomic characteristics of the decision making unit (Ehui *et al*., 2003). Several parameters have been identified as influencing the adoption behavior of farmers from qualitative and quantitative models for the exploration of the subject. Social scientists investigating farmers' adoption behavior have accumulated considerable evidence showing that demographic variables, technology characteristics, information sources, knowledge, awareness, attitude, and group influence affect adoption behavior (Oladele, 2005).

Also according to Alemu *et al. (*1998), many variables can influence farmers' awareness and adoption of new varieties: human capital variables such as literacy; farm size; information sources such as agricultural extension or the research station; and distance from seed sources. Farmers with more land had a higher probability of adoption, probably because they are wealthier and have more land to experiment with improved wheat varieties. Extension visits also resulted in a higher probability of adoption by raising farmers' awareness of new wheat varieties and providing information about agricultural practices to accompany them. Oxen ownership increased the probability that farmers would adopt improved wheat varieties. Oxen owners usually participate more frequently in a demonstration, which gives them access to information on new technologies.

Distance is a major obstacle for adoption of technologies in developing countries. The impediment posed by distance is likely to decline with the spread of wireless communication technologies. It is a greater challenge to adopt technologies across different latitudes and varying ecological conditions (Sunding *et al*., 2000).

Farmers with some education attainment are also less likely to go without adopting one or more of the technology choices: the marginal effect of the education variable is significantly negative for the probability of no adoption. More educated households are commonly well informed and receptive, which translates to a higher likelihood of engaging in new technologies. This finding is in line with several previous studies which point out innovation is positively related to farmers' abilities to decipher and analyze information (Ersado *et al*., 2003).

The rate of adoption is defined as the percentage of farmers who have adopted a given technology. The intensity of adoption is defined as the level of adoption of a given technology. The number of hectares planted with improved seed (also tested as the percentage of each farm planted to improved seed) or the amount of input applied per hectare will be referred to as the intensity of adoption of the respective technologies (Nkonya *et al*.,1997as cited in Mesfin, 2005).

2.5. Partnership in Farmers Based Seed Multiplication

According to the study made on farmers based seed multiplication in Tanzania by Rohrbach *et al.* (2002), strong implementation partnership are essential to ensure both the success and sustainability of these seed projects. The role and responsibility of each implementing partners need to be clear both to the partner and to the other involved in the project. The full team should know who to call up on when problems or disputes arise. Clear responsibilities help to insure consistent implementation of the mandated program, and eventually the sustainability of those efforts.

Improved communications and collaboration between various participants in the seed sector is vital. Literally, hundreds of institutions, donors, and programs are currently active in African seed programs, all of which are to some extent directly or indirectly interrelated. Coordinated efforts are essential to facilitate system reforms and no initiative can achieve this objective by working independently as a program of a single donor or organization (WBG, 1999).

Farmers' seed production can be quite efficient and some producers will have potential to expand as specialized, small or medium-sized seed companies. Seed trade associations, government agribusiness promotion programs and especially NGOs have a potential role in promoting improvements in production, marketing, and distribution systems for traditional farmers' seed producers. This may involve training in seed production and handling, establishing linkages to sources of foundation seed, developing marketing skills and approaches, and promoting the transformation into commercial seed companies. For these interventions to be sustainable, they must be accompanied by appropriate legal changes, training and market development, and elimination of direct subsidies (WBG, 1999).

Recent years have witnessed a proliferation of NGO and research support to local level seed production and dissemination activities. These activities have a wide range of objectives including improved dissemination of modern varieties, preserving genetic diversity and quality, improving seed availability (time, place, quantity), and reducing the cost of seed and dependence on external sources (David, 2003). However, there are different NGO and relief agencies involved in the seed sector, the role played by them in the Ethiopian seed system is difficult to assess because their activities are dispersed and uncoordinated especially in the case of relief interventions. A few NGOs are now focusing on providing source seed, other inputs, and technical assistance aimed at strengthening local community-driven multiplication of improved open pollinated varieties, and in a few cases, enhanced local varieties. With regard to the distribution of relief seed after emergencies such as war or drought, NGOs were initially responsible for acquiring and providing early maturing varieties seed to service cooperatives at cost, including transport. However, the distribution of free seed by NGOs and relief agencies has caused negative effects; creating dependency on free services, disrupting the informal farmers -to-farmers seed exchange system, and weakening sustainable development in the seed sub-sector (Abdisa *et al*.,2001).

Tripp (2003) also verify that, seed system development requires support and funding and many countries may be able to take advantage of donor projects in the seed sector. Unfortunately, much of donor activity to date has not been supportive of sustainable seed sector development. Indeed, if we need an analogy from crop production, a strategy towards donor projects might be compared to weed control.

Donors and NGOs as well as policymakers should think more carefully about what types of community level activities are most likely to stimulate seed system development. There is now good evidence that despite its attractive image, the strategy of village-level seed enterprises is untenable. Part of the problem is mistaking seed multiplication (which all farmers are capable of) for the more complex process of market development. Community seed projects may achieve a greater impact by strengthening the capacities of farmers to test new varieties and to make them well-informed consumers of agricultural inputs. Local-level interventions should also develop farmers' crop marketing capacities (Tripp, 2001*).*

The study made by Bekele *et al. (*2006) pointed that, among the potential market-supporting institutions can that enhance market functions in rural areas are farmers' organizations such as Producer Marketing Groups (PMGs). Their potential in this process lies in enabling contractual links to input and output markets. They can facilitate collective marketing of agricultural outputs that will help reduce transaction costs related to the marketing of agricultural inputs and small marketable surplus emanating from a large number of widely dispersed small producer.

2.6. Seed Market

2.6.1. Nature of seed marketing

Seed marketing is the most important as well as a challenging aspect of seed industry because of the nature of the product. Seed being a living organism, its quality deteriorate faster. Thus, its shelf life is limited and it must be marketed with in the season. Another peculiar feature of seed is that it requires two to three years lead time to meet the specific requirements that is to meet the demand for particular seed, its production has to be organized at least two years in advance. The changes in the weather, price of crop, and price of competing crop, may change the prospects of demand for seed of particular variety at the commencement of sowing season (Singh, 2004).

The nature of seed demanded by farmers differs. Large- and medium-scale farmers use markets to purchase uniform genetic materials that are highly responsive to chemical inputs and embody specific characteristics (e.g., color, uniformity of grain size) rewarded by the market. By contrast, more subsistence-oriented smallholders may value characteristics such as drought tolerance, early maturity or good storage more than fertilizer responsiveness. Because of the small size of their land holdings, mixed cropping practices, and strategy of minimizing production risks by diversifying the variety base, smallholders also demand relatively small quantities of seed but for a number of varieties of the same crop and recycle seed over more seasons than larger commercial farmers (Maredia *et al*., 1999).

Seed demand from different users can be met by promoting a range of seed organizations with comparative cost advantages in supplying seeds of distinct commodities to different groups. For example, multinational seed companies can meet the seed needs of large-scale commercial farmers whose quality requirements and willingness to pay are higher than smallholder farmers. The seed needs of the latter group can be met more effectively by small-scale firms' or Community-based Seed Multiplication and Distribution Schemes such as farmers seed groups and Cooperatives (Maredia *et al*., 1999).

The largest problem faced by seed multiplication program else where in Africa is difficulty of building a sustainable seed market. Small quantities of seed are being profitable sold with in the village community. Sales are strongest for newly introduced varieties. But most small-scale farmers are unwilling to pay premium price to their neighbors for seed they can obtain from their own harvests (Rohrbach *et al*., 2002).

According to Tsigedingle (2003), from the total seed produced by farmers in 1998/99 in the SNNPR only 10.7% was purchased by as a seed WTC, 6.8% exchanged through informal system as seed to neighbors and relatives, 26.6% was used for home consumption and 55.9% sold as grain similarly from 1999/2000 produced wheat seed, 40.6%was purchased by WTC the rest used as own seed and sold as grain to the market.

To increase the sales of seed produced by farmers, promotion activities should be conducted to raise awareness of all farmers in villages under smallholder seed production programs (Kibiby *et al*., 2001). Promotional activities should focus on the advantage of improved seed and the quality of seed produced in their own villages by small holder seed producers. A primary objective of these promotional activities would be to increase the willingness of farmers to purchase seed from small producer.

The study made by Abdisa *et al.* (2001) stressed on that, if the farmers could not find sustainable and dependable market for his improved seed produced they never engage in the activities perhaps obliged to restrain from the activities. Those would lead farmers to be suspicious and reluctant to adopt any technology offered to them .Hence market information; on where and when to sale is quit essential, if informal seed production to be sustainable.

One of important factors that influence farmers' seed multiplication is the performance of the existing market channel. The choice of the marketing channel depends on a number of aspects. These include availability of markets, prices offered in the market, distance to the market and the potential of the market to absorb the stock on sale (Montshwe, 2006).

A commonly used measure of market performance is the marketing margin or price spread. A marketing margin is the percentage of the final weighted average selling price taken by each stage of the marketing chain. A wide margin means usually high prices to consumers and low prices to producers (Getachew, 2002 as cited in Rehima, 2007).

2.6.2. The role of quality control and certification with respect to farmers multiplied seed

Seed regulation involves a range of activities around deciding which MVs should be released, testing for purity in seed certification, regulating seed marketing, and protecting intellectual property rights. Such regimes aim to ensure the physical and genetic quality of formally supplied seed, and to build farmers' confidence in such seed, through certification tags or other means (McGuire, 2005).

Seed and grain prices vary substantially by quality, color, and point of origin. However, the inexistence of quality standardization makes price comparisons difficult (Lipper *et al*., 2005). If local-level seed production were to expand significantly then some formal system of quality control would be needed (Tripp, 2001).

Seed certification is the "official" seal declaring that the "certified" seed has been grown from a proven, tested and recognized genetic source, and that it has the stipulated germination percentage, purity, health and moisture content. Quality control checks adulteration of seed by seed marketers and should be enforced regardless of whether certification is mandatory or not (WBG, 1999).

Seed certification follows a kind of chain-control system, where the variety's identity and purity are checked from the very first generation (commonly called 'breeder's seed') through a prescribed number of generations to arrive at sufficient quantities of final seed that can be distributed to farmers. Every generation of seed has its own procedures and standards, which are monitored through checks, documents and seed production fields. Standards include, for instance, the distance to neighboring fields with the same crop or to weeds that may cross with the seed crop, the number of allowable off types, and so on. Certification also involves strict procedures for labeling and sealing seed packs. Seed certification thus requires a very organized formal system, and is normally reserved for well described and stable varieties (Louwaars *et al*., 1999).

Standards are "Rules of measurement established by regulations or authority" and the grades thereof a system of classification based on quantifiable attributes (Eshetu, 2004). Establishing a common system and terminology has several benefits, which include:

- Make market information meaningful.
- Products can be sold by weights, measures and description in the form of grades.
- Products can be pooled into large units through blending and upgrading.
- Enables diverse market mechanisms such as future trading, commodity exchange, and inventory credit (Warehouse Receipt System) etc.
- Facilitate resolution of disputes regarding quality.

However, the regulatory and legal framework of the national formal seed system in many countries becomes a factor that limits the development of the informal seed system (GTZ, 2000). Some countries, such as India, now recognize this by applying an intermediate 'farmer-produced seed' certification to good quality seed produced by small, local enterprises, designating an appropriate and accessible standard for decentralized seed production (McGuire, 2005).

3. METHODOLOGY

3.1. Description of the Study Area

3.1.1. Southern Nation Nationality People Regional State

Southern Nation's Nationalities and Peoples Regional State (SNNPR) is one of nine regional states in Ethiopia. It is located in the southern and south western parts of the country .There are 13 zones and 125 Woredas in the region.

3.1.1.1. Physical feature

SNNPR is astronomically roughly lies between 4^0.43'- 8^0.58' North latitude and 34^0.88'- 39^0.14' East longitude. It is bordered with Kenya in the south, Sudan in the southwest, Gambella region in northwest and Oromia region in north and east.

The region has very divers agro ecological conditions ranging from *Kola and Kefil-bereha* (hot arid climate type) in the southern most parts such as the flat plain of Debub Omo Zone to a *Dega and kefil-wurch* (tropical humid type) the highlands of the North and North west. Between these extremes the climate is defined to be *Woina Dega* (Tropical sub-humid type). From the total area 34% is moderately suitable for settlement and crop production. In general, about 49% of the region lies under *kola* type of agro-ecology while the smallest proportion about 0.2% lies under *Wurch* conditions.

Figure 2 The Map of Southern Nation Nationality and People Regional State

3.1.1.2. Population

According to BoFED (2006), the total population of the region was 14, 489,705 having 20 % share of the countries population with 10% of the total area of the country. Therefore, with an average population density of 131 persons per sq.km, SNNPR is one of the most densely populated regions in the country. The age distribution of the population revealed that the young (1-14 age) and the old age (65 and above years) account for about 47 % of the population.

The region holds about 56 ethnic groups with diversified language and identities, which are categorized under Cushitic, Omotic, Nilosehara and Semitic super language families. Based on such ethnic and linguistic diversity, the region at present is divided in to 13 zones, which are further sub divided into 125 Woredas and 8 special Woredas (BoFED, 2006).

3.1.1.3. Agriculture

Agriculture is the dominant economic activity in the region. Sedentary farming is dominantly practiced in the highlands while livestock herding supplemented with archaic flood retreat farming is the basic livelihood of people in the marginal lowland areas. The region has also been known in cash crop production such as spices and coffee in the country.

Out of the total land area of the region 29% is cultivated, 20.17% is cultivable, 15.76% used for grazing, 12.77% is covered with forest, bush and shrubs and remaining 22.3% used for other purpose. From the total rural household 76.2% live on mixed farming. The rest 14.7% and 9.1% produce crop and livestock only (pastoralists) respectively. Concerning the land holding of farmers, 55% of farmers have less than 0.5 ha of farm land. The remaining 40% have 0.5 – 2 ha, and only 5% of farmers have more than 2.0 ha of land. The fragmentation of this farm land is mainly due to population density of the region. One of important means of production for subsistence farmers is ox. However, according to (BoFED, 2006) 51% of the total farmers in the region have no ox and 24% of the total farmers have one ox. Only 25% have 2 and more oxen.

The major crops produced in the region are (Table 1) maize, sorghum, teff, wheat, coffee and root crops. The dominant crops are maize which is one of the staple foods in the region and coffee as the major exportable agricultural product. This region contributes around 40-45% of annual average export of coffee (BoARD, 2006).

Table 1. Area coverage and production of major crops in the region during 2005/06 cropping season

Types of crops	Area coverage (ha)	Production (quintals)
1. Maize	672,768	23,546,880
2. Sorghum	172,480	2,113,330
3. *Teff*	286,653	2,292,719
4. Wheat	240,595	6,506,258
5. Barley	149,961	2,044,860
6. Haricot bean	115,126	926,274
7. Root crops	87,346	8,618,328
8.Coffee	102,000	471,130
Total	1,724, 929	46,519,779

Source: SNNPR Bureau of Agriculture and Rural Development (2006), Annual Report,

3.1.1.4. Input Distribution

Farmers in the region have been utilizing different agricultural inputs which increase the productivity and production of their small plot of land in order to assure their food security and increase household income. Even though there are different types of agricultural inputs that can increase the production and productivity of crops and livestock's, the dominant inputs utilized are seed and fertilizer. According to BoARD (2006), in the year 2005/06 283,878 quintals of fertilizer and 21,980 quintals of improved seed were distributed to the farmers.

The distribution of those inputs in this region carried out by different organizations and companies. Fertilizer has been distributed mainly by primary cooperatives and unions, AISCO (Agricultural Input Supply Corporation) and WTC (Wondo Trading Company). Besides ESE, that is the dominant improved seed source of the region, Pioneer Ethiopia and other private companies distributing different variety of hybrid maize and other cereal crops seed in the region. Currently, farmers in the region are becoming seed source in the potential Woredas. They are multiplying mainly wheat, *teff* and bean seeds. For instance in the year 2006, farmers used to multiply different types of cereals seed on 7,021 ha of land.

The major sources of fruit seedlings are farmers, governmental organization and NGOs. The supplies of fruit seedlings have no definite way. It is different for each type of fruit and areas in the region .However, the involvement of farmers has significant place in the production and distribution of seedling of fruits. For instance, farmers in Gamogofa zone had been produced and sold annually around 139,207 apple seedlings in average through their union to different customers in the region and out of the region. Farmers are also involved in coffee seedling multiplication. Currently, the coffee seedling produced by farmers' share 76% of the total seedling supply of the region. Vegetable seeds have been distributed by small traders in each locality and Woredas agricultural office, which is imported by private companies and AISCO.

3.1.1.5. Institutional service

Agricultural extension is of paramount importance to introduce better agricultural practices and improved technologies to smallholder farmers in a country like Ethiopia where the traditional practices are dominating. The agriculture and rural development bureau through its technical experts and development agents at community level has been providing agricultural extension services in the region.

In order to give effective extension service to the farmers the region assigned 3 DAs in each *kebeles* who were graduated from ATVET colleges specialized in Crop Production and Protection, Animal Husbandry and Natural Resource Management. Currently there are 12,801 DAs in the region. The Southern Agriculture Research Institute (SARI) with its 4 centers and more than 12 sites has been carrying out different researches that increase the production and productivity of agriculture in the region.

In the region there are 25 unions 1,895 primary cooperatives with 963,603 members' and 194,889,205 birr capital. Those cooperatives started their activity by distributing fertilizer which obtained from Wendo Trading Company and AISCO. Today they diversify their activity to involve in output marketing and seed distribution and enhance their capacity from mere distributor to importer of fertilizer.

3.1.1.6. Infrastructure

The widely used means of movement of people as well as goods from one place to another in the region is road transport. At the end of 2004, the region has total road length of 8,250 km., Out of which 421 km is constructed from asphalt and 4,778 kms is gravel road constructed by federal road authority, while the remaining is rural road which constructed by the region. These indicate that the region has the road density of 74 m per square km. Except the remote woredas of Bench Maji, Debub Omo and Gamo Gofa Zones; the region is considered as accessible for transport. In addition to road transport, there are air flights twice a week from Addis to Jinka (debub Omo zone) and Tepi (Sheka zone). Around 48% of the region's residents were obtaining clean water from 6,346 different capacity wells and developed springs with point and net worked distribution.

3.1.2. Description of the specific study areas (Sample Woredas)

3.1.2.1. Angacha Woreda

Angacha Woreda is found in Kembata Tembaro Zone with a distance of 157 km from south of Hawassa, capital city of the region. The total area of this Woreda is around 380.6 km^2 or 37,360 ha. From the total area the woreda 76.62 % is already under cultivation and 17.53% used as grazing land and forest area only 5.85 % remain as cultivable land.

The mean annual temperature of the Woreda is between 12.6-20 ^{0}c and mean annual rainfall is 1001-1400mm also the altitude ranges from 1501-3000 masl which shows the climatic condition is suitable to main cereal crops.

The total population of this Woreda was 214,992 and from this 107,866 was male and 107,126 were female. The age distribution of the population revealed that the young (1-14 age) and the old (65 and above age) accounts for about 46 % of the total population (BoFED, 2006).

Even though oxen are the main power source especially in the area of cereal crop production, from the total farmers in this Woreda 47.27% of farmers have no oxen. The remaining 45.36% have one ox and only 7.37% have two and more oxen.

Improved cereal seed is important agricultural input in this Woreda. From the commonly used seed types by the farmers, wheat, barley, bean and *teff* have been distributed by ESE. However, the supplies from this company were below the required quantity and it was far below the potential demand of the Woreda. For instance the wheat seed demand in 2006 was 2,700 quintal, whereas the amount supplied by ESE was only 300 quintals, the difference was covered by grain and farmers multiplied seed.

Inability to satisfy the demand for improved seed is not a recent issue. Due to this, Angacha Woreda has become one of the first implementer of seed system development program launched in 1996 by NSIA. Currently farmers based seed multiplication implemented by BoARD, SARI, cooperatives and ESE as the main stakeholders to give technical support, avail agricultural input and purchase seed produced by farmers to redistribute to farmers in the Woreda or others. The main marketing bodies are ESE and cooperatives. ESE has well organized system to redistribute seed purchased from farmers with contractual agreement of 15% premium on current market price. However cooperatives lack the capacity to involve effectively in the seed market. In the year 2005, for instance, Angacha cooperative union purchased 750 quintals of seed from farmers, but they sold only 350 quintal. The rest was sold for consumption, which is mainly due to capacity, promotional problem and attitude of relevant bodies.

3.1.2.2. Chencha Woreda

This Wereda is located at about 320km North of Hawassa. The Wereda is categorized into two agro climatic zones: *Dega* (high altitude) covers about 44% of the area with an altitude of more than 2300 masl and *Woinadega* (mid altitude) ranging from 1900–2300 masl and encompasses about 56% of the area.

The mean temperature of Chencha Wereda is 22.5^0c.According to the meteorological report, the mean annual rainfall is 1201-1600 mm. Rain usually starts in mid March, but the effective rainy season is from May to mid September.

The estimated total population of Chencha Wereda was 125,363 or 0.87% of the total population of SNNPR, which comprises of 55,140 males and 70,223 females. Out of the total population of the Wereda, 13,403 persons are urban dwellers and the remaining 111,960 persons reside in the rural areas of the Wereda (BoFED, 2006).The total number of households in the Wereda were 24,647 and the estimated average family size stands at 5.08 persons per household.

According to the Office of Woreda Agriculture and Rural Development, the total area of the Wereda is estimated to be 373.6km^2 (37,360 hectare). From the total area 55.26% is cultivated land, 8.51% used as grazing land, 15.47% is covered with forest and shrubs and 20.76% is used for settlement and other purpose.

The dominant crops grown in the Wereda are barley, wheat, bean, and root and tuber crops like potato and sweet potato etc. From the total cultivated land in 2007, 4,831 ha covered with barley, 4350 ha covered with wheat and 2,451ha with pea and bean. Concerning oxen ownership 55.6% of farmers in Chencha Woreda have no oxen while 22.20 % of the farmers have one and 22.2% have two and more oxen.

There are a total of 135 DAs working in all Kebeles to provide extension service for about 24,647 farm households. The DA to farmers' ratio is estimated to be 183 farm households per one DA (BoFED, 2006). To supplement the efforts of the governmental institutions, Kalehiwot church and WVE were also involved in the provision and support of extension service, in addition to facilitating the introduction of apple fruit production technology to the study area. This Woreda is believed to be the place where apple fruit is introduced by religious organization known as Kalhiwot church found in the Woreda. Due to market demand for the fruit, the support from the church indicated and government attention, current evidence show that more than 1000 farmers are getting benefit from multiplying and selling of apple seedlings to other farmers.

3.1.2.3. Dale Woreda

Dale Woreda is one of the 19 Woredas found in Sidama zone of SNNPR with the total area of 1,450 km^2, at about 320 km from Addis Ababa. Its specific location lies between 6^0.44'-6^0.84' latitude and 37^0.92'-37^0.60' longitude. The altitude of the Woreda ranges from 1001-2500 masl. The mean annual rainfall is between 801-1600mm.

According to CSA (2003), the total population of the Woreda was 369,548 of which women account for 57.6% of the population. From the total population 41,270(11.20%) are urban resident and 328,278 (88.8%) live in the rural area with an average population density of 295 persons per km^2.

The farming system is composed of garden coffee, *enset*, and cattle which are kept for manure and production of dairy products. Because of the perennial nature of the crops which commonly produced by the farmers and the small landholding size (between 0.25-0.5 ha per family), hand hoeing is the predominant method of cultivation. Coffee is the main cash crop to the farmers' .According to available statistics, the area under coffee is 15,375 ha.

To improve the agricultural sector productivity 189 DAs' were assigned that makes the DA to household ratio 1:2117. This is relatively higher than other Woredas and significantly different from the regional average.

3.1.2.4. Hula Woreda

Hula is one of 19 Woredas of Sidama zone situated 67 km north of the region as well as zonal capital, Hawassa. The total estimated area of this Woreda is 617.6 km^2 or 0.56% of the area of the region. It is dominated by *Dega* climate type with altitude range of 1501 – 3500 masl. The mean annual temperature and the mean annual rainfall are 10.1^0c -22.5^0c and 1401 – 1600 mm, respectively.

The total population of Hula Woreda was 246,838 that constitute 8.64% of population in Sidama zone and 1.7 % of the total population of the region. From the indicated number 123,578 were male and 123,261 were female. According to (BoFED, 2006) from the total population 97% live in the rural area. In the same year there were 311 DA to give extension service with the DA house hold ratio of 1: 797 or below the regional average.

Comparatively Hula is one of the potential Woredas in Sidama zone in cereals crops production. However 84.82% farmers in this Woreda have no oxen, 11.69% farmers have one ox and the rest have two and more oxen.

From the total area of 61,760 ha only 30.09 % were used for crop production and 37.74 is not cultivated but potential for crop production. The rest used as grazing land and covered with forest bushes and shrubs. This figure indicates that there is potential for extensive farming better than both the region and the Sidama zone with cultivable land of 20.17% and 17.84% from the total area, respectively. As the report of Hula Wereda ARDO (2006) shows, 1,409 ha of land was covered with wheat, 17,344 ha with barley, 2,907 ha with maize and 620 ha of land cultivated and was covered with potato.

3.2. Sampling Techniques

A multistage sampling technique was used to select sites and draw sample of farmers for the study. First four Woredas (discussed in part 3.1.2) were selected purposively from the region considering their agro-ecology, experience in farmers' based seed multiplication, and the production potential for respective crops in the region demonstrated by the consideration of the Woredas as model demonstration area for farmers' based seed and seedling multiplication. From each sample Woredas 2 *kebeles* were selected purposively based on their relative numbers of seed producing farmer and experience in farmers' based seed and seedling multiplication.

Sampling of households was carried out considering two sampling frames of farmers: adopter of respective seed/seedling multiplication and non-adopters. A farmer engaged in seed multiplication for two or more years was considered as adopter. This is because of the intention not to consider opportunistic farmers that just try for a year and abandon the next year. The sampling frame for adopter (participants in seed multiplication) was farmers' list from the respective Woreda Agriculture and Rural Development Office registered as seed producers. In the same way, non-seed producers' sample was taken from name of total resident in the respective *kebele* by excluding seed producing farmers.

Since each woreda represented different crops, the sample frames for each Woreda were established independently. The sample farmers (both adopters and non-adopters) for each Woreda (each seed) were selected using random sampling. Accordingly, a total of 60 farmers i.e. 30 from each group from each Woreda were selected randomly. The total sample of each Woreda shared between the two samples *kebeles* in the same Woreda based on the proportion of number of households in each *Kebeles (*Table 2).

Table 2. Number of samples from each Woreda

Crop type	Name of Woredas	*Kebele* Selected	Sample farmers from each *Kebeles*	Size sample Household
Wheat	Angacha	Gerbafandide	35	
		Bondena	25	60
Coffee	Dale	Dagia	26	
		Doba	34	60
Apple	Chencha	Dekalosha	32	
		Kale	28	60
Potato	Hula	Gase	26	
		Sbara	34	60
Total				240

3.3. Methods of Data Collection

For qualitative study, observation, individual and group discussion were the main methods for data collection. This was done with the help of semi-structured questionnaires. The source of this qualitative data were farmers, *kebeles* and cooperative leaders, DA, Woreda agriculture and rural development office experts, researchers in the regional agricultural research centers, and NGOs working in activity related to seed production and distribution. This condition created opportunities for observation, discussion and identification factors determine the involvement of farmers in seed multiplication activities besides the socio-economic condition of the farmers in the study area to have the right status of the regional seed system

The primary data necessary for the quantitative study was collected from sampled households by conducting formal survey using a structured interview schedule. The data was collected from

January - April/2007. However, before the actual data collection several preparatory activities were carried out. First, enumerators were given one day classroom training on the objectives, content of the interview schedule and method of data collection. Second, the interview schedule was pre-tested on twelve randomly selected farm households from each Woreda before conducting the formal survey. The data were collected by eight development agents of Agricultural Development Office with the assistance of Woreda subject matter specialist who has better knowledge about and experience on the farming system of the study area and particularly farmers' based seed and seedling multiplication.

To supplement the result obtained from primary data analyses and to fill information gap; secondary data about the socioeconomic and agro-ecology of the sample Woredas and seed production and distribution in the region were collected. Those secondary data were collected from reports and other publication of organizations like BoFED, BoARD, SARI, ESA and WARDO found in the region.

3.4. Methods of Data Analysis

In order to describe and compare different categories of the sample units with respect to the desired characteristics, mean, standard deviation and percentage were computed. Further more t-test and chi-square test were used to supplement or testify significance of results obtained from the models specified.

Gross marketing margin (GMM) and Gross Margin analysis was also employed to analyze the market performance and the contribution of seed production to increase farmers' income. Also qualitative descriptions were used to discuss important aspects of farmers based seed/ seedling multiplication in the region.

3.4.1. Model specification

Econometric model employed to analyze the data on farmers' participation in seed multiplication. The two most common functional forms used in adoption studies are the logit and the Probit models. The advantage of these models is that the probabilities are bounded between 0 and 1.The dependent variable is dichotomous taking two values, 1 if the event occurs and 0 if it doesn't.

Technology use studies based up on dichotomous regression model have attempted to explain only the probability of use and non use rather than the extent of intensity of technology use. Knowledge that the farmers are using high yielding variety may not provide much information about farmer's behavior because he/she may be using 1% or 100% of his/her farm for the new technology (Feder et al., 1985 as cited in Dereje, 2006). Similarly with respect to participation in seed multiplication a farmers may allocate small or large part of his plot for seed multiplication, a model that employ dichotomous variable as dependent often is not sufficient for examining the extent of participation and intensity of allocation of land for seed/seedling multiplication.

There is broad class of model that has both discrete and continuous parts. One important model in this category is Tobit. Tobit is an extension of the probit model and it is really one approach to dealing with the problem of censored data (Johnston and Dinardo, 1997). Some authors call such model limited dependent variable model because the restriction put on the value taken by regressed (Gujarati, 2003). In this study, Tobit model was employed for each crop type.

Oladele (2005) stated that the Tobit model, originally developed by Tobin, may be expressed in the following way:

$$Y^* = X\beta + Ui \qquad (1)$$

Where β is a vector of unknown coefficients, X is a vector of independent variables, and *ui* is an error term that is assumed to be independently distributed with mean zero and a variance of ∂^2. Y* is a latent variable that is unobservable. If data for the dependent variable is above the limiting factor, zero in this case, Y is observed as a continuous variable. If Y is at the limiting factor, it is held at zero. This relationship is presented mathematically in the following two equations:

$$Y = Y^* \text{ if } Y^* > Y_0;\ Y = 0 \text{ if } Y^* \leq Y_0 \qquad (2)$$

Where Y_0 is the limiting factor these two equations represent a censored distribution of the data. The Tobit model can be used to estimate the expected value of Yi as a function of a set of explanatory variables (X) weighted by the probability that Y$i > 0$.

The Tobit model therefore measures not only the probability that a farmer will adopt the improved technology but also the intensity of use of the technology once adopted. The empirical model can be used to draw economic implications for commodity improvement strategies for farmers, the effects of changes of given attributes and characteristics of farmers on adoption probabilities and use intensities can be obtained by decomposing the marginal effects following a Tobit decomposition framework suggested by (McDonald and Moffitt, 1980 as cited in Langyintuo and Mulugetta, 2005). Thus, change in X_i (explanatory variables) has two effects. It affects the conditional mean of y_i^* in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. Similarly, in this study, the marginal effect of explanatory variables was estimated as follows.

1. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial \mathrm{E}(yi)}{\partial X_i} = F(z)\beta i \qquad (3)$$

Where, $\frac{\beta_i X_i}{\sigma}$ is denoted by z, following Maddala, (1997)

2. The Change in the probability of adopting a technology as independent variable Xi changes is:

$$\frac{\partial F(z)}{\partial X_i} = f(z)\frac{\beta_i}{\sigma} \qquad (4)$$

3. The change in the intensity of adoption with respect to a change in an explanatory variable among adopters is:

$$\frac{\partial \mathrm{E}(y_i / yi > 0)}{\partial X_i} = \beta_i\left[1 - Z\frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)}\right)^2\right] \qquad (5)$$

Where, F (z) is the cumulative normal distribution of Z, $f(z)$ is the value of the derivative of the normal curve at a given point (i.e., unit normal density) and Z is the z-score for the area under normal curve, β is a vector of Tobit maximum likelihood estimates and σ is the standard error of the error term.

An econometric software known as "Limdep" was employed to run the Tobit model. The analysis carried out for each seed /seedling type independently to identify the specific factors determines farmers' participation in the multiplication of each type and then aggregated based on the nature they have in common.

3.4.2. Test of multicollinearity and heteroskedasticity

Before fitting the model it is necessary to carry out multicollinearity test because of the fact that multicollinearity may cause lack of significance of individual independent variables, while the overall model may be strongly significant (Monteshwe, 2006). It may also result in wrong signs and magnitudes of regression coefficient estimates and consequently in incorrect conclusions about relationships between independent variables.

Different methods are often suggested to detect multicoliniarity problem among them, Variance Inflation Factor (VIF) technique was employed to detect mulicoliniarity in continuous explanatory variable. According to Gujarati (1995), VIF (X_i) can be defined as:

$$VIF = \frac{1}{1 - R_i{}^2}$$

Where Ri^2 is the multiple correlation coefficients between X*i* and other explanatory variables, for each selected continuous variable (X_i) were regressed on all other continuous explanatory variable .The coefficient of determination (R_i^2) constructed for each case. The larger the value of R_i^2 ,the higher the value of VIF (X_i) causing higher multicolinearity in the variable (X_i) for continuous variables. If the value of VIF is 10 and above the variables are said to be collinear (if the value of R^2 is 1), it would result in higher VIF and cause perfect collinearity between variables. Contingency coefficients were also calculated to detect the degree of association among the dummy variables. Contingency coefficient is the Chi-square based measure of association. A value of 0.75 or more indicates a stronger relationship (Healy, 1984; cited in

Paulos, 2002). The contingency coefficient was computed as follow:

$$C = \sqrt{\chi^2 / N + \chi 2}$$

Where C= Contingency Coefficient, χ^2 = Chi-square test, N= total sample number

If normality or homoskedasticity fail to hold, the Tobit model may be meaningless. In OLS, estimates are consistent but not efficient when the disturbances are heteroscedatic. In the case of the limited dependent variable models also, if we ignore heteroscedasticity, the result estimates are not even consistent i.e. is the regression coefficient is upward biased (Maddala, 1997). In this study heteroscedasticity was tested for some suspected variables by running, heteroscedatic Tobit using econometric software (Limdep). For the convenience of computing the marginal effects and adoption probabilities, in the study, the Tobit model was estimated by simply excluding the variables which were found to be significant for heteroscedasticity.

3.5. Description of Variables and Working Hypothesis

Dependent variables: The Tobit model uses censored values as dependent variable. As observed in different empirical studies, this variable can be expressed in terms of ratio, actual figure and logarithmic form depending on the purpose of the study. In this study, the size of land allocated for seed/seedling multiplication was used as dependant variable.

Independent variables: It is hypothesized that farmers' decisions to adopt or reject new technologies at any time are influenced by the combined effect of a number of factors. This includes both discreet and continuous variables such as: household characteristics, socio-economic characteristics and institutional characteristics in which farmers operate. Even though most factors are common to all crops, like availability of supplementary water and ownership of farm oxen are specific for some crops due to their nature. Based on the review of adoption literature, past research findings and the researcher's knowledge of the farming system of the study area, among the large number of factors which were expected to relate to farmers' adoption behavior, 17 potential explanatory variables were considered in this study and examined for their effect in farmers' decision to involve in seed or seedling multiplication or increase the land allocated for seed/seedling multiplication. Those variables presented below are common to all seed /seedling type except ox ownership to wheat and potato and distance from water source to apple and coffee seedling.

1. Education level of the house hold (HHeducation): In almost all of studies on agriculture, education was taken as an important explanatory factor that positively affects the decision of households to adopt new agricultural technologies (Abay and Assefa, 2002). Farmers with more education should be aware of more sources of information, and be more efficient in evaluating and interpreting information about innovations than those with less education. Thus it is hypothesized that producers with more education are more likely to be adopters than farmers with less education (Teklewold *et al*., 2006). It is measured as a categorical variable in grades or number of years in school.

2. Family size (FAMSIZ): It is a continuous variable which indicate the number of person living in the house of the farmers. It is expected that as the size of the house hold increase the adoption of new technology increase .This indicates the family with large number more involved in seed or seedling production since seed or seedling multiplication need more labor and continuous follow up.

3. Land size (HHland): It represents the total owned and cultivated land by household. It is expected to be positively associated with the decision to adopt seed production technologies. This means that farmers who have relatively large farm size will be more initiated to involve in seed production, and the reverse is true for small size farm land. It is continuous variable measured in hectares. The positively significant coefficient of farm land size indicates its positive influence on technology adoption. Subsistence oriented small farmers are highly risk averse to apply innovation due to limited holding and uncertain outcome of technology (Bahadur, 2004).

4. Off-farm income (OFINCM): Off-farm income represents the amount of income the farmers earn in the year out of on-farm activity. It is the amount of income (in Birr) generated from activities other than crop and livestock production. These include petty trading, charcoal selling, firewood selling and others. The households engaged in off-farm activities are better endowed with additional income to purchase initial seeds or other essential agricultural inputs for seed or seedling production. Therefore, it is expected that the availability of off-farm income is positively related with participation in seed production.

5. Farming experiences (YFEIA): Is measured in the categorized number of years since a respondent started farming on his own. Experience of the farmers is likely to have a range of influences on adoption. Experience expected to improve farmers' involvement in seed production. A more experienced grower may have a lower level of uncertainty about the technology's performance (Chilot *et al,* 1996). Farmers with higher experience appear to have often full information and better knowledge and were able to evaluate the advantage of the technology. Hence it was hypothesized to affect adoption positively.

6. Total livestock ownership (TLU): This refers to the total number of animals possessed by the household measured in tropical livestock unit (TLU). Livestock is considered as another capital which is liquid and a security against crop failure. Moreover, livestock used for threshing, transporting and etc hence increase production thereby farmers' income. Therefore, this variable was hypothesized to have a positive impact on farmers' participation in seed/seedling multiplication.

7. Access to credit facility (HHcredit): It is a dummy variable, which takes a value of 1 if the farm household had access to credit and 0 otherwise. Adoption of new technology with complementary inputs require considerable amount of capital for purchase of inputs (seed, fertilizer).Farmers who have access to formal credit are more probable to adopt improved technology than those who have no access to formal credit (Yishak, 2005). On the other hand the availability of farm credit especially from formal sources is vital components of the modernization of agriculture and to increase productivity. Those farmers who have access to agricultural credit are believed to adopt technology more than those who have no access to credit. This indicates smallholder farmers cannot finance these inputs for seed production unless they get alternative means.

8. Extension service (HHextension): Extension visits will help to reinforce the message and enhance the accuracy of implementation of the technology packages (Oladele, 2005). More frequent DA visits, using different extension teaching methods like attending demonstrations and field day can help the farmers to adopt a new technology. If the farmers get better extension services, they are expected to adopt seed production technologies than others. In this study this variable was treated as a dummy variable. That is if the farmers gets extension service it is coded as 1 and 0, otherwise.

9. Availability of training (HHtraining): Farmers may obtain information from different source and may learn also from DA through extension program. However unless they can obtain required skill through training they may face difficulty to understand and apply seed production technology. So those farmers who got training on specific seed production technology are more willing than those who didn't get training. It is dummy variable measured as 1 if farmers got specific training on seed multiplication and 0 otherwise.

10. Distance from the main road (DISroad): It is a continuous variable measured in kilometer. It refers to the distance from farmers home to the main all weather roads. As farmers' home gets closer to the main road, they can have access to transportation facilities and relatively better support from concerned bodies to their seed multiplication which might increase the use of technology. Therefore, in this study, it is hypothesized that this variable is negatively related to participate in seed production.

11. Market distance (DISmarket): As a farm household is nearer to market places, it is expected to be more likely participate in intensive farming activities that demands adoption of new agricultural technologies. Therefore, it is expected that as a given farm household gets far away from such areas the likelihood of involving in seed or seedling production practice to decrease. Since local market are the main place to exchange information among farmers on price ,variety demanded and others which contribute to involve in seed multiplication. It is continuous variable measured in km.

12. Distance from source of water (DFNWSF): Seedling production need relatively high amount and continuous application of water. So in addition to other factor the closeness of farm land to the source of water determine the willingness of farmers to produce seedling in large quantity for market. It is a continuous variable measured in km.

13. Ox ownership (HHoxen): Since ox is one of important means of production in agriculture, Oxen ownership and adoption were expected to relate positively. As the number of oxen owned by farmers' increased, adoption/Intensity of adoption was expected to increase. This approves those who have oxen for ploughing is likely to involve in seed multiplication particularly wheat and potato because those seed require preparation of land relatively larger size as compared to seedling multiplication.

14. Radio ownership (Radio): Information's are important to make a decision on alternative enterprise that helps farmers to achieve his goals .At present, radio is the popular means of mass communication. Therefore, radio ownership is assumed to increase the probability of participating in seed/seedling multiplication. In this study, this variable takes the value 1, if the respondent has a radio and 0, otherwise.

15. Availability of basic foundation seed (Planting material) (DFGBS): According to study made in Uganda on FSE (Farmers Seed Multiplication) by (David, 2003), establishing a sustainable system for supplying source seed are key elements needed to ensure the successful development of FSEs . Foundation seed is the main input for seed multiplication. In this study this variable was treated as a dummy variable in that if the farmers responded that there is shortage of foundation seed it is coded as 0 and 1, otherwise. Because if the farmers perceived as there is shortage of foundation seed to produce seed for market he will not be interested to participate in seed production activity.

16. Seed replacement (EFTRS): Seed replacement the experience of farmers to change or replace their seed stock with new variety or the same variety but new generation in a given period of time .It is expected that farmers who has interest to change their seed periodically create market for locally multiplied seed at the same time they will develop interest to multiplied seed of new Variety or new generation of the same variety that expected to motivate them to involve in seed production .The variable for seed replacement is dummy that is 1 if the farmers has the experience to renew seed 0 otherwise.

17. Access to input supply (PFTAI): However there is difference in type and quantity demanded for different type seed production, farmers involved in seed multiplication require other agricultural input besides planting materials and the perception of farmers about the availability of those input determine his participation in seed multiplication. Sanding *et al* (2000) indicate that the introduction of new technologies may increase demand for complementary inputs and when the supply of these inputs is restricted, adoption will be constrained. This perception of farmers measured as dummy variable and 1if he perceive that there is sufficient availability of input important for seed multiplication 0 otherwise.

4. RESULT AND DESCUSSION

4.1. Household Characteristics

4.1.1. Distributions of household by sex and marital status

More than 93% of the sample farmers' households are headed by males in all four sites of the Survey and 95% were married (Table 3). Chencha and Hula seed producers have better number of female participants as compared to Angacha and Dale woreda. Participation of single household in seed multiplication was 10% and 6.67% in Chencha and Angacha, respectively, whereas Dale and Hula have equal number of single household participants in seed multiplication, which is 3.33% of the total seed producers sample farmers. The percent of male-headed households of seed producers were higher than that of female-headed households. This is attributed to various reasons including the problem of economic position of female-headed households like shortage of labor, limited access to information and required inputs.

Table 3. Sample household sex and marital status

		percentage			
Sex	Farmers group	Angacha	Dale	Chencha	Hula
Male	Seed producers	96.67	96.67	93.33	93.33
	Non producers	96.67	96.67	96.67	90
Female	Seed producers	3.33	3.33	6.67	6.67
	Non producers	3.33	3.33	3.33	10
Marital status					
Married	Seed producers	93.33	96.67	90.0	96.67
	Non producers	86.67	96.67	86.67	93.33
Single	Seed producers	6.67	3.33	10.0	3.33
	Non producers	13.33	3.33	13.33	6.67

Source: own computational result

4.1.2. Distribution of household by age and family size

Average family size is about 7.55 people per household for seed producers in Angacha Woreda and 8.69 for non seed producers. Seed producers in Hula comprise the biggest family size (9.38 per household) of the three Woredas (Table 4). As statistical results of this survey show on the same table Angacha and Chencha Woreda have the larger family size of non seed producers with average size of 8.69 and 8.27 persons, respectively. As the t-test results indicate there was significant difference in average family size between seed producers and non seed producers of Dale and Hula Woreda sample farmers.

Average age of household head for the sample farmers of Angacha was 41.35 and 45.59 years for seed producers and non producers, respectively. At Dale, both groups had similar average age of 37 years. The average age of seed producers in Chencha and Hula was 48.67 and 46.69 years whereas; it is 46.47 and 48.07 years for the non producers, respectively. The t-test result indicates there is no significant difference between the average age of seed producers and non seed producers for sample farmers in the sample Woredas.

Table 4. Age and family size composition of sample house hold

Household characteristics	Farmers group	Means			
		Angacha	Dale	Chencha	Hula
Family size	Seed producers	7.55	6.93	8.73	9.38
	Non producers	8.69	5.60	8.27	7.18
t-test		1.422	-2.194**	-.607	-2.433**
Age of household	Seed producers	41.35	37.33	48.67	46.69
	Non producers	45.59	37.20	46.67	48.07
t-ratio		1.342	-0.051	-.614	0.346

Source: own computational result
** Significant at 5%

4.1.3. Household farming experience

With respect to respondents farming experience, 38.34 % of the total sample farmers had more than 20 years of farming experience (Table 5). From farmers responded as seed producers, 29.17% of them had farming experience of 10 years and below. In similar manner, 44.18 % from 10 to 20 and 26.67 % had more than 20 years of experience. On the other hand, 24.42 % of non producers had less than 10 years, 25.58 % between 10 to 20 years and 50 % had more than 20 years of experience in the farming activities**.** The chi-square test shows a significant difference between producers and non-producers of seed in the distribution of farming experience of sample farmers in Dale and Hula Woredas.

Table 5. Years of farming experience of respondent farmers

Years of farming experience	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
< 10 years	Seed producers	26.67	40.00	33.33	16.67
	Non producers	16.67	20.0	30.00	30.00
10 – 20 years	Seed producers	33.33	53.33	30.00	60.00
	Non producers	26.67	40.0	13.3	23.33
> 20 years	Seed producers	40.00	6.67	36.67	23.33
	Non producers	56.67	40.00	56.67	46.67
Chi-square		2.944	9.714**	3.261	7.172**

Source: own computational result

**Significant at 5%

4.1.4. Distributions of household by educational status

From the total non seed producers 27.5% of are illiterate, where as only 20.83% of seed producers found in this category. Also 55.8 % of seed producers farmers had formal schooling that help them not only to acquire and interpret information on agricultural technologies, but also to rationally allocate existing farm resource to achieve the objective and goals of farm household's. As shown in Table 6 sample farmers taken from Angacha, Dale, Chencha and Hula Woredas 16.5%, 13.4%, 23.35% and 20.0% found to be illiterate, respectively and the rest attended formal schooling or at least can read and write. However there is no significance difference between seed producer and non producer farmers in their educational status.

Table 6. Educational level of the household

Education category	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
Illiterate	Seed producers	20.00	10.00	23.33	30.00
	Non producers	26.67	16.7	30.00	36.67
Read and write	Seed producers	26.67	23.33	20.00	26.67
	Non producers	33.00	10.0	20.00	23.33
grade 1-6	Seed producers	26.67	36.7	23.33	26.67
	Non producers	10.00	30.0	16.67	13.33
grade 7-10	Seed producers	13.33	26.70	20.0	13.33
	Non producers	23.33	36.70	23.33	20.00
grade 11-12	Seed producers	10.0	3.30	10.0	3.33
	Non producers	6.67	6.7	10.0	6.67
above	Seed producers	3.33	-	3.33	-
	Non producers	-	-	-	-
Chi- square		5.041	3.619	1.66	3.683

Source: own computational result

4.1.5. Ownership of radio

With regard to radio ownership, it was assumed that respondents who owned radio got information regarding to new technologies and agricultural market. The statistical result depict that 93.33%, 76.67%, 96.67% and 73.33% of seed producers in Angacha, Dale, Chencha and Hula Woreda responded that they have radio that helped them to get market information about their agricultural produce and inputs, respectively (Table 7). Whereas, only 20%, 30%, 50% and 33.33% of the same Woredas' non-seed producer farmers were responded as they have radio. To see whether there is difference between each group of seed producers and non seed producers with respect to ownership of radio Chi-square test was employed. As shown from the result the difference was significant for all Angacha, Dale, Chencha and Hula farmers at 5% and 1%.

Table 7. Response of sample farmers on ownership of radio

Radio ownership	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
yes	Seed producers	93.33	76.67	96.67	73.33
	Non producers	20.0	30.0	50.00	33.33
No	Seed producers	6.67	23.33	3.33	26.67
	Non producers	80.0	70.0	50.00	66.67
Chi –square		32.851***	5.963**	16.705**	6.548**

Source: own computation,

,* significant at 5% and 1%

4.2. Farm Resource Characteristics

4.2.1. Land Holding

From the total sample farmers in the four Woredas 15.83 % of seed producers and 23.33% non seed producers have less than 0.5 ha of land. On the other hand only 13% seed producers and 5% of non seed producers own more than 2 ha of land .However the allocation of land for seed multiplication were greater at Angacha and Hula as compared to Dale and Chencha Woredas which is 0.52 ha and 0.33ha in average respectively. Seedling producer farmers allocate small plot of land as compared to wheat and potato seed producers. Chencha and Dale Woreda allocated an average of 0.054 ha and 0.017 ha for seedling production respectively. This could be due to the nature of the coffee and apple seedling, which can be produced in small area as compared to wheat and potato seed. Also the minimum size of land required to be owed for seed production by seed companies and sizes of government input package also encourages farmers to allocate large size of land for wheat and potato seed multiplication as compared to average land holding. For instance framers who have interest in multiplication of wheat seed need to allocate minimum 0.5 hectare of land. As (Table 8) the t-test reveals that, from sample farmers at four sites, there was significant difference between average landholding of seed producers and non seed producers in Angacha, Dale and Hula Woreda.

Table 8. Land allocation for seed /seedling multiplication

Farmers group	Average land holdings (ha)			
	Angacha	Dale	Chencha	Hula
Seed producers	1.479	0.9320	0.7836	1.450
Non producers	0.6657	0.5360	0.6784	1.043
t-ratio	5.018***	3.811***	0.807	2.079**
Land allocated	0.525	0.0173	0.0543	0.5984
SD	0.221	0.0313	0.0551	0.0550

Source: own computational result
,*significant at 5% and 1%, respectively

4.2.2. Livestock holding of the sample households

Farm animals have an important role in rural economy. They are source of draught power, food, and cash, animal dung for organic fertilizer and fuel and means of transport. Farm animals in the study area also serve as a measure of wealth in rural area. The types of livestock found in the study area were cattle, equine, sheep and goat. To help the standardization of the analysis, the livestock number was converted to tropical livestock unit (TLU). As it can be seen from

(Table 9),sample seed producer farmers of Angacha ,Dale Chencha and Hula Woreda owned in average 3.90,2.94,3.01 and 3.94 TLU while non seed producer of the same Woreda sample farmers have 3.06,2.45,2.99 and 3.14 TLU respectively. The t-test result computed to see the mean differences between seed producer and non seed producers farmer in livestock ownership indicate there was a significance difference in Angacha and Hula farmers at 5% significance level.

Table 9. Livestock ownership

Farmers group	TLU							
	Angacha		Dale		Chencha		Hula	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Seed producers	3.90	2.09	2.94	1.97	3.01	2.12	3.94	2.31
Non producers	3.06	2.18	2.45	2.01	2.99	2.23	3.14	2.40
t-ratio	2.32**		1.88		1.95		2.31**	

Source: own computational result
** Significant at 5%

4.2.3. Oxen ownership

Oxen are the main power sources in the region .In the study area farmers who grow cereal crop plough their land mainly using oxen. However, from total sample farmers' only 1.25% have more than 2 oxen and 60.83% of seed producers have no ox. As the statistical result from the survey signify (Table 10) 2.5% of seed producers farmers have more than two oxen, 7.5% have two oxen and 29.1 % have a single ox. The chi-square result indicates that there was no significant difference in ox ownership between seed producer and non producer except Angacha sample farmers.

Table 10. Distributions of oxen ownership by farmers group and location

Number of oxen	Farmers group	Percent of farmers	
		Angacha	Hula
>2 oxen	Seed producers	3.33	3.33
	Non producers	-	-
2 oxen	Seed producers	10.00	10.00
	Non producers	6.67	6.67
1 ox	Seed producers	46.67	40.0
	Non producers	13.33	43.33
No ox	Seed producers	40.00	46.67
	Non producers	80.00	50.00
Chi-square		10.00***	1.982

Source: own computational result
***significant at 1%

4.3. Access to Service and Institutions

Farmers' institutional factors have important bearing on the observed status of the farmers with respect to willingness to participate in seed multiplication. The most important institutional factors identified were agricultural extension, training and access to credit.

4.3.1. Extension service

The study found that about 83.33% of the seed producers and 48.33% non seed producers' respondents in four sites had made contact with extension agent during the previous season.

Table 11. Distribution of house hold by extension service and training

Service type	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
Extension Contact	Seed producers	73.33	73.33	96.67	90.00
	Non producers	50.00	23.33	76.67	43.33
	Chi-square	3.455**	10.417***	5.192**	9.676**
Training on seed multiplication	Seed producers	20.00	26.67	63.33	86.67
	Non producers	10.00	3.33	6.67	20.0
	Chi-square	1.176	6.405*	20.488*	17.176**

Source: own computational result
***significant at 1%** significant at 5%,

From seed producers sample farmers who got extension service responded that, 20% weekly, 16.47% once in two weeks, 5.88% monthly and the rest 57.65% obtain the service any time as they required or with out any fixed program. In the same way from non seed producers sample farmers 11.27%, 12.67%, 12.67%, and 63.39% received the service weekly once in a week, monthly and as any time required, respectively. The result of chi- square indicated that there is significant difference in obtaining extension service between seed producers and non seed producers at 5% and 1% significance level.

4.3.2. Training on seed production technology

Even though there is a great difference among sample areas, as it can be seen from (Table 11) from the total sampled farmers involved in seed multiplication only 47.5% got training on specific area of the seed they are multiplying. Higher proportion of respondent to have training is reported in Chencha and Hula that is 66.67% and 86.67% of Sample seed producers' farmers have got training on seed/ seedling multiplication technology respectively. This is mainly due to the nature of multiplication and the attention given by local government and NGOs involved in rural development program in these Woredas. From the total sample non seed producer's farmer

10% from Angacha, 3.33% from Dale 6.67% from Chencha and 20% from Hula responded that they abandoned seed multiplication after getting training on related issues. The chi-squere result depict that, there was a significance difference between seed producers and non producers except Angacha woreda.

4.3.3. Distance from market and main road

The average distance traveled to get to the nearest market is 2.25 km, 8.12 m, 1.26 km and 6.71 km for seed producers in Angacha, Dale, Chencha and Hula Woredas, respectively. While non seed producers travel 3.156 km, 10.22 km, 2.206 km and 8.66 km to the same Woredas. The average distance traveled by seed producer to get all weather roads is 0.5818 km, 0.83 km, 0.48 km and 0.94 km for Angacha, Dale, Chencha and Hula Woredas, respectively. One of the reasons that seed producers in Angacha to be nearer to the main road than the rest farmers is that it is one of the criteria to get involved in seed production by contract growers and interest of WARDO.

Though water is the most important resource for agricultural activities, supplementary water source was found to be important for seedling producers as compared to field crops. According to the survey result seedling producer of Dale and Chencha farmers have water source at average distance of 0.058 km and 0.015 km from their farm, respectively. Except in Hula Woreda(Distance from nearest market), there is a significance difference between distances traveled by seed producers and non producers sample farmers (Table 12).

Table 12. Distance traveled by farmers to different services

Distance	Farmers group	Mean value			
		Angacha	Dale	Chencha	Hula
Distance from market	Seed producers	2.247	8.119	1.255	6.721
	Non producers	3.156	10.220	2.206	8.660
	t - value	2.255**	3.426**	5.831**	1.592
Distance from nearest water source to the framers	Seed producers	-	0.058	0.015	-
	Non producers	-	0.781	0.570	-
	t - value	-	7.528**	5.514**	
Distance from all weather road	Seed producers	0.5818	0.83	0.484	0.940
	Non producers	1.4466	3.00	1.199	1.825
	t - value	2.361**	2.829**	4.010***	3.787**

Source: own computational result
***, ** Significant at 1% and 5%

4.3.4. Access to credit

The regional input distribution reports of the 2006/07 year show that 51% of fertilizer and 9% of cereal seed were distributed to the farmers with credit obtained from commercial bank of Ethiopia. The credit has been given by the bank through the collateral of the regional government budget. The credit was distributed through cooperatives and WARDO. In some pocket area of the region, micro finance institutions arranged credit for buying inputs other than cereal seed and fertilizer, even though it was not uniform.

Based on the survey result of this study 66.67% of sample seed producer farmers from Angacha 73.33% from Chencha and 63.33% from Hula Woreda obtained input credit in the year 2006 (Table 13). The lowest proportion of farmers with access to credit is observed in Dale Woreda, which is mainly due to repayment problem. Only in Chencha Woreda, there is a significant difference between seed producers and non producers group of farmers by access to credit at 5% significance level.

Table 13. Input credit availability to farmers

Credit availability	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
Yes	Seed producers	66.67	23.33	73.33	63.33
	Non producers	53.33	16.67	13.33	43.33
No	Seed producers	33.33	76.67	26.67	36.67
	Non producers	46.67	83.33	86.67	56.67
	Chi-square	1.111	3.786	21.991**	1.006

Source: own computational result.

** Significant at 5%

4.4. Farmers Attitude and Perception about Seed Multiplication Technology

4.4.1. Farmers perception about the benefit of farmers' multiplied seed

As indicated in (Table 14) about 83.33% of seed producers sample farmers perceived seed production activities have increased income and the rest consider that seed production has no any difference from grain production. Also from non seed producers 63.33% agreed that involvement in seed production can increase farmers' income.

Table 14. Response of farmers on the benefit of seed production

Parameters	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
Seed production increase income of producers	Seed producers	93.33	90.0	96.67	56.67
	Non seed producer	80.0	66.67	93.33	13.33
	Chi-square	0.56	1.02	0.02	3.45**
Help to get locally adopted improved seed	Seed producers	93.33	96.67	-	56.67
	Non seed producers	60.0	86.67	-	50.0
	Chi-square	2.312	0.892		0.239
Give better production than framer's saved seed	Seed producers	100.0	-	-	40.0
	Non seed producers	76.67	-	-	33.33
	Chi-square	1.24			1.23

Source: own computational result.
** Significant at5%

In Angacha Woreda 86.67% sample farmers reported that involvement seed production increase income of seed producer farmer than grain production .Where as 43.33% potato seed producers are in doubt of the contribution, while 96.67% of apple seedling producer admitted the profitability of this business. In addition, 88.34% of the farmers in Angacha and 36.67% in Hula have perceived that the seed produced by farmers gives better production as compared to farmers saved seed from grain production. The chi-square result reveal that there is no significant difference between seed producers and non seed producers sample farmers on perception of income contribution, better adaptation than commercially processed seed and better production of farmers multiplied seed than they saved from their own grain production. Only Hula Woreda seed producers and non seed producers have significant difference on the contribution of involving in seed multiplication to generate better income as compared to grain production of the same crop.

4.4.2. Opinion on capacities of farmers to produce quality seed

Both seed producers and non seed producers expressed their opinion on the capacity of farmers to produce quality seed. According to the survey result, 95% of seed producers and 46.67% of non seed producers' farmers from all sample Woredas responded that they strongly agree on the capacity of the farmers to produce quality seed, whereas only 35.83% of total non seed producer respondent express their disagreement on the idea.

Table 15. Farmers' opinion on seed production capacity

Items	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
Agree	Seed producers	93.33	96.67	100.0	90.0
	Non producers	46.67	80.0	26.67	33.33
Undecided	Seed producers	6.67	3.33	-	10.0
	Non producers	3.33	10.0	20.0	36.67
Disagree	Seed producers	-	-	-	-
	Non producers	50	10.0	53.33	30.0

Source: own computational result

Moreover, 46.67% of Angacha and 80% of Dale Woreda non seed producers' farmers have agreed on the capacity of farmers to produce quality seed. On the contrary, Chencha and Hula Woreda farmers have no confidence on seed/seedling produced by their neighbors as only 26.67% and 33.33% of the non seed producers accepted that farmers' ability to produce the right seed/seedling, respectively. This is due to the fact that there is no any experience with farmers' based seed production and distribution in those areas and cheap distribution of seed and seedling by NGO expected to influence the attitude of the farmers.

4.4.3. Opinion of farmers on problems that discourage to involve or continue in seed production

Price set to seed multiplied by farmers limit the participation to involve in seed production business i.e. 35% of Angacha, 53.33% of Dale 10% of Chencha 43% of Hula farmers, who were not involved in seed production responded that low price given to seed multiplied by farmers had limited their participation. Similarly, 30%, 33.33 %, 10% and 20% farmers' seed producers in Angache, Dale, Chencha and Hula Woredas responded that they may not continue in seed multiplication activity due to this price problem, respectively.

Table 16. Farmers' perception on problems related to seed production and marketing

Major problems considered	Farmers group	Percentage			
		Angacha	Dale	Chencha	Hula
Low price to locally produced seed	Seed producers	30.00	33.33	10.00	20.00
	Non producers	35.00	53.33	10.00	43.00
Absence of market place to locally produced seed	Seed producers	16.67	80.00	33.33	46.67
	Non producers	3.33	53.33	30.00	30.00
Shortage of planting material	Seed producers	16.67	10.00	3.33	3.33
	Non producers	40.00	23.33	13.33	40.00
Problem of labor	Seed producers	6.33	-	40.00	16.67
	Non producers	23.33	3.33	13.33	3.33
Scarcity of suitable land	Seed producers	16.67	10.0	80.00	3.33
	Non producers	3.33	26.67	93.33	40.00

Source: own computational result

One of the problems discouraged seed producers' farmers to continue as seed producers is that the lack of access to appropriate market place to sell their seed/seedling, which is more serious to Dale farmers. These indicate the importance of local market place, especially for perishable seedling to reach potential buyers timely.

Even though planting material or initial seed is important input to start seed multiplication, only 8.33% seed producers and 29.17% of non-seed producers sample group considered as important factor that affect continue or entry in seed production practice. This could be due to special emphasis given by government for seed production of cereal crops as ESE and research centers avail basic or certified seed to the farmers and the efforts of intervention of different NGOs also has significant contribution to satisfy the demand of planting material.

Due to the existence of high population density and large size of family, the consideration of labor shortage as a constraint to involve in seed multiplication was not significant except for Chencha Woreda.

From the total apple seedling producers 40% responded that labor was determinant factor to involve and continue in seedling multiplication. This could be due to the skill and time required for grafting seedlings and the cost incurred to guard the farm day and night to protect the seedling from theft prevailed due to high price of the seedling in the other area. Due to land fragmentation caused by population density, lack of suitable land for seedling multiplication in Chencha Woreda was taken as a serious problem by 80% of seed producers and 93.33% of non seed producer farmers.

4.5. Partners Involvement and Coordination

Organizations considered as key implementing bodies of farmers based seed and seedling multiplication in the SNNPR are BoARD, offices at different level and the DA in each *Kebel*e, SARI and centers, ESE, NGOs and Cooperatives.

4.5.1. Regional bureau of Agriculture and Rural Development

The Bureau of Agricultural and Rural Development (BoARD) has different departments which are responsible for production, quality control and marketing of seed produced by farmers. According to the organizational structure of the Agricultural Development Sector in the bureau, there are 3 teams to support farmers based seed and seedling multiplication incorporating to other developmental activity they are responsible for. However, except cereal crop production, the rest have no expert specialized and assigned in seed production. Therefore, coffee and spice team and fruit and vegetable team support the activity related for multiplication of seed and seedling of the farmers' besides their work of extension and production of the respective crops. In addition to expertise support, there are manuals developed on cereals seed production, which presents the guideline from seed production to distribution and the involvement of concerned bodies.

The other governmental body organized under the BoARD is the Input Sector. This department is established to carry out quality control and certification of seed produced by all bodies including the farmers. Besides, the sector is mandated to plan, follow and monitor annual and seasonal agricultural inputs production, distribution including seed, also responsible for facilitating loan from bank to purchase agricultural inputs and follow the repayment.

4.5.2. Southern Agricultural Research Institute (SARI)

Variety development, agro ecological and socio economy based research in the agricultural sector is the responsibility of the regional agricultural research institute mandated by the regional government. SNNPR Agricultural Research Institute, carry out its responsibility through 4 center and 12 sites since its establishment in 2001. According to report of 2005, 23 varieties of 6 crops developed and released. From the total crop type wheat and root corps shares 4.35 %and 39.1 % of the total verified and released varieties respectively. The research institution has been using farmers to farmers exchange mechanism by giving basic seed to some selected farmers in order to benefit the farmers from the new varieties. However except few activities to increase the production of wheat and potato, there is no evidence that show the efforts to satisfy the need of new variety for coffee and apple at farmers' level.

4.5.3. Farmers Marketing Cooperatives and Unions

To increase the efficiency of both input and output, marketing cooperatives have paramount importance to the region. From the 4 seed types considered in this research, based on the survey result wheat, apple and potato seeds use cooperative for marketing of seed produced and only coffee seedling is left to farmers to farmers traditional exchange. From cooperatives found in the selected research Woredas of the region three cooperative involved in seed marketing, Angacha union and member cooperatives, Chencha temperate fruit marketing cooperative, Sidama Elto union and Abela/Gare fruit and vegetable seed producers' cooperatives are the main actors in the seed system of the study area. Except Sidama Elto union, the rest of them directly purchase the seed produced by the farmers and sell to their customers. The Sidama Elto union facilitates the purchase of parent material and promotion of potato seed produced in Hula Woreda through Abela/Gare fruit and vegetable seed producers' cooperative with the support of Self help. Both Chencha temperate zones fruit producer and Abela/Gare cooperative sell the seed and seedling collected from farmers to other farmers out of their working boundary. Where as Angacha union purchase and sell the wheat seed mostly in Angacha area where the demand is very limited due to the potential of the area and farmers experience in community based seed multiplication. As to the response of cooperative managers and board members, all cooperative lack skilled man power and materials to process, grade, pack and transport seeds collected from producer farmers that limit the role of cooperative in seed marketing.

4.5.4. Ethiopian Seed Enterprise (ESE)

ESE is a government company, which controls approximately 80% share of seed production and marketing in the region, especially for cereals like maize, wheat, *teff,* barley, haricots bean and the like. This enterprise multiplied seed both on its own farm, state farm and on farmers' fields with contractual agreement by purchasing parent material from EARI and abroad when necessary. The role of enterprise in farmers based seed multiplication is to supply basic seed and purchasing seed from producer farmers as per agreed quality and price. However, the enterprise noted that, poor collaboration of government stakeholder, especially ARDO at all level including DA working in the Kebeles, unwillingness of farmers to carry out agronomic practice and to supply seed on agreed price affecting the relation. In fact, the response was contrary to farmers concerning the enterprise that is, its unaffordable quality standard and reluctant to keep agreed promise.

4.5.5. Non-governmental organizations (NGOs)

There are also different NGOs involved in supporting farmers' seed system financially, technically and in other forms. Kalehiwot and WVE in Chencha Woreda supply farmers with parent material of apple. In addition, Kalehiwot church provides skill training that helps farmers able to graft apple. Self Help Ethiopia supports potato seed producers in Hula Woreda by allocating revolving fund to purchase basic seed of potato from research center and on some capacity building activities. Also IPMS plays vital role in the promotion of farmers based coffee seedling multiplication in Dale Woreda. All this shows that there is an effort made to support farmers and contribute to fill the gap in the seed or seedling demand of some crops.

All the experience shows Multi-institutional coordination is needed for good participation in seed production by small scale farmers (Giusti, 2004). However, the role and responsibilities of each implementing partner need to be clear, clear responsibility help to ensure consistent implementation of mandated program, and eventually the sustainability of these efforts (Rohrabach *et al*., 2002).

As presented in Table 17, the support strategy of governmental organizations and NGOs engaged in promoting farmers based seed multiplication system were not as much coordinated and mostly their activities were governed by ad hoc committee approach. Even though, the involvement of the organizations has affirmative role, still the system need to be coordinated in order to meet its objective.

There are more than 7 unions in cereal crops production area to support farmers in input and output marketing. However, there were no clear line of cooperation of activity to balance the demand and supply of seed with different parts of the region. The important organization for input marketing is the regional input sector in BoARD. However, there were no market information system established to all types of seed and seedling produced by farmers, except for some cereal crops. There is also a gap in the promotional activity; there is no any designed promotional system that could expand the marketing of seedlings produced by farmers.

The role of NGOs was not also clear for each crop. For instance, in Chencha both Kalehiwot Church and WVE were involving in the extension service and distribution of seedling along with WARDO. Though the role played by Kalehiwot church was focused in building the capacity of the farmers through intensive training on grafting technology, the involvement in distribution of seedling especially by Kalehiwot church and WVE could negatively affect farmers' marketing of the seedlings in the long run.

Table 17. Stakeholders' analysis in seed production by farmers in SNNPR

Main activities in the system	Implementers for each seed type: Wheat seed	Coffee seedling	Apple seedling	Potato bulb
Availing parent material or initial seed	ESE, research center, WARDO	farmers field WARDO, Jimma research center,	Kalehiwot Church, WVE, WARDO	Holeta research center through cooperative
Training of seed producers farmers	ARDO (currently not available)	No	Kalehiwot Church	Awassa research center
Technical support on field	WARDO, DA	No	Kalehiwot Church WVE, WARDO	WARDO
Field inspection and quality control	ESE seed laboratories	No	No	Awassa research center
Avail supporting input	Cooperative and WARDO	WARDO	Kalehiwot Church	Cooperatives
Marketing bodies	Angacha cooperative union ESE	No	Cooperative	Cooperatives
Main customers	Woreda farmers and other (for ESE purchased seed	Farmers in the Woreda especially neighbors to the producer	Region s Zones NGO's	Zones and Woreda agricultural office.
The approach to support the farmers	with procedure and structure	Not clear	Not clear	Not clear

Source: own survey result

4.6. Situation of Seed Marketing in the Region and Market Margin

4.6.1. Seed marketing in the region to farmers multiplied seed

Wheat seed production started in Angacha Woreda when a seed development project was nationally counseled by NSIA in 1996 with a fund from IFAD. However, the production and distribution of the seed couldn't continue with the same pace due to market problem in later years.

Currently wheat seed production in Angacha is carried out through contractual agreement of ESE and farmers with the assistance of Woreda Agricultural and Rural Development Office. Those organizations provide technical support and avail basic and certified seed to seed producers' farmers. The main channels for the seed produced other than ESE was mainly cooperative union. Angacha Cooperative Union is one of the marketing cooperative involved in seed marketing in order to alleviate problem of market for member seed producers' farmers and supplying other farmers with seed of required quality at reasonable price that adapted the area. Information obtained from the union during the survey shows, overhead cost, lack of qualified personnel and mainly inability to sell seed out of the boundary of the union created difficulty .Hence, the unions only able to sale 350 quintal seed from 750 quintal seed purchased in 2005 with the price of 8 % above the current price of grain.

There was always disagreement during collection of seed produced by farmers, through contractual agreement between ESE seed producer farmers. This is mainly happening due to the intention of the ESE to pay the premium price based on grain price during harvest time, whereas, they try to collect the product on average after 3 month at the time when the price of grain are higher. Based on the data obtained from Woreda, the average price of the grain can increase to 10% after 3 months, which make the premium price given by the ESE smaller that the grain price like it was in 2006.

The other problem was absence of clear direction concerning seed marketing in the region. For instance, the Angacha Woreda WARDO is still distributing seed purchased from ESE transporting from Bale, which is around 180 km from the Woreda. Whereas, cooperative union couldn't sell seed collected from farmers and cleaned at the price lower than ESE by 9.5%. This problem was also common to potato seed (Bulb) multiplied by farmers. Different Woreda agriculture and rural development office representatives reported to travel a long distance out of the region (including to Holeta Research Center) to buy potato bulb while there is potato seed available, which is produced by Hula seed producer farmers.

In the last three years, Chencha temperate fruit producer cooperative sold on average 130,000 seedlings annually to customers out of the Woreda. The majority of buyers were governmental organization (mainly Agricultural and Rural Development Bureaus of different region) and different NGOs to distribute the seedling to other farmers. According to the survey result, 97% of seedlings were sold outside the Woreda through cooperative (Table 18). Even though, the high price, which reached on average 40 birr per seedling accelerate the production of the seedling at the fastest rate, and those areas that used to buy from Chencha are now producing for their requirement. This is expected to reduce the overall demand for Chencha seedlings.

Table 18. Main customers of each seed type

	Percentage			
Seed	Share of local market	Share of large traders	Share of cooperative	Others
Wheat	10	47	43	-
Coffee	100	-	-	-
Apple	3	-	97	-
Potato	1	-	99	-

Source: own computational result

Farmers in Hula Woreda sell the potato seed through their cooperative with the support of union, agricultural and rural development office, regional research institute and Self Help International. However, there is time gap between demand and supply which is not compatible to nature of the crop. As Awassa research center indicate the time lag occurred due to the seed production and planting time of the other farmers. This time lag caused quality loss even though the farmers have store that keeps from deterioration for 6-8 months.

The case of coffee seedling is different from the mentioned above. All coffee seedling producers sell their seedling directly to other farmers; no institutions or organizations found to support or intervene in coffee seedling marketing. However the survey data shows still the production of the seedling increasing from time to time. For instance in year 2001 totally 1,148, 800 seedling or 98.7% of the total supply covered from seedling produced by farmers. This shows that the farmer were capable to satisfy seedling demand. Currently, from the total sampled coffee seedling producer only 3 or 10 % responded as they face market problem and 66.67 % takes the current market price for seedling as fair or good. However, due to absence of market place in their *Kebeles* or Woreda level that is convenient for seedling, farmers forced to transact on the farm. This can limit the number of buyer by distance, location and accessibility especially to farmers from other Woredas. This problem expected to affect the marketing of seedling in the future.

When we see the sales experience of the seed multiplied by farmers, due to different reason they couldn't brought to the market the whole seed produced even though it is expected that they can retain some amount for the next cropping season .As indicated in table 19 coffee seedling and potato seed producers could sell 86.67% and 80.0% of their seed production .On the other hand, particularly due to rejection of seed by cooperatives and companies wheat seed and apple seedling producers can sell only 63.35% and 51,23% of their product.

Table 19. Average seed production and sales by sample seed producer farmers in 2006

Seed type	Seed/seedling Production		Seed/seedling sales		Percentage sales from total product
	Mean	Median	Mean	Median	
Wheat seed	12.06	10	7.64	6	63.35
SD	(5.738)		(4.103)		
Coffee seedling	12354	8005	10704	7700	86.67
SD	(12737.9)		(12210.28)		
Apple seedling	193	150	99	55	51.23
SD	(186.98)		(120.1)		
Potato seed	50	24.4	40	18.62	80.00
SD	(12.68)		(10.10)		

Source: own computational result

Note: Wheat and potato seed measured in quintal, coffee and apple seedling measured in number

4.6.2. Gross Marketing Margin of farmers multiplied seed in the region

Products reach to final consumers through a market chain. The price paid by the eventual consumers is thus made up of the amount of money paid out to the farmers for his produce plus all the costs involved until the produce reach the consumers. A marketing margin exists as the price difference between any stages in the marketing chain. The percentage share of final price, which is taken up by the marketing function is known as the marketing margin (Eshetu, 2004).

$$\mathbf{GMMp = \frac{End\ buyer\ price - marketing\ gross\ margin}{End\ buyer\ price} X100}$$

Where, GMM_{p} = the producer's share in consumer price

The margin analysis was made based on the data collected from each market actors. However, detail analysis of cost associated to marketing of seed/seedling was difficult as most of organizations involved in the chain are non profit organizations.

The result of the survey shows all four types of seed type pass not more than three stages in the seed marketing channels to reach the final user farmers. From those seed type only wheat has two alternative channels the rest uses mainly cooperatives or direct sell to the final user.

Main market channel for farmers multiplied seed:

1. Wheat seed
    - Seed multiplier farmers → ESE → WARDO → farmers
    - Farmers → farmers
    - Seed multiplier farmers → Union → WARDO → farmers
2. Coffee seedling
    - Seed multiplier farmers' → farmers
3. Apple seedlings
    - Seed multiplier farmers → cooperative → different GO and NGOs → farmers
4. Potato seed
    - Seed multiplier farmers → cooperative → different GO and NGOs → farmers

The computational result from the price of seed at each level shows (Table 20), wheat seed produced by farmers and marketed through ESE included 26.20% of market margin in the sales price to farmers which is higher than the margin when the seed marketed through cooperative union of the farmers .Since there is no middle men involved in the marketing of coffee seedling in Dale Woreda farmers obtain the final or 100% of sales price on the market. Cooperative in Hula and Chencha Woreda collect a fixed margin of 7.5% and 11.48% from the sale of apple seedling and potato seed to the final user farmers respectively .Generally the margin share of market for seed shows that in all case farmers collect the larger share of the final price even though there is difference among the seeds type.

Table 20. Market margin from sales of seed

Types of seed	Sales price to wholesalers (in birr)	Sales price to user farmers (in birr)	Total gross marketing Margin (%)	Farmers share from the final sale (%)
Wheat	233.75 (ESE)	295.00	26.20	73.80
	218.38(union)	255.80	17.30	82.87
Coffee	-	0.12	0	100
Apple	40	43.0	7.5	92.5
Potato	275	305.0	11.48	88.52

Source: own computational result

Note: the price for wheat and potato seed measured per quintal and numbers of seed ling for coffee and apple

4.6.3. Quality control and certification

The availability and applicability of standards for seed/seedling multiplied by farmers and certification procedure to enter or continue a small holder farmer as a seed producer was evaluated. The existence of legalization and policies, which are conducive to farmers' level seed production, plays a vital role in fostering the participation of small holder farmers in seed multiplication (CTA, 1999). However, the new federal seed proclamation No 206/2000 seems to encourage only large scale enterprises as it states the need for qualified personal, internal quality control system, good knowledge of seed, and processing plant, which are all difficult to be fulfilled by small-scale farmers.

The proclamation No 90/2006 of SNNPR state enacted to reorganize the implementing bodies of the regional state mandates the BoARD (Bureau of Agricultural and Rural Development) bureau for quality control and certification of agricultural input produced and distributed in the region. By the power vested with the proclamation, the bureau is required to prepare different manuals and procedure of seed production and distribution. One of the documents is fertilizer and improved seed marketing quality control and certification procedure.

This regional procedure take into consideration not only grain seed but also specifically vegetable seed like bulb, tuber and fruit (seedling and its part), which are commonly produced by farmers in the region. According to the regional procedure, to involve as certified seed producers in the region, one must have good knowledge and skill of seed production; should have investment certificate; and should have appropriate farm plot allocated to seed Production.

Besides the limitation in availability of policy and legal background, the quality control and certification activity for seed and seedling produced by farmers was negligible. Currently, no activity is observed to control the quality by training producer farmers about the standard on seed/seedling quality and marketing. Even quality control of common seed produced is carried below the expected level.

There are two seed quality testing laboratories in the region at Wolkite and Durame towns, which are mainly designed for cereals and they have limited capacity. For instance, the area planned to be supervised in the 2006 production year was 3,100 ha but only 2,246 ha of land was inspected.

On the other hand, the quality of apple seedling is approved by the marketing cooperatives, which are not authorized by concerned body that has created difficulties and conflict with producer farmers. Indeed the temperate fruit cooperatives have no legal ground to certify apple seedling, but according to this survey result 48.6% of seedling produced by the member farmers was rejected due to quality reason.

4.7. Determinants of Farmers' Participation in Seed Multiplication

As indicated in part 3, Tobit models were employed to analyze the probability of participation in seed/seedling multiplication and intensity level to expand the amount of seed/seedling production. The dependent variable for each crop in the different Tobit models was the amount of land in ha allocated by seed producers for the specific seed / seedling production, which is censored at lower limit of zero by non-seed/seedling producers.

Before running the models, a test for multicolinearity among the hypothesized independent variables was made using variance inflation factor (VIF) and contingency coefficient (CC) for continuous and discrete variables, respectively. Then those variable detected with serious multicolinearity problem were excluded from further analysis.

4.7.1. Determinants of wheat seed multiplication

The VIF and CC result for wheat variables (Appendix Table 4 and 5) indicate that, there is no any multicolinearity problem that affect including of the indicated variables in the model. From five continuous and four discrete variables identified to influence seed multiplication of wheat two of them were found to influence significantly the participation of farmers in seed multiplication of wheat.

As indicated in the methodology several variables were assumed to influence farmers' participation in wheat seed multiplication. Among the hypothesized variables (Table 21), Distance to all weather roads (DISroad) and ownership of oxen (HHoxen) were found to significantly influence the participation of farmers in wheat seed multiplication and intensity of seed multiplication.

Distance from all weather roads (DISroad): This variable shows the length in km from farmers' house to suitable road. Accessibility of road to travel by vehicles affects the participation of farmers in wheat seed multiplication. The result shows that the closest the framers areas for transportation the higher probability of participation or the distance from all weather road influence the probability of participation, negatively. That is as the distance of the farmers' residence increase from road side the probability to participate in wheat seed multiplication decrease by 0.057% and reduce land used for seed multiplication 0.154 ha. This tendency is not only resulted because of farmers' accessibility to market but also other social services which stimulate the utilization of new technologies. As the result of survey shows seed production promoters influence the variable by giving priority to farmers who live closer to the main road for easily inspection of the seed.

Oxen ownership (HHroad): The other hypothesized variable to significantly influencing variable is oxen ownership. As the model result reveals that, the percentage increase in ox ownership increases probability of participation and land allocation for wheat seed multiplication by 0.105 % and 0.284 ha respectively. This is due to the fact that wheat seed multiplication require relatively large farm land preparation specially farmers who multiply wheat seed plough their land more than two times to reduce weed infestation and let better circulation of air to produce quality seed which increase the need of farm oxen.

Size of farm land owned (HHland): Refers to the cultivable land owned by a household (ha). Land is the major productive asset in rural areas. Households that own larger land can produce more crops and possibly diversify their crop enterprises and income sources. The result of tobit analysis indicate size of land owned influence significantly and positively at 10 % that is household with larger area of cultivable land more willing to participate in wheat seed multiplication and allocate better proportion of his land as compared to farmers with small holdings. The decomposition result (Table 21) show as land holding increased by one ha the probability of participation in wheat seed multiplication by 0.073 % and allocation of land for multiplication with 0.199 ha.

Table 21. Probability and intensity of participation in Wheat seed multiplication

Variables in the model	Coeff	t-ratio	Marginal effects: Change in the probability of participation	Change in the intensity of multiplication	Total change
Constant	-0.040	-0.132			
FAMSIZ	-0.020	-0.832	0.007	0.020	-0.020
HHeduca	-0.008	-0.169	0.003	0.008	0.008
DISroad	-0.154	-2.117**	0.057	0.154	0.154
HHextension	0.142	1.050	0.052	0.142	0.142
HHland	0.199	1.976*	0.073	0.199	0.199
IGFNFA	0.637	0.747	0.000	0.000	0.000
HHoxen	0.284	2.179**	0.105	0.284	0 .284
Log likelihood function		-33.563			
Sigma		0.413			

*,** significant at 10%,5%

4.7.2. Determinants of coffee seedling multiplication

As The result of Tobit model analysis of the variable which are left from screening and postulated to influence the participation of farmers in multiplication of coffee seedling, only three variables found to influence significantly at 10% and 5% significance level. As observed from table 22 Radio ownership (Radio), training given on seed multiplication (HHtraining) and distance from market center (DISmarket) increase the probability of farmers' participation in coffee seed multiplication.

Radio ownership (Radio): Radio ownership indicate accessibility of the coffee seedling grower farmers to information like price of coffee which expected to influence the demand for seedling. This variable found to influence farmers participation in seedling multiplication positively. As the result of model analysis depicts increase in the probability of Radio ownership improves farmers' participation in seedling multiplication of coffee. The decomposition result of the coefficient (Table 22) indicate, as ownership of radio increase the probability to involve in seedling multiplication improved by 0.025% and seed producer farmers allocated land increased by 0.041 ha .

Distance from market center (DISmarket): As different literatures indicate farmers with closer contact or nearer to market area can get better information about the price of both agricultural out put and input and other information which might help farmers to make decision. The result of Tobit analysis also confirm that as distance traveled to market decrease the probability of farmers to participate in coffee seed multiplication increase which implies that there is negative relation ship between market distance and participation. That is the increment of distance from market decreases the probability of participation in coffee seedling multiplication by 0.004% and the intensity by 0.007 ha. As the distance decrease to arrive to the nearest market seedling producer farmers could go more frequently to market in order to identify potential buyer of seedling and obtain information on price of seedling and coffee timely that stimulate the involvement in coffee seedling multiplication.

Training on seed multiplication (HHtraining): Farmers training refers to transferring knowledge and skill of coffee seedling multiplication. Participation in training influences significantly the probability of participation in coffee seedling multiplication at 5% significance level. That is percentage increase in obtaining of training on seed multiplication increase participation and intensity of seedling multiplication by 0.015% and 0.025 ha, respectively. According to (Edlu, 2006), Participation in training will enable farmers to get more information and improve their understanding about the available packages, which may intern lead to a change in their knowledge, attitude and behavior.

Table 22. Probability and intensity of participation of coffee seedling multiplication

Variables in the model	Coefficient	t-ratio	Marginal Effects: Change in the probability of participation	Change in the intensity of participation	Total change
Constant	0.028	1.207			
FAMSIZA	-0.006	-0.396	0.004	0.0006	0.007
DISroad	-0.002	-0.743	0.000	0.002	0.002
Radio	0.041	3.169***	0.025	0.041	0.041
DFGBS	0.007	0.703	0.004	0.007	0.007
HHtraining	0.025	2.249**	0.015	0.025	0.025
DISmarket	-0.007	-4.104***	0.004	0.007	0.007
Log likelihood			59.8389		
Sigma(∂)			0.00343		

*,**,*** significant at 10%,5%and 1%

4.7.3. Determinants of apple seedling multiplication

In this section the significant variables for participation in seedling multiplication of apple are discussed to what extent they conform to a priori expectations about the variables. Table 23 indicate from the six variable expected to influence the participation in apple seedling multiplication three variables of which two desecrate and one continuous variables resulted to affect the probability of participation significantly at 10% and 5% significance level.

Training on seed production technique (HHtraining): Attending training specifically on the grafting and other seedling management practice hypothesized as influential factor to involve in multiplication of apple seedling. Attending training is a dummy variable that is 1 if the farmers responded to obtain training on related topics 0 otherwise. As the analytical result of Tobit model (Table 23), farmers who obtain training more probable to involve in apple seedling multiplication than the other means training influence the probability of participation in apple seedling multiplication positively. That is a change in availability of training increase the probability of participation with 0.001% and increase the allocated land for seedling multiplication of apple increased with 0.042 ha. This might be apple seedling multiplication is recent technology in the area and grafting process requires better skill than common agricultural practice the farmers accustomed to.

Access input credit (HHcredit): As the model result depicts the variable access to credit had positively and significantly influenced the likelihood of participation in apple seedling multiplication at 5% significant level. The result shows those farmers who have access to credit from formal organization like micro finance institution more probable to participate in seedling multiplication than those who have not. Earlier studies also confirm that credit is one of factors influence adoption or participation in application of new technologies (Yishak, 2005). The decomposition result of the coefficient (Table 23) reveal, percentage change in availability of input credit increase the probability of participation with 0.002% and intensity apple seedling multiplication with 0.071 ha.

Size of farm land owned (HHland): The result of the model indicate that there is positive association between size of farmland owned by the farmers and participation in seedling multiplication. Those farmers who have better size farm land have more willingness to involve in apple seedling multiplication or as the sizes of farm land increase the probability to participate in seedling multiplication also increase. That is a percentage increase in the size of farm land owned by the farmer increase probability of participation by 0.001% and the land allocated for apple seedling multiplication increase by 0.052ha. This is due to the fact that, farmers in this Woreda have landholding of less than one hectare, so only those farmers with better size of land will be interested to allocate their land for new technology.

Distance from all weather roads (DISroad): It was hypothesized that those farmers who live in remote areas are in most cases reluctant to involve in seed multiplication technology. This is possibly because they have limited access to modern agricultural inputs and market access for some easily perishable products. The result of the model is in agreement with the hypothesis at less than 5% probability level. The inverse relation to distance traveled to get vehicle transport and adoption apple seedling multiplication technology indicates that farmers located further from road will have a smaller probability of involving in multiplication of seedling. The result of the model depict as the distance of farmers residence increase by one km the probability of participation in apple seedling multiplication decrease with 0.001% and intensity with 0.052 ha.

Table 23. Probability and intensity of participation in apple seedling multiplication

			Marginal effects		
Variables in the model	Coeff	t-ratio	Change in the probability of participation	Change in the intensity of multiplication	Total change
Constant	-0.062	-1.541			
DISroad	-0.052	-2.082**	-0.001	-0.052	-0.052
OFINCM	-0.003	-1.679	0.000	-0.000	-0.000
FFland	0.052	2.983***	0.001	0.052	0.052
FFtraining	0.042	2.109**	0.001	0.042	0.042
FAMSIZA	0.001	0.353	0.000	0.001	0.001
HHcredit	0.071	3.393***	0.002	0.071	0.071
Log likelihood function		38.429			
Sigma		0.0537842			

*,**,*** significant at 10%,5%and1%

4.7.4. Determinants of potato seed multiplication

Based on variables which are tested for multicolinearity problem (Appendix table 10, 11), it was tried to identify significant variable in potato seed multiplication. The analytical result of the model to identify important variables that affect the probability as well as the intensity of participation in potato seed multiplication depict that distance from all-weather road (DISroad) family size (FAMSIZA) and availability of extension service(HHextension) were significantly affect both probability and intensity of participation in potato seed production at 10% and1% significance level.

Distance from all-weather road (DISroad): The result of Tobit analysis (Table 24) depict that, as distance from the main road decrease the probability of participation in potato seed multiplication increase with 0.066 % and the allocation of land by seed producers increased by 0.172 ha. This means farmers influenced by the distance they live from the main or all-weather road to participate in seed multiplication. This could be due to the fact that bulkiness of potato to transport to market or cooperative office. So as the distance increase by one km the willingness of the farmers goes to the opposite direction.

Family size (FAMSIZA): It was one of the hypothesized variables to significantly contribute to participation in seed multiplication considering their labor requirement than common crop production. Large households will be able to provide the labor that might be required for Potato seed production. This variable is found significant at 10% and positive. That is, farmers with large number of family size are more probable to participate in seed multiplication. Also the marginal effects both on participation and intensity indicate that, a percentage changes in family size increase the probability positively with 0.150% and the intensity or land allocated for seed production of potato increase by 0.039 ha.

Availability of extension service (HHextension): Extension service availability or contact of farmers with DA influences the participation of farmers in potato seed multiplication**.** This indicates that farmer who has got better extension service, more willing to participate in seed multiplication than the other. These results go inline with the conclusion of Bahadur (2004). According to this study, the coefficient of extension service was found positively significant, which implies that regular visit of an extension worker is necessary to enhance the rate of adoption by providing necessary information, knowledge and skills to the farmers. The decomposition results describe a percentage changes in availability of extension service increase the probability of participation positively with 0.168% and the land allocated for seed production of potato increase by 0.436 ha respectively.

Table 24. Probability and intensity of participation in potato seedling multiplication

Variables in the model	Coefficient	t-ratio	Marginal effects		
			Change in the probability of participation	Change in intensity of participation	Total change
Constant	-0.483	-1.934			
DISroad	-0.177	-2.532***	0.066	0.172	0.002
HHland	0.121	1.273	0.450	0.118	0.001
EFTRS	0.345	1.532	0.060	0.523	0.003
FAMSIZA	0.041	2.182*	0.150	0.039	0.000
TLU	0.139	1.746	0.040	0.001	0.002
HHextension	0.449	2.638***	0.168	0.436	0.004
Log likelihood function			-136.7		
Sigma(∂)			0.7096		

*,*** significant at 10%and1%

4.8. The Contribution of Farmers Based Seed Multiplication

4.8.1. Contribution in regional seed supply

Wheat:

The utilization of improved seed is doubtless to increase yield even determines the response of other inputs. The utilization of improved seed has been increasing for the last 10 years due to different intervention programs and policy of the government. If we see the data from the year 1998-2006, the average percentage increase in improved seed utilization was 112.3%. However, the supply of some selected seed in SNNPR had been 95% of the actual demand and only 4.8 % of the potential demand of the region. Since the agro ecology of the region is diverse, the shortage of the seed is not only manifested by the quantity of supply. As the data of survey shows from the total required type and variety of the seed only 70% were obtained on average from seed companies in the region including ESE. After reestablishment of the new scheme of seed supply with farmers' involvement for some selected cereals crops, 1750 quintals of wheat seed was produced on average in the last three years by farmers in Angacha Woreda. So regardless of poor marketing system and other related problems, the wheat seed produced can satisfy the demand of farmers in Angacha Woreda.

Apple seedlings:

It couldn't be possible to think about apple seedling supply from Chencha Woreda with out involvement of farmers. Even though, apple has a long history (> 50 years) in churches farm, no company or government organization recognized the production and distribution of the seedling as profitable agricultural business. In the past three years, most of the country's apple seedling requirements had been satisfied by the supply from Chencha Woreda.

Coffee:

As indicated in figure 3, from the total coffee seedling distributed in Dale Woreda in average 89.6 % covered by farmers producer. The seedling productions by farmers due to demand preference of user farmers and other factors have been growing in average at the rate of 119 % in the last 6 years. This shows that the share of seedling produced on government nursery site decreasing and substituted by farmers managed seedling production.

Potato:

Farmers in Hula Woreda are involved in potato bulb production with the help of Awassa research center and Self Help International. Those farmers for instance in the year 2006 produced and sold 464 quintals of potato seed to farmers in the region through agricultural and rural development office with the support of cooperative union at average price of 270 birr per quintal.

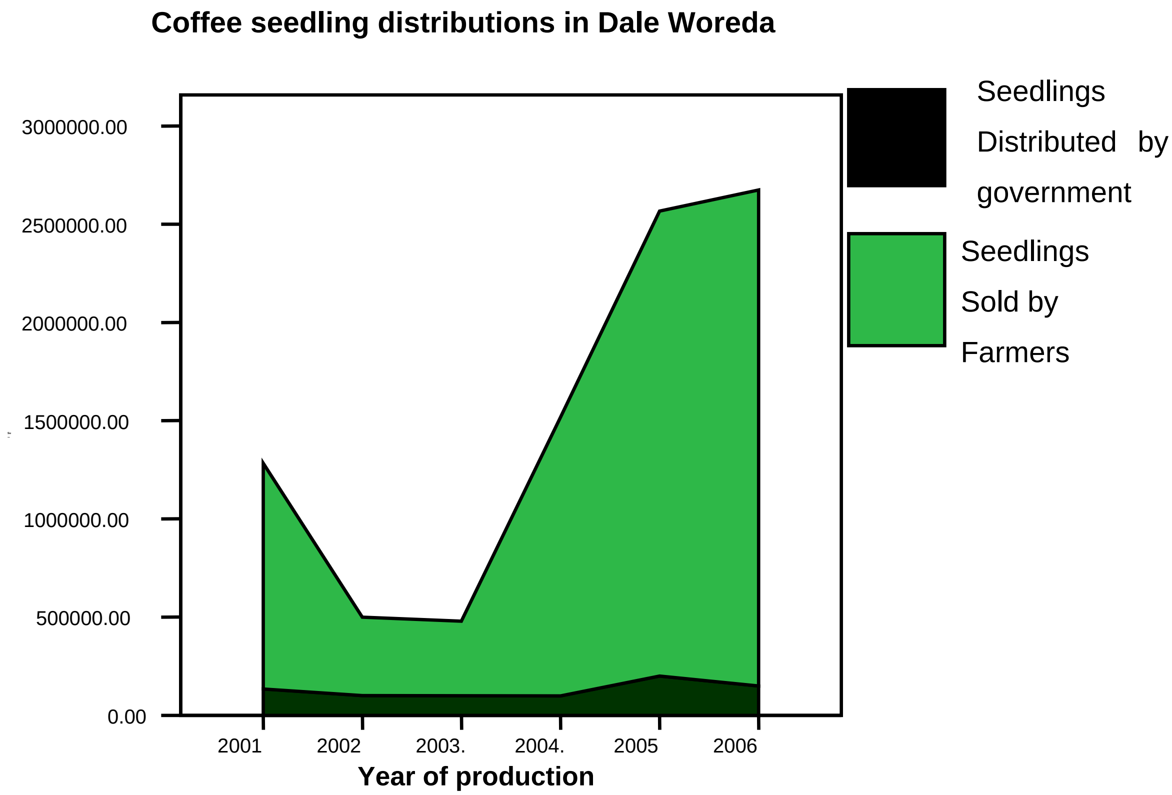

Figure 3 Coffee seedling distribution in Dale Woreda

4.8.2. Analysis of impact of seed production on farmers income

This study was attempted to address the effect of participation in seed multiplication particularly on seed producer farmers' income using gross margin analysis. The term gross margin generally refers to the remaining income from an enterprise after the variable costs are deducted (Gross income less variable costs). A gross margin budget is a fairly detailed estimate of the output, cost, and profitability of individual crop enterprises. That is

Gross Margin = Gross income – Variable cost

Gross income = Avg. Yield/area x Price/unit

Based on data collected during interview of farmers about the seed produced and sold by each farmers and current market price of input and labor it was tried to estimate the cost and return per hectare of each seed type. This computation also applied to grain production of the same types of crops and common crop type produced in the study area on the same size of land for comparison purpose. The price of out put and input that used to produce both grain and seed of indicated crops was obtained from local market and input dealers during the survey.

Table 25. Average production and price of crops

Crop type	Woreda	Average production per ha	Price Birr/quintal
Wheat	Angacha		
Grain		25	250.00
Seed		28	281.13
Maize	Dale	46	230
Barley	Chencha	24	380
Potato	Hula		
Grain		120	70
Seed		120	280

Note : The productivity belongs only to those indicated Woredas

Table 26. Average production and price of seedlings

Seedling type	Woreda	Average production per ha	Price Birr/unit
Coffee seedling	Dale	618,728	0.12
Apple seedling	Chencha	1823	38

Wheat seed multiplication: Wheat grain production on one hectare required in average 1,011.82 birr to purchase fertilizer and seed and 468.11 birr for labor expense. That is from land preparation to harvesting. Whereas to produce wheat seed on the same area of land needed 1,182.5 birr for fertilizer and seed also 521.40 birr for labor expense.

Based on the average current price (Table 25), farmers sold 25 quintal of wheat with 6250.00 birr which produced for consumption on one hectare while wheat produced as seed on the same land size sold in average with 7955.64 birr. This result indicates that besides the productivity difference as a result of intensive management , follow up and the quality of basic seed utilized for seed multiplication, due to price difference, a farmer can generate additional gross margin of 1481.37 birr per ha by producing wheat seed than grain for consumption at the current market price.

Table 27.Comparative benefit of Wheat seed and wheat grain production

Wheat seed	birr	Wheat grain	birr
Total income		Total income	
(Value of total product)		(Value of total product)	
28quintal x 281.13 birr	7955.64	25 quintal x 250 birr	6250.00
Total variable cost	1703.9	Total variable cost	1479.93
Gross margin	6251.74	Gross margin	4770.37
Gross margin difference		**1481.37**	

Coffee seedling multiplication: One of the common crops produced in Dale Woreda besides coffee is maize. So to avoid complication that may arise because of the perennial nature of coffee plant, the comparative analysis was carried out taking maize as alternative enterprise for coffee seedling multipliers.

Common agricultural inputs applied for maize production in Dale Woreda are fertilizer and improved seed. Based on average application of those inputs by farmers and current input price, it was estimated that farmer utilized 555.00 birr for fertilizer and improved seed and 636.90 birr for labor. Similarly coffee seedling production on one hectare required 600 birr for purchase of seed and 610.12 birr for labor.

As the computational result depicted, based on the average current price it was estimated that maize produced on one hectare of land sold with 10,580 birr and coffee seedling produced on the same area of land sold with 74,247.36 birr. This indicates keeping other factor constant, farmers who involved in coffee seedling multiplication by replacing his maize production can get gross margin of 63649.14 birr.

Table 28.Comparative benefit of coffee seedling and maize production

Coffee seedling	birr	Maize grain	birr
Total income (Value of total product) 618,728 seedling x 0.12birr	74,247.36	Total income (Value of total product) 46 quintal x 230 birr	10,580
Total variable cost	1,210.12	Total variable cost	1,191.9
Gross margin	73,037.24	Gross margin	9,388.1
Gross margin difference		**63,649.14**	

Apple seedling multiplication: Because of the same reason with coffee seedling, apple seedling multiplication was compared with barley production which is common cereal crop in Chencha Woreda. As the current market survey result (Appendix table 14 and 15) shows, the production of barley on one hectare require 1,090 birr for fertilizer and seed and 453.17 birr for labor expense. While farmers in the same Woreda multiplied apple seedling on one hectare with average of 11,290.85 birr for purchase of parent material and labor required for nursery activities.

Based on current sales value of apple seedling and barley grain produced on one hectare of land, the result of gross margin analysis tell that, farmers in Chencha can increase their income by 50,406.32 birr by substituting barely with apple seedling multiplication.

Table 29.Comparative benefit of apple seedling and barley production

Apple seedling	birr	Barley grain	birr
Total income		Total income	
(Value of total product)		(Value of total product)	
1823 seedling x 38 birr	69,274.0	24 quintal x 380 birr	9,120
Total variable cost	11,290.85	Total variable cost	1,543.17
Gross margin	57,983.15	Gross margin	7,576.83
Gross margin difference	**50,406.32**		

Potato seed (bulb) multiplication: During the survey of this study both the type and average input requirement of potato produced for consumption and for seed were gathered. Based on the current market price (Appendix table 14, 15), farmers who produced potato for consumption purpose on one hectare of land applied fertilizer and seed which cost 1,530 birr and estimated labor cost of 554.28 birr. On the other hand farmers those produced potato seed reported that they required 5,914.7 for purchase of basic seed and fertilizer also, 737.95 for labor expense.

The current market price of potato seed and potato produced for consumption (Table 25) shows, farmers sold those 70 birr per quintal and 280 per quintal respectively. Taking in to consideration those common costs of production and sales value, it is estimated that involvement in potato seed multiplication resulted change in gross income of 20,631.63 birr to the farmers.

Table 30.Comparative benefit of potato seed and potato grain production

Potato seed	birr	Potato grain	birr
Total income		Total income	
(Value of total product)		(Value of total product)	
120 quintal x 280 birr	33,600.0	120 quintal x 70 birr	8400.0
Total variable cost	6652.65	Total variable cost	2084.28
Gross margin	26947.35	Gross margin	6315.72
Gross margin difference	**20631.63**		

4.8.3. The contribution of farmers based seed multiplication in implementation of other agricultural programs

The numerous seed varieties released from the regional research institute wouldn't reach farmers without the involvement of farmers as multiplier and distributor of the seed. Because, no private or government organization found to multiply seed like root crops and some cereals which are the main area of emphasis with the institute and also the dominant agricultural produce of the region. As the report of the institute (2006) shows, a total of 23 varieties which are released from the institute, multiplied and distributed through farmers to farmers exchange or through farmers cooperative to user farmers. It is also employed as one way of demonstration and popularization of the variety from the research center.

The production of seed in each locality by farmers also reduces the government expenditure to transport seed a long distance. For instance, Angacha is approximately 180 km from the main source of wheat seed that is Bale ESE center. So, to transport a quintal of seed in average require 50 birr and need 20,000 birr total to transport 400 quintal which is the average annual demand of the Woreda. This cost didn't include transport, and others in addition to the time spent by agronomist and other expert to transport the seed which makes important issue to decide about farmers based seed multiplication. The production of seedling in coffee area like Dale Woreda by the farmers show there is a good opportunity to government to shift and use huge amount of money to other development activity which could be allocated to establish and run coffee nursery site. Based on the minimum cost per unit seedling, the government have been in average make use of annually 26,164 birr to satisfy the coffee seedling demand of Dale Woredas farmers.

The other important advantage found with farmers seed multiplication was creation of an opportunity to Woreda ARDO to test and demonstrate the performance of new variety before it distributed at large scale to the farmers' .Angacha Woreda have good experience with this. For Instance, Angacha Woreda tested different variety side by side caring out the multiplication of wheat variety which obtained from research centers. After demonstrating the result on farmers' field, Wheat variety which got acceptance by farmers expands the multiplication and supply of the seed. This experience helped to decrease the risk associated to the distribution of seed which fail to adopt or continue maintaining the original quality in the specific agro-climate condition or lose the interest of farmers due to different parameters.

5. SUMMARY AND CONCLUSION

5.1. Summary of Major Findings

This study was conducted to identify major factors that determine the seed multiplication by farmers and its contribution in the Southern Nation Nationality and Peoples Regional State taking 4 sample Woreda (Angacha, Dale, Chencha and Hula): 4 crops (wheat, coffee, apple and potato) those were expected to be representatives of common type of crops farmers used to multiply as a source of seed for their farm or a means to get additional income.

To carry out this research, 4 Woredas and 4 crops were selected based on different reports, discussion with professionals and researchers experience in the region. Then from each Woreda 2 *Kebels* were selected based on their relative potential and accessibility. From 4 Woreda and 8 *Kebeles* a total of 240 sample farmers were randomly selected for interview. In addition to interview of sample farmers using survey questionnaires, different quantitative and qualitative information were collected from different organizations, professionals and group of farmers in order to have clear vision of the situations.

In order to describe and compare different categories of the sample units with respect to the desired characteristics, mean, standard deviation and percentage were computed. Further more t-test and chi-square test were used to supplement or testify significance of results obtained from the models specified.

Tobit model was employed to identify important variables that influence both the probability of participation and intensity of participation in farmers' seed multiplication. As summarized from econometric analytical result, there are different variables that determine both the probability and intensity of participation in seed/seedling multiplication which can be categorized as farmers and farm characteristics, socioeconomic and institutional factors.

From hypothesized variables to influence each seed/seedling multiplication family size, distance from all-weather road and market , extension contact, Radio ownership , availability of input credit ,ox ownership, size of farm land and training were significantly influenced both the participation and intensity. But it does not mean that all variables influence all seed multiplication type. For instance, access to training increased the participation in coffee and apple seedling multiplication, with 0.015 % and 0.001 % and the intensity with 0.025 and 0.042 ha respectively. Also as distance from the main road decrease the probability of participation of wheat and potato seed and apple seedling multiplication increased with 0.057 %, 0.066 % and 0.001 respectively. In addition the likelihood of participation of farmers in wheat seed and apple seedling multiplication increased by 0.073 % and 0.001 % as the size of land owned by farmers improved by 1 ha.

Some variables found to influence only one type of seed or seedling multiplication. That is percentage change in ownership of radio, ox ownership and family size improve the probability of participation of coffee, apple, wheat and potato seed multiplication with 0.025%, 0.105 % and 0.150 % respectively. Similarly accesses to credit influence the probability of participation in apple seedling multiplication with 0.002 % and intensity with 0.071ha. In the same way increase in access to extension service with one percent increase the likelihood of participation and intensity of potato seed multiplication with 0.160% and 0.436 units respectively. On the contrary as the distance from market increase the participation in coffee seedling decreased by 0.004% and the intensity with 0.007 units.

Seed multiplication activity also determined by different condition that may encounter at each level of the seed system. So in addition to analyzing variables obtained with respect to farm level characteristics, socioeconomic and institutional factors , the performance of market for farmers multiplied seed also measured using GMM besides describing the overall condition of the regional seed market like actors role and associated constraints including quality controlling and seed certification mechanism.

It was also hypothesized that seed multiplication has diverse benefits from gap filling to means of employment .So to analyze the benefit gross margin method employed to see income contributions to seed producers' farmers. Based on some descriptive results and qualitative data it was tried to explain the contribution of seed multiplication in the region in different aspects.

5.2. Conclusion and Policy Recommendations

To assure food security and reduce poverty increasing agricultural productivity using modern agricultural input plays a vital role. Among the important agricultural inputs, seed takes the first place. To improve the use of improved seed, ensuring the supply of standard quality at the required quantity, at the right time and at fair price is decisive. Under the current condition, the seed demand of the region is not satisfied due to the limited number of private seed companies and the public seed company (ESE).

Different literatures worked in developing countries including Ethiopia emphasized on farmers based seed multiplications as the main alternative seed source. The farmers based seed multiplication has paramount importance in satisfying the seed demand of subsistent farmers characterized by diverse type of variety requirement with small quantities, which makes difficult to meet. Moreover, seed multiplication can be considered as a means to generate additional income or even an alternative to specialize on as an income generating activity. The farmers based seed multiplication has more meaning to SNNPR, where there is diversity in agro-ecology and socio-economy, which resulted to diverse farming system and diverse seed requirement. For instance, the central part of the region is dominated by cereals crop production whereas the western part including Sidama and Gedeo zone commonly produces coffee and other perennial crops.

Based on the research findings of this study, the following points are recommended to improve farmers' participation in multiplication of seed and overall supply of seed in the region:

The analyses of determinants of participation and intensity of seed multiplication reveals that credit have significant positive effect. Moreover improving ox ownership found to have positive contribution to increase participation and intensity of seed multiplication. Therefore efforts aimed at promoting seed/seedling multiplication by farmers should take the importance of additional finance to seed producer farmers for purchase of input including farm oxen.

Hence, to sufficiently extend input credit to resource poor farmers, establishment of rural finance institutions besides improving the capacity of the existing one contributes very much for such purpose.

The study also revealed that distance from all-weather road and market center has influence the likelihood of participation in seed multiplication. This is due to the fact that farmers who produce seed need to transport input like fertilizer and initial seed from market or distribution center of cooperatives and WARDO. On the other hand, bulky natures of the crop like potato discourage producer farmers unless they are accessible to road transport. Other important factor aggravates the problem is biasedness of both contract grower and WARDO experts to farmers near to the main road. So, improving the transportation capacity of cooperatives, creating alternative channel to seed market, and reorientation of seed system support will need the attention of government besides improving the road coverage.

This study also signifies the reality that extension and training play a key role in adoption of new technologies in the agricultural sector. The transfer of knowledge and information concerning seed technology including training that could develop the skill of farmers found important to increase the number of willing farmers in seed multiplication activity. On the other hand, those who lack information and knowledge besides the skill to produce required seed were reluctant to involve in seed multiplication, which clearly indicate the need of improvement in extension system and particularly letting established FTC in the rural area to give continuous and standard training to the farmers.

According to the results of the survey and literatures, Involvement of different actor in the seed system create access to seed producers farmers like input, credit and market for their seed that increase the participation of farmers. However the project nature of support, absence of clear guide line, lack of clear organizational structure with respect to the requirement of seed multiplication and distribution have negative influence on the development of local seed system. To avoid the problem regional government particularly the agriculture and rural development bureau need to give emphasis in assigning manpower and to the issue of rules and regulation that help to coordinate and facilitate the support of different actors in farmers based seed/seedling multiplication.

The other problem investigated in this study was weakness of quality control and certification including both availability and implementation. There is no documented quality standard in the region that shows what traits should contain an apple seedling or potato seed. It is only wheat seed have standard quality control and certification, based on field inspection starting from site selection for multiplication to lot sample analyses in laboratory, even though its application has its own limitation. This problem considered one of source of disagreement or conflicts between seed producers' farmers and buyers and cause of low sales of seed produced. So improving quality control and certification system appropriate to seed produced by farmers requires building the capacity of regional input sector and laboratories besides arrangement of training on the subject matter to all stakeholders including seed producer farmers.

The involvement of cooperative has positive impact in increasing the bargaining power of farmers and to get market information and materials as well as technical support which are difficult to own individually like seed cleaning machine and standard storage for seed. But due to lack of skilled man power and other important resource, low contact with whole sellers or other cooperative outside their territory to transfer surplus seed to deficit area .So it is difficult to conclude that they were giving effective and efficient service to seed producers member farmers. These problems were clearly seen from Angacha and Chencha Woreda cooperatives. As observed from those Woreda the problem causes some disagreement and conflict on quality and price setting. This can be tackled by organizing cooperative federation as one option besides building the existing primary cooperatives and their union manpower and material capacity.

6. REFERENCES

Abay Asfaw and Assefa Admassie, 2002.The Role of education on the adoption of chemical fertilizer under different socioeconomic environments in Ethiopia, Center for Development Research (ZEF), University of Bonn, Walter Flex Street 3, 53113 Bonn, Germany.

Abdissa Gemeda,Girma Aboma, V.Hugo and M.Wilfred, 2001. Farmers' maize seed systems in Western Oromia, Ethiopia.

Abera Deressa, Ademassu.H, Nigussie and M Seboka.B, 2001. Participatory decentralized secondary improved maize seed multiplication in the Central Rift Valley of Ethiopia. Paper presented on the seventh eastern and southern Africa regional maize conference, feburuary, 2001, Nazreth Ethiopia.

Aberhalay Gebrelibanose, 2006. Farmers perception and adoption of integrated stringa management technology in Tahtay Adiabo Woreda,Tigray ,Ethiopia .An MSc thesis presented to the School of Graduate Studies of Haramaya University.120p.

Alemu Haile, V.Hugo, M.Wilfred and Asmare Yallew, 1998. Farmers' wheat seed source and seed management in the Enebssie area, Ethiopia. 48p.

Almekinders, C.J.M, 2000. Increasing the Resilience of the Farmers' seed system through linkage with formal sector, technology and Agrarian Development, Wageningen University, in Targeted Seed Aid and Seed System Intervention, strengthen small-Framers seed Systems in East and central Africa, Kampala, Uganda, 112p.

ARDO,2006.Hula Woreda Agriculture and Rural Development Office annual report,An published document,Hagereselam.

Bahadur, K.L, 2004. Technology adoption and household food security. Analyzing factors determining technology adoption and impact of project intervention: A case of smallholder peasants in Nepal,Paper prepared to present in The Deutscher Tropentag to be held on 5 - 7 October, 2004, Humboldt-University, Berlin.

Baniya, B.K, D. Singh and B. sthapit, 2003. Factor affecting seed systems, Experience from Nepal, Nepal Agricultural Research Institute, *Proceeding of Workshop, 16-20 September 2003, Pucallpa, Peru.*

Bekele Shiferaw, Gideon Obare, and M.Geoffrey, 2006. Organizations in imperfect markets: Experiences from Producer Marketing Groups in Semi-Arid Eastern Kenya International Crops Research Institute for the Semi Arid Tropics, paper presented Research Workshop on Collective Action and Market Access for Smallholders, Cali, and Colombia.79p

BoARD, 2006. Southern Nation Nationality and People Regional State Agriculture and Rural Development Bureau annul Report, Unpublished document, Awassa ,Ethiopia.

Bronwyn, H. Hall, K.Beethika, 2003. Adoption of New Technology, *University of California at Berkeley*, Institute of Business and Economic Research.22p

Bureau of Finance and Economic Development (BoFED), 2006. Southern Nation Nationality Peoples Regional state statistical abstract of 2004/05, Awassa.

Byerlee D, S.David, Dawit Alemu, and G.Madhur, 2007. Policies to Promote Cereal Intensification in Ethiopia: A Review of Evidence and Experience. IFPRI Discussion Paper 00707. Development Strategy and Governance Division. International Food Policy Research Institute. 44p.

Camargo C.P, C.Bragantini and A.Monares, 2004. Small scale farmers' seed production system; a non Conventional Approach. FAO, Rome.

Chilot Yirga, B.I.Shampiro, , and Mulat Demeke. 1996. Factors influencing adoption of new Wheat technologies in Wolmera and Addis Alem Areas of Ethiopia. Ethiopian Journal of Agricultural Economics. 1:63-83.

CSA (Central Statistical Authority), 2003.Ethiopian agricultural enumeration, 2001/02: Result of Southern Nations Nationalities and People Region. Report on area and production of crops. Part II B,Addis Abeba.628p

CSA (Central Statistical Authority), 2005. Annual statistical abstract,Addis Abeba, Ethiopia

CTA, 1999. The role of small holder farmers in seed production system. Report and recommendation of study visit to Zimbabwe, 15-26feburary 1999.

David. S, 2003. Farmers seed enterprise: a Sustainable Approach to Seed Delivery.

Dereje Hamza Mussa, 2006. Assessment of farmers' evaluation criteria and adoption of improved bread Wheat varieties. An MSc thesis Presented to the School of Graduate studies of Alemaya University.

Diederen, P., M.Hans van, W.Arjan, B.Katarzyna. 2003. Innovation adoption in agriculture; Innovators, Early adaptors and laggards, Wageningan University and Research center, the Netherlands, 22p.

Edlu Badwo, 2006.Extension program coverage and utilization by different categories of farmers in enemor and Ener Woreda,Gurage Zone .An MSc Thesis Presented to the School of Graduate Studies of Haramaya University.

Ehui, S.K, M.M Ahmed, Berhanu Gebremariam, A.Nin Praff,.L.Laper , 2003.Livestock policy analysis, IRLI.

Ersado lire, A.Gregori and A.Jeffrey, 2003. Productivity and land enhancing technologies in Northern Ethiopia ;Health, Public investment and sequential adoption ,Environment and production Technology Division ,International food policy institute, Washington DC 20006 USA 23p.

Eshetu Abtew, 2004. Agricultural commodity marketing system study project, Wheat Marketing System Study,Amhara National Regional State, Head of Government Office ,Bahir Dara, Ethiopia ,106p.

FAO, 1999. Seed policy and programmers for SSA. Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO, 1999a. Sustainable seed system in SSA, Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO, 2004. Seed Multiplication by resource poor farmers. Food and Agricultural Organization of the United Nations, Rome

Getahun Degu, M. H.Wilfred, Verkuijl, Abdishekur Wondimu, 2000. An Assessment of the adoption of seed and fertilizer packages and the role of credit in smallholder Maize Production in Sidama and North Omo Zones, Ethiopia**.**

Getinet Gebeyehu, Gudissa Shaka and Gurmu Dabi, 2001. Focus on seed programs on the Ethiopian Seed ,ICARDA.

Giusti, V, 2004. On farm seed production, a practical and participatory proposal for Seed Production, FAO, Rome, Italy.

GTZ . 2000. Support For Informal Seed sector in development cooperation a conceptual issue, Deutsche Geselleschaft fur Technnische Zusammenanarbeit ,Gmbh in collaboration with the center for Genetic Resource, the Netherlands(CGN).21p

Gujarati, D.N, 2003.Basic econometrics, fourth edition. United State military academy, west point, USA.

Hailemariam Tefera,Tesfaye Getachew, Zewdenesh Tesfaye, 2004. Deciduous fruit trees for the highlands of Ethiopia, Ministry of Agriculture (MERET) project, Addis Ababa, Ethiopia.

Johnston, J. and Dinardo, J. 1997. Econometrics Methods. 4th Edition, The McGraw-Hill. Companies, Inc., New York. 250p.

Kibiby,J.M., T.Flavianus, , A.Z,M. Magayane, , 2001. Existing mechanisms for smallholders seed production and disseminations in Tanzania: Acase of SUA B/C CRSP , Sokoine University of Agriculture, Morogoro, Tanzania.

Kidane and D.G.Alber, 1994. Production technologies in Ethiopia agriculture, *The journal of the international Association of Agricultural economics*, Volume 10, No2.

Langyintuo.A and Mulugetta Mekuria,2005.Modeling agricultural technology adoption using the software STATA, Presented at a Training Course Organized by CIMMYT-ALP for its NARS Partners in Southern Africa on: "Econometric Application to Modeling the Adoption of Agricultural Technologies".21 – 25 February, 2005, Harare, Zimbabwe.

Lipper, L., C .Romina and Paul C. Winters, 2005. Seed system, households' welfare and an economic methodology applied in Ethiopia, ESA technical paper. Agricultural and Development Economics Division, the Food and Agricultural Organization of United Nation.32p.

Louwaars N.P,with M.Gam .1999. Seed supply system in developing countries, CTA, the Netherlands.

Maddala, G.S, 1997.Limited dependant and qualitative variables in Econometrics (Cambridge University press: Cambridge)

Maredia, M, H.Julie and B Duncan, with N.Anwar, W .Mariah and Kei kajia, 1999. Increasing seed system efficiency in Africa; Concepts, Strategies and Issue. MSU, international development working paper, Michigan

McGuire, S., 2005. Re thinking seed system analysis and reform for sorghum in ethiopia, Thesis, Wagenigen University, the Netherlands.293p

Mesfin Astatkie, 2005. Analysis of factors influencing adoption of Triticale (X-Triticosecale Witmack) and Impact, the case of Farta Woreda, MSc thesis, Alemaya University.

Monteshwe, B, D, 2006. Factor affecting participation in mainstream cattle market by small-scale cattle farmers in Souse Africa, MSc Thesis, Department of Agricultural Economics, University of Free State ,Bloemfontein. 118 p

Mugonozza ,S, G.T, 2001. Seed system in Africa, International center for agriculture research in the dry Areas. ICARDA.

Nkonya, E., T. Schroeder and D. Norman, 1997. Factors affecting adoption of improved maize seed and fertilizer in North Tanzania. Indian j. Agri.econ. 48(1):1-12

Oladele, O.L, 2005. A Tobit Analysis of propensity to continue adoption of agricultural technology among farmers in South Western Nigeria, Journal of central European agriculture .volume 6(2005)No 3(249-254)

PASDEP, 2005. A Plan for Accelerated and Sustained Development to End Poverty in Ethiopia, Minstry of Finance and Economic Development, the Federal Republic of Ethiopia, Addis Abeba.137p

Paulos Asrat Shiferaw, 2002. Determinants of farmers' willingness to participate in soil conservation practice in the highlands of Bale: The case of Dinsho farming system area. An MSc thesis presented to the School of Graduate Studies of Alemaya University.145p

Rehima Mussema, 2007. Analysis of red pepper marketing: the case of Alaba and Silti in SNNPRs of Ethiopia, Unpublished MSc thesis, Haramaya University.

Rohrbach,D.D, Mtenga,K. M.Kiriwaggulu, , S. Mwaisela, 2002. Comparative study of three community seed supply strategies in Tanzania, International Crops Research Institute for the Semi-arid Tropics, Bulawayo, Zimbabwe.

Singh,S, 2004.Rural marketing focus on agricultural inputs, Institute of Rural management,

Sunding,D. and Z.David, 2000. Research and technology adoption in a changing agricultural sector, Handbook of Agricultural Economics, University of California at Berkeley.105p

Teklewold,H.,L.Dadi,A.Yami and N.Dana, 2006. Determinant of adoption of poultry technology: double–hurdle approach, Debre zeit Agricultural Research Center, Debrezeit, Ethiopia.

Tripp, R., 2001. Seed provision and agricultural development, the Intuition of Rural Change, odi ,UK.

Tripp, R., 2003.Howto cultivate a commercial seed sector,Overseas Development Institute, London, Paper Presented for Symposium “Sustainable Agriculture in Sahel” Bamako, Mali. December 2003.

Tsgedingil Mengist,2002. Potential and limitation of small holder seed production in Ethiopia: the case of Soro Destrict. An Msc thesis Presented to Sokoine University of Agriculture, Morogoro. 107p.

WARDO, 2007. Hula Woreda Agriculture and Rural Development office annual report, An published document, Hagere Selam, Ethiopia.

WB., 1999. Sub-Saharan Africa seed initiative, program description, World Bank Group, Africa Region.36p.

Weir, S. and K.John, 2000. Adoption and diffusion of agricultural innovations in Ethiopia: The Role of Education, WPS2000-5, Center for the Study of African Economies 21 Winchester Road Oxford OX2 6NA, UK.22p.

Weltzien, E. and K.Vom Brocke, 2001. Seed System and their potential for innovation ;Conceptual Framework for Analysis, Hohenheim University, Preceding presented on Workshop Targeted Seed and Seed-System interventions; Strengthening Small-Farmers Seed Systems in East and Central Africa, Kampala, Uganda.112p.

Yenealem Kassa, 2006. Gender disparities in adoption of improved maize varieties between Male Haded and Femal Headed Households in Kuni Woreda,Western Harerge Zone, Ethiopia ,unpublished MSc thesis, Alemaya University.106p.

Yishak Gecho, 2005. Determinants of adoption of improved maize technology in Damot Gale Woreda,Wolaita, Ethiopia. An MSc thesis Presented to the School of Graduate studies of Alemaya University.

7. APPENDIXES

Appendix table 1. Coffee seedling multiplication in Dale Woreda

Year	Annual demand	Source of seedling		Share of farmers from the total supply %
		Government nursery	Farmers	
2001	1163450	134650	1148800	98.7
2002	499968	100700	399268	79.85
2003	479313	100233	379080	79.20
2004	1518185	99341	1418844	93.45
2005	2566510	200000	2366510	92.20
2006	2673702	150000	2523702	94.39

Source: own computation

Appendix table 2.Price of wheat seed produced of different years and buyers (In birr)

Organizations	2005/06			20006/07		
	Price paid to the farmers	Seed sales price	Average grain price	Price paid to the farmers	Seed sales price	Average grain price
Union	162.00	207.00	150	274.76	304.60	250.00
ESE	180.00	245.00	150	287.50	345.00	250.00

Source: ESE Awassa center and Angacha cooperative

Appendix table 3. Seed requirement and supply of the region for the last ten years (1997-2006)

year	Total amount required	Total amount supplied
1997	24606.6	20753
1998	181078	49850
1999	107153	45302
2000	73532	57491
2001	66886.5	6920
2002	39911	3795
2003	286000	38575
2004	93862	37161
2005	142354	32750
2006	75725	41233

Source: ESE Awassa

Appendix table 4. Contingency coefficient of discrete variables (Wheat)

	HHeduca	HHextension	DFGBS	Hhoxen
Hheduca	1			
HHextension	0.328	1		
DFGBS	0.078	0.098	1	
HHoxen	0.187	0.282	0.069	1

Source: own computational result

Appendix table 5.VIF result for continuous variables (Wheat)

Continuous variable	Collinearity Statistics	
	Tolerance	VIF
Distance from all weather road	0.888	
Distance from market	0.842	1.187
Size of the farm land the framers have	0.698	1.433
Total off-income generated in the indicated production year	0.667	1.499
Family size	0.897	1.221

Source: own computational result

Appendix table 6. VIF result for continuous variable (Apple)

Variable in the model	Collinearity Statistics	
	Tolerance	VIF
Family size	.434	1.579
Distance from all weather road	.542	1.844
Total off income generated in the indicated production year	.884	1.131
The size of the farm land the framers have in hectare	.876	1.142

Source: own computational result

Appendix table 7. Contingency coefficient of discrete variables (Apple)

	HHtraining	HHcredit
HHtraining	1	
HHcredit	0.431	1

Source: own computational result

Appendix table 8. VIF result for continuous variable (Coffee)

Continuous variables	Collinearity Statistics	
	Tolerance	VIF
Family size	0.824	1.214
Distance from all weather road	0.894	1.118
Distance from market	0.790	1.266

Source: own computational result

Appendix table 9.Contingency coefficient of discrete variable (Coffee)

	Radio	HHeduca	HHtraining
Radio	1		
HHeducation	0.072	1	
HHtraining	0.011	0.216	1

Source: own computational result

Appendix table 10. VIF result for continuous variable (Potato)

Variables in the model	Collinearity Statistics	
	Tolerance	VIF
Family size	0.939	1.065
Distance from all weather road	0.976	1.025
The size of the farm land the framers have in hectares	0.948	1.055
TLU	0.999	1.076

Source: own computational result

Appendix table 11.Contingency coefficient of discrete variable (Potato)

	DFGBS	EFTRS	HHextension	HHtraining
DFGBS	1			
EFTRS	0.697	1		
HHextension	0.095	0.163	1	
HHtraining	0.351	0.056	0.251	1

Source: own computational result

Appendix table 12. Average cost of labor requirement of different crops produced as a grain

Activity	Wheat	Maize	Barley	Potato
Labor for plowing (md ha^{-1})	12.5	14.7	12.1	10.8
Wage rate for plowing (birr)	7.1	9.3	6.8	6.2
Cost of plowing (birr)	88.75	133.77	82.28	66.96
Labor for weeding(md ha^{-1})	36.4	24	34.3	33.4
Wage for weeding (birr)	6.5	7.2	6.8	7.8
Cost of weeding(birr)	236.6	172.8	233.33	260.52
Labor for harvesting(md ha^{-1})	17.2	27.3	18.1	27
Wage rate for harvesting (birr)	8.3	12.1	7.6	8.4
Cost of harvesting(birr)	142.76	330.33	137.56	226.8

Source: own computational result

Appendix table 13.Average cost of labor requirement for seed production of different crops

Activity	Wheat	Coffee	Apple	Potato
Labor for plowing (md ha^{-1})	12.5	22.6	19.7	10.8
Wage rate for plowing (birr)	7.1	9.1	6.5	6.2
Cost of plowing (birr)	88.75	205.66	128.05	66.96
Labor for weeding(md ha^{-1})	43.45	27.2	34	37.9
Wage for weeding (birr)	6.5	8.1	7.2	8.1
Cost of weeding(birr)	282.4	220.32	244.8	306.99
Labor for harvesting(md ha^{-1})	18.2	22	22	40
Wage rate for harvesting (birr)	8.3	17	15	9.1
Cost of harvesting(birr)	150.23	374	330	364
Labor for grafting(md ha^{-1})	-	-	25	-
Wage rate for grafting (birr)	-	-	50	-
Cost of grafting(birr)	-	-	1250	-
Labor for watering(md ha^{-1})	-	34.2	36.3	-
Wage rate for watering(birr)	-	5.4	6.2	-
Cost of watering(birr)	-	184.14	223.82	-

Source: own computational result

Appendix table 14.Average cost of input requirement for grain production per hectare

Input type and cost	Wheat	Maize	Barley	Potato
Seed (qu ha^{-1})	1.5	.25	1.5	18
Cost of seed (birr)	479.82	175	570	1260
Fertilizer (qu ha^{-1})	1	1	1	-
Cost of fertilizer (birr)	367	380	374	-
Chemical (lt ha^{-1})	1	-	-	-
Cost of chemical (birr)	-	-		-

Source: own computational result

Appendix table. 15Average cost of input requirement for seed production per hectare

Input type and cost	Wheat	Coffee	Apple	Potato
Seed (qu ha^{-1})	1.5	24	1823	18
Cost of seed (birr)	487.5	600	9115	5400
Fertilizer (qu ha^{-1})	1.5	-	-	1
Cost of fertilizer (birr)	530	-	-	394.7
Chemical (lt ha^{-1})	1	-	-	.5
Cost of chemical (birr)	-	-	-	120

Source: own computational result

Appendix table 16. Conversion factors used to estimate TLU

Types of animals	TLU
Cow	1
Ox	1
Bull	0.75
Heifers	0.75
Sheep/ Goat	0.40
Donkey	0.70
Horse/ mule	0.50
Camel	1.25