ASSESMENT OF FACTORS INFLUENCING ADOPTION OF AGROFORESTRY TECHNOLOGIES IN HALABA SPECIAL WOREDA, SOUTHEREN ETHIOPIA

M.Sc. THESIS

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March, 2016

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A THESIS SUBMITTED TO THE

SCHOOL OF PLANT AND HORTICULTURAL SCIENCES, COLLEGE OF AGRICULTURE, SCHOOL OF GRADUATE STUDIES,

HAWASSA UNIVRSITY,

HAWASSA, ETHIOPIA

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN PLANT AND HORTICULTURAL SCIENCES

(SPECIALIZATION AGROFORESTRY)

March, 2016

APPROVAL SHEET

Department of Graduate Committee

HAWASSA UNIVERSITY

As members of the Examining Board of the Final MSc Open Defense, we certify that we have read and evaluated the thesis prepared by Mihretu Erjabo titled Assessment of Factors Influencing Adoption of Agroforestry Technologies in Halaba Special District, Southern Ethiopia and recommend that it be accepted as fulfilling the thesis requirement for the degree of Masters of Science in Agroforestry.

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I declare that this thesis is my genuine work and all sources of materials used for this thesis have been duly acknowledged. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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Date of Submission: _____

ACKNOWLEDGEMENTS

First of all, I would like to thank God for making everything beautiful in his time.

My greatest thank and deepest appreciation go to my major advisor, Dr. Ambachew Demissie and Co- advisor, Dr. Tesfaye Abebe for their interest, unreserved guidance and constructive advising in the progress of this thesis work. They had devoted much of their time in critically reading and commenting on the paper starting from writing the proposal to the completion of the thesis.

I would also like to express my thanks also to Soro woreda administration and Agricultural Development office for their willingness to cover tution fee. Furthermore; I extend my gratitude to Halaba special Woreda Agricultural Development office head Ato Ahmed Habib for his willingness to let me collect the data I needed. I am also grateful to the experts Ato Fentahun Gobeno, Ato Endalekachew lema, Ato Tsegaye Terefe & Ato Belaye Tesema and Development Agents Ato Bederu Lombeso and W/ro Fenta Demissie for devoting their time in the process of data collection.

I am most grateful to farmers of Halaba special woreda for the time they have devoted to respond patiently to my lengthy interview and for providing me the information necessary that made the successful achievement of this work.

Finally, I extend my gratitude to my family for their material, financial and moral support that helped me carry out this study until its completion.

ABBREVIATIONS (ACRONYMS)

AF	Agroforestry
ARDO	Agricultural and Rural Development Offices
AWARDO	Alaba Special Woreda Agricultural & Rural Development Offices
CSA	Central Statistics Authority
EC	Ethiopian Calendar
FHI	Food for the Hungry International
GOs	Government Organisations
HESS's	Household Energy Strategy Study
ILRI	International Livestock Research Institute
IPMS	Improving Productivity and Market Success of Ethiopian Farmer
KAs	Kebele Administrations
KIs	Key Informants
MERET	Managing Environmental Resources to Enable Transitions
MPTs	Agroforestry Multipurpose Trees
PRA	Participatory Rural Appraisal
SD	Standard Deviation
SNNPRS	Southern Nation Nationalities and Peoples Regional State
SWC	Soil and Water Conservation
UNDP	United Nations Development Program
WFP	World Food Program

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ABSTRACT

Halaba special district is characterized by drought, soil erosion, high population pressure, poor livestock production, lack of feed for livestock, very deep water table, very low productivity of crops and food insufficiency. In order to address these problems, the woreda Agricultural Development office along with other management practices such as soil physical conservation measures agroforestry was introduced decades ago as a means to alleviate the problem. However, the level of agroforestry adoption remains low. The main objective of this study was to identify the factors that influence adoption of agroforestry technologies by farmers in the district. Random sampling procedure was employed to select two kebele administrations and respondents. Data collection was conducted by employing five different types of techniques such as rural household questionnaire survey, participatory rural appraisal, questionnaires for local and woreda extension staff, scanning government records & secondary data resources and field observation. A total of 12 key informants, 6 extension staffs and 182 households, samples were used in the data collection process. Chi-square test and t-test were used to determine whether there were statistically significant relationships between adoption of agroforestry and 15 selected variables. Out of which eleven were found to be significant to affect farmers' adoptiveness. These were frequency of visits of farmers(13.39%), participation in training(11.49 %), farmers' attitude towards agroforestry practices(10.61%), frequency of visits of extensionists(10.38%), participation in extension meeting(10.34%), participation in field day(10.28%), land holding size(9.29%), level of literacy(8.78%), awareness about the importance of agroforestry technology packages(7.06%), time taken from their residence to nearest extension(5.04%) and gender of respondents(3.34%). This study also identified various factors that may result in low adoption rates of agroforestry including fear of competition between trees & crops for water and nutrients uptake, seedling shortage, rainfall shortage, free grazing after crop harvest, financial problem, labor shortage, expecting trees as soil degrader & long span of trees and lack of need ranking of farmers by extension staff. To improve farmers' adoption, the factors identified should be well addressed by launching a series and recurrent outreach extension program appropriate and suitable to farmers need.

Keywords: Technology packages, Farmers participation, Farmers attitude, Free grazing, Climate, soil degradation and Awareness.

1. INTRODUCTION

Agriculture is the dominant sector of the Ethiopian economy. However the agricultural produce did not satisfy the needs of the population mainly due to land degradation. Land degradation in Ethiopia is triggered by complex processes and factors (Fistum, *et al*., 1999, Lakew *et al*., 2000; Bezuayehu *et al*., 2002; Aune *et al*., 2003).The major causes of land degradation in Ethiopia are the rapid population increase, severe soil loss, deforestation, low vegetative cover and unbalanced crop and livestock production (Taddese, 2001) and the widely practiced free grazing system. Inappropriate land-use systems and land-tenure policies enhance land degradation, desertification and loss of agro-biodiversity (Taddese, 2001).

Recent reports on the several dimensions and processes of land degradation in Ethiopia reveal that the area coverage of soil loss was 30,000 hectares annually by water erosion as a result of which more than 2 million hectares have already been damaged severely (National Review Report 2002). A total loss of 4,000 hectares on state farms owing to severe salinization and an estimated one billion tons of topsoil lost each year (Tefetro, 1999), Nutrient depletion of 30 kilograms of nitrogen and 15-20 kilograms of phosphorous per hectare (UNDP 2002).

Among the various forms of land degradation, soil erosion is the most serious problem, which results in soil nutrient depletion and loss of fertility of farm land (Tsegaye and Bekele, 2010). Rates of soil erosion documented in Ethiopia range from 16–300 tons/ha/year (Hurni 1988, Hawando 1989, 1995).

However different soil physical conservation methods have been undertaken throughout the country by government and World Food Program (WFP) under the food for work (FFW)

schemes (Tsegaye and Bekele, 2010). Nonetheless, soil erosion problem still persists and becomes the major cause for food insecurity. However, through agroforestry many countries not only minimize the land degradation but also increased the production (GTI, 1995; Mishra and Sarim, 1987; Swaminathan, 1977). For example, the intercropping of trees with millet and sorghum in the semi-arid regions of West African Sahel (Felker, 1978; Dancette and Poulain, 1969) and Eastern Ethiopia (Poschen, 1986), the rotational production system of Gum Arabic (*Acacia senegal*) combined with agricultural crops in Sudan (Amin, 1973), the stable bush-fallow system in Bougage, Niger, the peanut and Millet areas of Sahelian zone of West Africa (Nair, 1984) indicate the successfulness of agroforestry in the conservation of soil resource and sustaines the food, feed and fuel wood security by maintaining the decline of soil fertility (Wilson, 1989). In many of these cases, crop growth was reported to be better if are grown with trees, due to their effect on micro-site enrichment (Agrawal, 1980; Radwanski and Wickens, 1967; Virginia, 1986).

Halaba special woreda is characterized by; drought, land degradation, population pressure, poor livestock production, lack of feed for livestock, very deep water table, very low productivity of crops and food insufficiency (ILRI, 2005). As a result of long history of agriculture and high population in the area, vegetative cover is very low. Consequently, erosion hazards in the sloppy areas are enormous. This is believed to have been aggravated due to the extensive deforestation in the area coupled with the easily erodible nature of the soil (Eshetu, 2000).

Many NGOs and GOs were involved in soil and water conservation efforts in the Woreda (Eshetu, 2000). The most common practices employed for soil and water conservation in the woreda were: area closure, stone and soil bund, micro basins, fanya juu, check dam, gully

treatment and shaping. It was established in 2009 by the Managing Environmental Resources to Enable Transitions (MERET) project funded by the World Food Program (WFP) and the woreda Office of Agriculture (Eshetu, 2000). The Agroforestry multipurpose trees (MPTs) planting efforts by Kale Hiwet Church, Food for the Hungry International (FHI) and World Food Program (WFP) were not effective (IPMS, 2005). Halaba special woreda Agricultural Development office introduced agroforestry packages to solve the problem of food insufficiency, low productivity of crops, lack of feed and land degradation. Agroforestry packages (seeds, grasses, seedlings of fruit trees & MPTs that includes Mango, Avocado, Coffee, *Leucenia lecosphala* and *Acacia* species) respectively were introduced. Seeds of MPTs included were *Sesbania sesban*, *Leucenia lecosphala* and *Acacia species*. Grasses used for adoption includes *Elephant grass* and *Desho grass*. Despite of all these efferts however, the agroforestry adoption by farmers remains low.

The commonly observed tree species in the area are *Acacia* species, *Cordia africana*, *Croton spp.* and *Eucalyptus* spp. These tree species are observed throughout the woreda standing in scattered pattern. As a whole, Tree density is small on the land surface of the woreda due to poor management and overstocking clearing. Natural pastures are highly overgrazed resulting in severe land degradation, loss of valuable species and dominance by unpalatable species (Alemu, 1998).

2. Statement of the problem

In the study area, adoption of agroforestry technologies has been a long term concern of agricultural experts, policy makers, and agricultural research and many others linked to the sector. However, the agroforestry adoption conditions by farmers have not been encouraging.

Evidence indicates that adoption rate of agroforestry technologies in the study area is very low. Yet there is no such study which tries to look into the factors influencing adoption of agroforestry technologies in Halaba special woreda.

3. Objectives

3.1 General objective

- To investigate the factors that influence adoption of agroforestry technologies by farmers in Halaba Special Woreda, Southern Ethiopia.

3.2 specific objectives

- To assess the strength of extension activities in motivating farmers to adopt agroforestry practices as land use systems.
- To identify the effect of legal rights on land and tree tenure, marketing, transfer and inheritance of land.
- To determine the attitude, needs and priorities of farmers towards integration of trees in their farms.

4 Research questions

- What are the determinants of agroforestry adoption?
- What is the strength of extension activities in motivating farmers to adopt agroforestry practices as land use system?
- What are the effects of legal rights on land and tree tenure, marketing, transfer and inheritance of land?

- What are the attitude, needs and priorities of farmers towards integration of trees in their farms?

5. Significance of the study

The significance of this study is related to the provision of views and ideas of the underlying problems and possible solutions of agroforestry adoption by farmers. The knowledge acquired through this research may contribute for the overall efforts of agroforestry development activities at Halaba Special Woreda. The results of this study will be useful in redirecting, improving and strengthening the existing agroforestry practice. The study will lead to improved crop, tree and livestock production.

6. Scope of the study

Due to resource constraints and for the sake of making the study more manageable, the study was limited to two kebele administrations of Halaba special woreda.

7. LITERATURE REVIEW

7.1 Agroforestry and its importance

Agroforestry is defined as a collective name for land use systems and practices where woody perennials are deliberately integrated with crops and/or animals in the same management unit (ICRAF, 1990). Agroforestry technology refers to an innovation or improvement, usually through scientific intervention, to either modify an existing system or practice, or develop a new one. Agroforestry practice denotes a distinctive arrangement of components in space and time.

Agroforestry plays a significant role in increasing agricultural productivity by nutrient cycling, reducing soil erosion, and improving soil fertility and enhancing farm income compared to conventional crop production (Kang & Akinnifesi, 2000; Neupane & Thapa, 2001; Neupane *et al.*, 2002). Agroforestry can also potentially reduce deforestation while increasing food, fodder and fuelwood production (Neupane & Thapa, 2001; Neupane *et al.*, 2002). Benefits that accrue from usage of agroforestry include food and nutrition security, increased income and assets, improved land management (Garrity, 2006); it also creates environmental and management synergies (Race, 2009).

Traditional agroforestry has been practiced for millennia by agrarian-based societies throughout the world (Garrity, 2006). The World Bank estimates that 1.2 billion people practice some form of agroforestry on their farms and in their communities (World Bank, 2004). Although agroforestry has been practiced by these farming communities for a long time, there is inadequate awareness about its potential to the millions that live in poverty (Garrity, 2006). In

the past 3 decades, agroforestry has progressed as a science-based pathway for achieving important objectives in natural resource management and poverty alleviation (Garrity, 2006).

7.2 The concept of adoption

Adoption of innovation by the individual innovator is conceptualized as five stages (Adams, 1982):

Awareness – the individual first hears about or becomes aware of the innovation, but is not yet motivated to seek further information.

Interest stage – he feels that the innovation may be relevant to his needs and he becomes interested and seeks additional information about it.

Evaluation stage – weigh up the advantages and disadvantages of using it.

Trial Stage – If his evaluation is favorable, he may decide to give the innovation a trial, by applying it on a small scale to determine its utility under his condition.

Adoption – in the light of his experience during the trial stage, the individual may decide to apply the innovation fully, thus, on a relatively large scale and continuous use of the idea and personal satisfaction of it. It does not necessarily mean the constant use of the idea but that the idea has been accepted and the individual intends to include it in his practice. According to Ahmed (1991) a farmer is considered to have adopted a technology if he uses it to any extent on his farm. However, in this study farmer is considered to have adopted a technology if he uses AF package to any extent on his farm otherwise not adopted.

From the concept put forward by Adams (1982), the adoption of new innovations is not immediate and the final decision is usually the result of a series of influences operating through time. It might also be important to distinguish between adoption and diffusion. Agyemang

(1991) gave a theoretical distinction between diffusion and adoption as: - Diffusion begins at a point in time when technology is ready for use. How the technology is made available to the potential user is the main focus of diffusion. Adoption considers the behaviour of individuals in relation to the use of the technology; more particularly the reasons of adoption at a point in time are of primary interest. The concept of adoption has often attracted considerable attention as a result of the infrequent success in achieving high adoption rates in developing countries (Feder *et al*, 1985). Some of the underlying factors for low adoption rates can be found in the proposition by Rogers and Shoemaker (1971). According to them the adoption rate usually is a function of: - The relative advantage of the innovation as perceived by the farmer; the compatibility of the innovation in the context of the farming systems; the complexity, that is the degree to which the innovation is perceived as difficult to understand and use; the degree to which it can be subjected to simple and non – consequential trial on the farm; and the observability of the innovation and its effect. These propositions have been the core of much research on adoption. For example, Burch (1992) analyzing evidence from 100 studies found that innovations that permit a trial run have strongest initial local support. The perceived advantage and compatibility, he concluded, does not seem to be a great consideration in adoption.

Socio-economic considerations are increasingly becoming important in technology diffusion and adoption processes. This is more so for agricultural, forestry, agroforestry and related innovations, which are meant for the diverse environments and circumstances of rural people (Rocheleau and Raintree, 1986).The need to examine socio-economic factors in the adoption of agroforestry technologies has been highlighted by Raintree (1991) in his evaluation of the storm over Eucalyptus in social forestry programs in India. Among his findings he stated that: “On

closer examination of the issues, it appears that while most of the debate has been couched on ecological terms, many of the underlying issues are social and economic in nature. The debate demonstrated how important the socio-economic context of the intended user can be in determining whether or not he or she will be able to make effective use of a particular tree planting practice. Again, Hoskin (1987) gives a partial list of socio-economic issues that must be taken into consideration if farm families are to adopt agroforestry technologies as: local uses and knowledge of trees, tenure, organization, conservation, landlessness, enterprises and marketing, labour, nutrition and gender/age. In his analysis on socio-economic context and development strategy for tree growing Raintree (1991) pointed out that factors that are relevant to consider under the broad heading of socio-economic will vary from place to place. Among the most important are: - degree of local socio-economic stratification (by wealth, land holding size, gender, ethnic group etc.); access to resources (land and tenure); overall economic development strategy; general approach to tree planting programs, opportunity for relocation of resources; access to credit; processing technology and marketing assistance etc. It could be seen from the above discourse that the socio-economic factors that affect the adoption of agroforestry are many and varied and differ from place to place and it is time specific.

7.3 Agroforestry adoption decision-making

There are different types of models that have been used to explain agro-forestry adoption decisions of new technologies. However, no single model can embrace and explain all aspects of adoption and the traditional attitude of smallholder farmers towards technologies (Thangata & Alavalapati, 2003). Rogers (1995) developed the adoption and diffusion of innovations theory, which has been widely used to identify factors that influence decisions to adopt or reject an

innovation. He defines an innovation as a "new idea, practice or object that is perceived as new by an individual or other unit of adoption" and said that the perceived newness of the idea for the individual is what determines their reaction to it.

According to Rogers (2003), adoption occurs when one has decided to make full use of the new technology as a best course of action for addressing a need. Adoption refers to the process through which one is exposed to, considers, and finally rejects or accepts and practices an innovation (Mosher, 1978). Adoption is determined by several factors including socioeconomic, environmental, and mental processes that are governed by a set of intervening variables such as individual needs, knowledge about the technology and individual perceptions about methods used to achieve those needs (Thangata & Alavalapati, 2003).The adoption and diffusion model identifies five aspects that influence adoption: perceived attributes of the innovation; type of innovation decision; communication channel; nature of the social system; and the extent of change agent promotion efforts (Rogers, 2003). Some of Rogers' generalizations as significant variables that affect adoption, which have also been used in other adoption studies, include educational level, farm size and income.

The adoption-diffusion of innovations model is a useful model for understanding farmers' decision making processes when they consider taking up and eventually adopting new technologies. Adoption is reached after an innovation-decision process that occurs in a five-step time-ordered sequence namely: knowledge; persuasion; decision; implementation; and confirmation (Rogers, 2003). This model assumes that the heart of the diffusion process lies in the modelling and imitation by potential adopters of their neighbours with the new practice (Rogers, 2003), and that the tendency to adopt new practices relies on: the relative

innovativeness and; the personal attributes of farmers, with some farmers adopting innovations more quickly than others. There is an assumption in this model that research generates information that is inherently valuable, desirable and suitable for increasing farm production and productivity (Jangu, 1997).

Rogers (2003) has categorised adopters into five including innovators, early adopters, early majority, late majority and laggards. This kind of classification is a problem to use in the situation where adoption has not reached 100 percent use (Rogers, 2003) as it does not include those that cannot be grouped within the five groups, the discontinuance and non-adopters.

Research results indicated that agroforestry adoption is a decision based on many factors. Adoption is most likely when the farmers have the available land, labor, income and agricultural inputs to begin a new agricultural technique (Adesina and Chianu 2002; Bannister and Nair 2003. Scherr 1995; Thangate and Alava lapati 2003).Experience, social capital, training and membership in adoption behavior when the appropriate economic conditions are present (Adesine and Chianu 2002.Casey 2004; Neupane etal.2002; Thangata and Alavalapati 2003). Agroforestry adoption research has yet to explore self-efficacy specifically in its role in farmer decision-making, although Rogers (1995) mentions it in the innovation diffusion theory.

7.4 Influence of land tenure and tree ownership issues

One of the critical factors that have been given consideration in determining the potential acceptability and viability of agroforestry is land tenure systems and tree ownership. Francis (1987) gave the assertion that patterns of technology adoption will be shaped by the structure of opportunities and constraints presented by the rules of tenure. In the study of "Agroforestry adoption and risk perception by farmers in Senegal", Caveness and Kurtz (1993) found out that

land ownership was one of the two predominant factors (the other was labour) affecting the adoption of agroforestry practices. Raintree (1991) has also found that if user does not have security over the intended planting location, adoption of the tree planting innovation may be quite out of question. Kolade (1984) also noted that in vast agricultural lands of Tropical Africa, agroforestry has yet to make a break through. The reason is largely due to the flexible system of land tenure as well as its attendant insecurity. Land tenure reforms in Ghana has been advocated by Benneh (1976) on the grounds that the old system does not provide security of tenure; that it discourages the investment on natural resources and does not encourage investments which bring about development in the land. Miniature farm sizes and the manner, in which they are fragmented and scattered, Benneh (1976) argues, constitute an obstacle to farm improvement for they do not enable farmers to take advantage of economies of scale in production. The old system, Benneh (1976) claims prevent the use of farmland as collateral for credit; also it discourages the adoption of innovations and individual initiative in farming.

Governments in many African countries are aware of the need for tenure reformation. For example in Ghana the Rent Stabilization Act 109 of 1960 as amended the same year by Rents (Cocoa Farms Amendment) regulation among others prohibited ejection of tenants without ministerial approval (Arhin, 1985). Okyere *et al* (1993) pointed out that many government interventions at tenure reformation have given rise to clashes between landowners and tenants. They pointed out that despite attempts by government to intervene by legislature; the bulk of statutory law relating to rural land has remained migratory. Most land matters are handed by linage elders and local chiefs in accordance with their interpretation of indigenous land laws.

Leach and Mearns (1988) asserted that tenure issues in agroforestry do not relate to land tenure only but also to tree tenure. The distinction between land and tree tenure is crucial to the participation of rural communities in projects involving tree growing. Fortmann (1985) has listed four major categories of rights that make the bundle, which comprises tree tenure: - the right to plant, the right to use, the right to dispose and the right to own or inherit. Each of these categories or combinations of any, (Fortmann 1985), have restrictions on community participation in agroforestry projects in several African countries. He also points out that tree tenure issues in the community intended for the project needs careful examination to avoid problems like the loss of rights, particularly to other uses of land or the trees on it and loss of gathering rights among others. The complexity of tenure issues is believed to have discouraged many tenants from growing trees. Francis (1987) said that in areas where land pressure is more intense and other terms of tenancy are more definite, permanent tenants, many of whom grow food crops under tenancy leases, may be disallowed from planting tree.

7.5 Socio-economic stratification

Raintree (1991) pointed out that the degree of socio-economic stratification, which exists within a locality, is important in determining the adoption of a new technology particularly if it is highly attached to factors, which govern access to resources. The stratification of a community can be on the basis of wealth, landholding size, gender, age, ethnicity, religion, education etc. For example, results of studies by Akorhe (1981) and Nweke (1981) as quoted by Njoku (1991) indicated that the level of technology adoption on smallholder farms is influenced by the farmers' age, literacy rate, and access to material inputs of technology and food security needs.

Eckman (1992) deduced from his studies that individuals within a household may have different rights depending on gender, birth or intra-family status. He found also that in some African countries, for example, women plant and tend firewood or fruit trees but do not have right to harvest fruits or wood; these may be sold or appropriated by male members. Fortmann (1985) has also pointed that group rights which alienate "strangers" and deny them use rights of trees and discourage their participation in agroforestry projects. Socio-economic stratification has been found to be important in extension work. Johnson (1987) has concluded that to be effective in encouraging adoption of innovations, extension workers must work with rather homogenous categories of farmers i.e. Based on their access to land, water, labour inputs, markets, credit and information.

7.6 Labour requirements

One of the major factors influencing farmers' adoption of agroforestry is labour requirement (Arnold, 1987). Arnold, (1987) stated that a farmers' decision to grow trees can be influenced by two main factors: one is the high cost of labour and capital and the other is the potential of income to be generated from tree as distinct from food production in farmers' production objectives. Njoku (1991) in his studies on adoption of improved oil palm production found that a major constraint was high cost of labour. He concluded that many new technologies require intense labour use, which contrasts greatly with the limited amount of labour expended in the traditional wild oil palm groves and that smallholder farmers must hire expensive labour to implement the improved technologies. The strong competition for household labour with other activities in the farming system particularly during critical periods in the agricultural season

would obviously influence farmers' decision about adopting agroforestry. This has been found for example to be true of alley farming (Kang and Wilson, 1987).

7.7 Capital

One of the captivating arguments about capital requirements and adoption of agroforestry products has been put forward by Arnold (1987) as; "It is widely argued that the lengthy production period and the incidence of most of the costs at the time of establishment, create financial problems for farmers in adopting practices involving tree growing". It is this argument that underlies the widespread provision of planting stock, either free or at subsidized prices in programmes to support tree growing. However, the evidence that tree systems are favoured by farmers when capital is scarce because trees require less investment than alternative crops and/ or provide substitutes for purchased inputs example fertilizer and herbicides suggests that improved access to capital would not necessarily increase adoption of agroforestry practices. In support of Arnold argument, Hyman (1983) in his investigation on pulpwood production in the Philippines concluded that capital could be an impediment to investment in larger rotation timber species grown as cash crops. In this situation however, the constraint seems to be not the capital cost of establishment but lengthy period that elapses before there is any return. Schutjer and Van der Veen (1977) argued that adoptions of scale-neutral innovations are not necessarily inhibited by credit constraints. They stated that the profitability of innovations often induces small-scale farmers to find the cash required for adoption from their relatively meager resources.

Contrary to the above discourse, capital in the form of savings and credit is required in order to form many agricultural and agroforestry innovations. Therefore differential access to capital is frequently cited as a major factor determining adoption rates (Mercer and Hyde, 1992).

For example, Owusu Sekyere (1991) concluded that participating farmers in an agroforestry project complained that they needed credit in the form of cash to pay for extra labour required to maintain their agroforestry plots and that without attending to farmers cash needs project implementation can be very slow.

7.8 Markets

Marketing of products could serve as a great incentive or disincentive to virtually all productive ventures. According to Hedge (1990), the important criteria for farmers to grow any new tree species, depend among others on assured demand for the produce and really market outlets, minimum support price, at which tree growing is profitable; and generation of cash surplus as the most powerful incentive for most farmers.

"Having invested heavily in planting and maintaining the trees we waited patiently for four years. Now it is the end of 1986 and we have not been able to sell the trees. There are no buyers the Lokhariti workers are hiding away from us and the Forest Department Official who used to visit us has been transferred to another place, so we have nobody to turn to. We see this business of farm forestry as a disaster for our people". The scenario above depict the frustrations farmers go through if they cannot market their tree products and also it underscores the risk aversion tendencies of farmers in adopting tree planting practices. It is only with a co-ordinated effort to market the forest produce at a ruminative price that afforestation programmes can be implemented successfully with the active participation of the rural people (Hedge, 1990).

7.9 Institutions

Policy analysis defines institutions as rules, norms and values that shape our behaviour. Sometimes known as the rules of the game; institutions can be:

- Both formal (example, laws that govern land tenure, market transactions or civil rights) and informal (example, social customs and conventions);
- Created (example, as a result of deliberate political or policy decisions) or may evolve overtime;
- Present at local, organizational, national, and international levels.

In many developing countries, policies and institutions discriminate against those with few assets and disadvantage poor people. Such discriminatory policies and institutions undermine development efforts to eradicate poverty. It is now generally accepted that significant and sustainable gains in poverty reduction cannot be achieved unless accompanied by pro-poor reforms to domestic and international policies and institutions (Ashley and Carney, 1999).

7.10. Farmers' attitude towards agroforestry practices

Rural poor households are believed that agroforestry practices have been a different advantage and disadvantage in the component interaction (Nouman *et al.*, 2008). Agroforestry practice is seen by the farmers to have a potential of solving their fuel wood needs, improve the soil fertility, and provide favorable climate for crops. Farmers have indigenous knowledge on the usage of trees in farming systems as well as some environmental uses, such as watershed protection and climate moderation (Felix *et al.*, 2003). Also, many research studies have proved that when the crops were grown under monoculture system, the soil resources could not be utilized in their full extent. While by making a combination of agricultural crops with trees, the farmers can get better soil fertility and economic returns (Nair, 1996). Survey analysis of

farmers' perceptions has showed a strong step for the positive outcomes of tree planting. The opinions of farmers towards agroforestry either encourage or discourage farm level tree plantation. Tree planting was perceived by the large number of the farmers either for timber, fodder or income enhancement (Irshad *et al.,* 2011). However, research study in Pakistan indicated that a majority of the local community (68.8%) were not willing to grow trees due to competition of trees grown on farmland along with agricultural crops for water and nutrients uptake (Nouman *et al.,* 2008).

Farmers' attitude can be measured by using a five point continuum Likert-type scale suggested by Thurstone (1976). The scale or categories used to measure these variables were 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

7.11 Agroforestry extension

Often, the uptake of new technology is said to be influenced by the farmer's contact with extension services. Extension agents are said to provide inputs and technical advice (Doss & Morris, 2001). How well or poorly conducted extension education can also be a major factor in influencing adoption of new technology (Mosher, 1978). Some extension agents are said to be better teachers and how much better a teacher an extension agent is determines the level of confidence that farmers would have in him. The more farmers have confidence in the extension agent, the more likely they are to adopt a particular technology being promoted, regardless of its profitability or even if they would have to dis-adopt it later (Mosher, 1978). The role of the extension agent is to help farmers to be in the position to make their own decisions and not to make decisions for them (Mosher, 1978).

8. MATERIALS AND METHODS

8. 1 Description of the study area

8.1.1. Location

The study was conducted at Denoqosa and Andegna choroko Kebele in Halaba Special District located 310 km south of Addis Ababa and about 85 km southwest of Hawassa, capital of the Southern Nations Nationalities and Peoples Regional (SNNPR) State. Geographically it lies between 7º 17’ 12’’ latitude north and 38º 04’ 47’’ longitude east. The Woreda is bordered with Shala and Aris Negele Woreda to the East, Kedida Gamela, Silte and Hadya Zone to the West, Silte zone and Adami Tullu Woreda of to the North, and East Badewacho Woreda and Siraro Woreda to the South (Messay, 2012). The altitude ranges from 1554 to 2149 meters above sea level (m.a.s.l) (Figure 1).

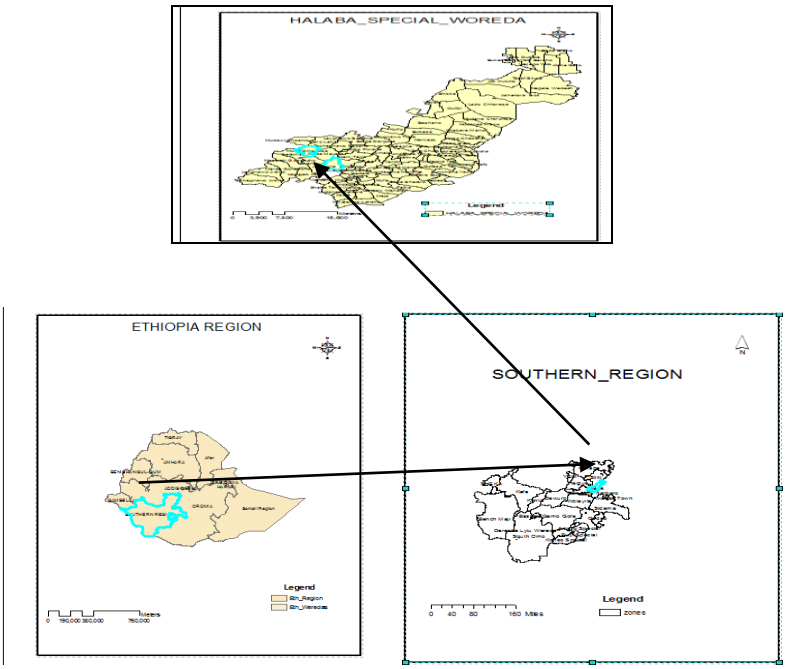

Figure 1: Location map of the study area

Source: SNNPR Land and Environmental Protection Bureau, 2012

8.1.2. Climate

The annual rainfall and mean temperatures varies from 857 to 1085mm and 17 ^{0}C to 28 ^{0}C respectively (AWARDO, 2004). The rainfall is bimodal where the small rainy season/months occurs between March and April while the main rains are from July to September. Agroecologically, the woreda is classified as Weina Dega (ILRI, 2005).

8. 1.3. Soil

The most dominant soil of the area is andosol (Orthic) (IPMS 2007). Based on FAO textural soil classification (FAO 1997) and the Land use/land cover practice of the Halaba special woreda, the soil of the basin is reclassified into four classes. Class –1(clayey- soil), Class – 2(Fine sandy loam), Class – 3(clay loam soil) and Class – 4(silt loam).

8.1.4. Land use and farming system

There are two farming systems in Halaba that are classified based on the crop commodities namely1) Teff / haricot bean / livestock farming system and 2) pepper / wheat / livestock framing system. Lareger portion of farmlands are assigned for teff / haricot bean / livestock farming system leaving only very small plots for grazing in every land holding. Due to this, shortage of feeds is the limiting factor in livestock production aggravated by both shortage and distribution of rainfall (IPMS 2005). The total land area of Halaba woreda is 64,116.25ha of which 48,337 ha (75%) is suitable for agriculture. The main land use types of the woreda include arable land, grazing land, forest, potentially cultivable, uncultivable land (hills) and others (Table 1).

Table1: Land use types of the district

No	Land use type	Area coverage (ha)
1	Arable land	44,020.00
2	Grazing land	4,316.95
3	Forest/Wood land	4,592.00
4	Potentially cultivable	3,644.50
5	Uncultivable land (hills)	2,805.00
6	Others	4,737.80
7	Total	64,116.25

Source: Alaba Special woreda Bureau of Agricultural & Rural Development (2007)

8.1.5. Population

According to the 2007 census conducted by the Central Statistical Agency of Ethiopia (CSA), the woreda has a total population of 232,325, of whom 117,291 are men and 115,034 women. A total of 49,028 households were counted in the woreda.

8.1.6 Livestock

Farmers in the Woreda have an estimated total of 135,637 head of cattle, 40,223 Sheep, 54,462 Goat, 20,497 Donkeys, 1,685 Mules, 3,581 Horses, 130,116 Poultry and 4,722 Bee hives (CSA, 2006/07).

8.2 Design of the study

Two Kebele Administrations (KAs) from the Woreda were selected randomly. Households of Denoqosa and Andegna choroko Kebele Administrations are 502 and 524 respectively or total of 1026. Out of 502 and 524, 77 and 109 were adopters, respectively or total of 186 while out of 1026, 840 were non adopters. The data was collected through face to face interviews using

a questionnaire that was pre-tested and validated. Data collection was conducted by employing five different types of techniques namely:-

1. Rural household questionnaire survey
2. Participatory rural appraisal (PRA)
3. Questionnaires for local and woreda extension staff.
4. Scanning government records and secondary data resources.
5. Field observation

❖ Each of the techniques used for this study are briefly described below:

8.2.1 Rural household questionnaire survey

The sample size for collecting data for this research was determined by using (Cochran, 1977) formula as indicated in Bartlet Kortlett and Higgins (2001).

$$n = \frac{N}{1+N(e)^2}$$

Where;

n =designates the sample size the researcher uses;

N= designates total number of household heads

e =designates maximum variability or margin or error 5 % (0.05);

1=designates the probability of the event occurring.

Therefore;

Although it was intended that 288 farm household heads be interviewed, this was not possible within the budget available. Due to this 182 random samples were interviewed.

Of these 40 AF adopters and 142 non adopters were identified. Therefore the sample size was 93 for Andegna Choreko and 89 for Denoqosa proportionally.

Three types of questionnaire were prepared, the first questionnaire for household, the second for key informants and the third for local & Woreda extension staff.

8.2.2 Participatory rural appraisal

PRA method is a family of approaches to enable rural people to present, share and analyze their knowledge of life and conditions in order to plan and act (Chambers, 1994). It empowers the local community to analyze its situation and improve its decisions. In this approach, 12 participant farmers (Key informants) were identified by development agents and took the active role in the investigation of facts and the researcher assumes the facilitator role. Out of twelve key informants four were women. Aged adopters were selected as a key informant from each Keble administration.

Different types of tools of PRA were employed in both of the KAs to search out the basic facts, problems, priorities and aspirations of the people of the area:-

Some of the tools and techniques that were employed in this study were indicated below

♥ Diagramming and mapping

- historical analysis
- seasonality analysis

♥ Ranking and scoring

- matrix ranking and scoring

- pair wise ranking of problems
- Wealth ranking
- Ranking preference

8.2.3 Questionnaire for local and woreda extension staff

A questionnaire was conveyed to the staff by physical contact and the responses were collected from them. The questions were concentrated on the extension and management issues, which are important for technology transfer and dissemination.

8.2.4 Scanning government records and secondary data resources

Facts and quantitative figures of different socioeconomic and physical conditions of the study areas were obtained from different government records such as strategic plans & reports.

8.2.5 Field observation

Farmlands of the households selected for the survey were carefully visited to verify results obtained through the interview (Patton 2002).

8.3 Data collection and organization

After the final preparation of the questionnaire and training of the translators, data collection using different information gathering methods mentioned above were conducted in different periods of time at Denoqosa and Andegna Choreko. Data collection at Denoqosa was conducted from July 01/2005 to 15/11/2005 and at Andegna Choreko from July 21/2005 to August 05/2005 EC.

8.4 Data analysis

Data analysis was carried out using MS-Excel and Statistical Package for Social Science (SPSS 20). The quantitative data were entered in SPSS and then analyzed using descriptive statistics such as frequency, percentage, mean, standard deviation and test of significance. Chi-square test and t-test were used to determine whether there were statistically significant relationships between adoption of agroforestry and selected variables. Chi-square test was preferred to be used since it measures the strength of association between variables by its' Cramer's V (CV).

8.5. Definition of variables and hypothesis

8.5.1. Dependent variable

A dependent variable is a variable that is said to be affected or explained by another variable/

variables. In this study, farmers' adoptiveness is treated as a dichotomous dependent variable, i.e. it takes the value of 1 if the farmer is adoptive and 0 otherwise.

8.5.2. Independent variables

The independent variables are those, which are hypothesized to have an association with the farmers' adoptiveness. The independent variables that are hypothesized to affect the dependent variable are described below.

Gender: It is nominal variable to be used as a dummy (1 if male, 0 otherwise). In this study it was hypothesized that male farmers are more likely to be adoptive than female farmers.

Literacy level: Literacy is measured in terms of the number of years of schooling the respondent has completed. In this study it was hypothesized that there is significant correlation between the

literacy level and adoptiveness of farmers. **Awareness of AF technology packages:** This variable was defined as the farmers' awareness of AF technology packages that are present in the woreda. In this study it was hypothesized that awareness of AF technology packages affects farmers' adoptiveness positively. **Attending extension events:** This reflects on the level of participation of the respondents in different extension events. The frequency of attending extension events was hypothesized to positively influence farmer adoptiveness. **Access to extension services:** This variable was defined as the farmers' contact with extensionists. The more frequent contact of farmers' with extensionists was hypothesized to positively influence farmer adoptiveness. **Land holding size:** It is measured in terms of total land holding of the respondents in ha. It was hypothesized that farm size and farmers' adoptiveness are not related.

Means of ownership of land: It is a way of gaining land. Farmers owned land through marriage, land allocation, inheritance and borrowing from others. Those farmers who owned their land through land allocation may can be better adopters since they are more confident on their land holding as it is gained from government and no fear of redistribution of the land. Therefore, it was hypothesized that, means of ownership of land through land allocation influences farmer adoptiveness positively. **Land security:** Land security express feeling of the farmers towards owned land. Those farmers who feel the land they owned belong to them may be better adopters due to land security. Therefore, it was hypothesized that, land security influences farmers' adoptiveness positively. **Market for land:** it is selling and buying of the land. Lack of opportunity for buying and selling land may hinder farmers' adoptiveness to agroforestry practice. Therefore, it was hypothesized that, market for land influences farmers' adoptiveness positively.

Land Rent: Land rent for one or more years is common in the study area. But it may decrease farmers' adoptiveness of longterm strategy such as agroforestry technology due to the uncertainty of the land rent for prolonged period. Therefore, it was hypothesized that, land renting **negatively** influences farmers' adoptiveness. **Attitude of farmers:** Some people do not feel proud to be a farmer and consider farming as a last option. They generally prefer to go for other option than agroforestry. In contrast, some farmers are proud of their farms and do not consider farming to be an inferior occupation. Studies have shown the latter to be the ones who are much adoptive than the former. Therefore, it was hypothesized that, individual outlook itself is a factor for low level of adoption of agroforestry.

9. RESULTS AND DISCUSSION

9.1 Gender and literacy level of the respondents

9.1.1: Gender of Sampled Household

According to the result of the study, out of the total sampled respondents 72% were male and 28% of them were female (Table 2). The agroforstry technology adopters from the total respondents sampled were 26.7% for male and 9.8% for female.

The result suggest that male farmers are more likely to be adoptive than female farmers. The results of the chi-square indicates the relationship of gender with adoptiveness to be significant (P = 0.013).

Table 2: Relationship between gender of respondents & adopter category

Adopter category	The respondents' gender							X^2
	Male			Female			Grand total	
	n_1	n_2	total	n_1	n_2	total		
Adopter	14	21	35	2	3	5	40	
Non adopter	55	41	96	18	28	46	142	
Total	69	62	131	20	31	51	182	4.63**

**, Significant at less than 5% level, (df = 1, CV = 0.159), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.1.2 Literacy level

The result of this study demonstrates that there is significant relationship between the level of literacy and the adoptiveness of farmers (Table 3). Some studies indicate that education is an important socio-economic variable that may make a farmer more receptive to advice from an

extension agency or more able to deal with technical recommendations that require a certain level of literacy (Trip, 1993) which corroborates with the finding of this study

The proportion of respondents in terms of literacy level shows that 55.5% cannot read and write, 42.9% and 1.6% have completed grades 1- 8, and 9 - 10 respectively and (Table 3). The results show that the proportion of the respondents who cannot read and write in the adopter and non-adopter category is 30% and 62.7% respectively.

Table 3: Relationship between educational level of respondents and adopter category

Adopter category	Adopter category							X^2
	Adopters			Non adopters			Grand total	
	n_1	n_2	total	n_1	n_2	total		
Can't read and write	7	5	12	45	44	89	101	
1-4	3	12	18	22	16	38	56	
5-8	6	5	8	6	8	14	22	
9-10	0	2	2	0	1	1	3	
10^+	0	0	0	0	0	0	0	
Total	16	24	40	73	69	142	182	31.76***

***, Significant at less than 1% level, (df =4, CV = 0.418), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

The data also show that, 65% of the adopter and 36.6% of the non- adopter farmers completed grades up to 8, whereas 5% of the adopter and 0.7% of the non- adopter farmers have completed grades 9 and10.

In line with the expectations, the Chi-square test indicates the relationship between adopter categories and level of education to be statistically significant (P = 0.000). The finding of this study is in agreement with the study conducted by Trip (1993). In his study, he has

demonstrated that "There is significant relationship between the level of literacy and the adoptiveness of farmers."

9.2 Strength of extension activities in motivating farmers adoption of agroforestry practices in Halaba special woreda.

9.2.1 Awareness of the available agroforestry technology packages

Agroforestry has been started to be introduced in Halaba special woreda by the government and Land project since 1977EC while it was introduced at Denoqosa and Andegna choroko KAs since 1986 E.

Table 4: Relationship between awareness of AF technology packages and adoptiveness

Aware of AF technology packages	Adopter category							X^2
	Adopters			Non adopters			Grand total	
	n_1	n_2	Tota	n_1	n_2	Tot		
No	0	0	0	28	24	52	52	
Yes	16	24	40	45	45	90	130	
Total	16	24	40	73	69	142	182	20.50***

***, Significant at less than 1% level, (df = 1, CV = 0.336), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko,

Farmers were asked if they had heard about agroforestry technology packages that are present in the woreda. 71.4% of the respondents were aware of agroforestry technology packages whereas 28.6% of the respondents were not (Table 4). The data showed that 100 percent of the agroforestry adopters and 63.4% of the non adopters were aware of agroforestry technology packages whereas 36.6% of non adopters were not aware of agroforestry technology packages.

The result of the Chi-square test indicates the relationship between awareness of agroforestry technology packages and adopter category is highly significant (P = 0.000). This result agrees with the assumption of the study which was made at the beginning.

The periods of awareness of farmers were different from one another even though some of them were not able to identify exact period (Table 5).

The numbers of farmers aware of AF technology packages before 1997 were low (Table 5). Starting from 1997 a better increment was observed. The general increase after 1997 could be attributed to the presence of development agents at kebele level and the involvement of Food for the Hungry International (FHI) during this period.

Table 5: The periods showing the number of farmer's awareness about AF technology packages

Years of awareness (EC)	No of farmers		Total
	Denoqosa	Andegna choroko	
Before 1997	4	8	12
1997	2	4	6
1998	3	5	8
1999	5	5	10
2000	5	8	13
2001	8	6	14
2002	5	10	15
2003	7	9	16
2004	7	10	17
2005	9	10	19
Total	55	75	130

9.2.2 Level of acceptance of agroforestry technology packages

Retaining trees in their farms, planting Eucalyptus camaldulensis in their homestead, planting of Euphorbia tirucalli and Entada abyssinica as live fences a common practice for both adopters and

non adopters in the study area. Adopters for this study are farmers who practice AF package as homegarden while non adopters are farmers who did not practice AF package at all.

Table 6: Level of acceptance of agroforestry technology packages

Agroforestry packages	Option in frequency					
	Accepted			Not accepted		
	n_1	n_2	Total	n_1	n_2	Total
1. Mango seedlings	15	24	39	74	69	143
2. Avocado seedlings	16	24	40	73	69	142
3. Coffee seedlings	16	24	40	73	69	142
4.*Acacia salegina* seedlings	6	9	15	83	84	167
5.*Sesbania sesban* seeds	14	23	37	75	70	145
6. *L. lecosphala* Seeds	2	1	3	87	92	179
7. *Acacia salgena* Seeds	2	3	5	87	90	177
8.*Elephant grass*	3	3	6	86	90	176
9. Desho grass	12	23	35	77	70	147

n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

The study showed much lower acceptance of agroforestry technology packages (Table 6). The respondents mentioned more than one reasons as an external factor for not accepting agroforestry technology packages. The data given in Table 7 indicate that (52.1%) of the respondents were not accepting packages due to seedling shortage. They complaining about lack of nursery sites at their kebele administrations. Respondents of Denoqosa kebele administration get their seedlings from Aweshona kebele administration which is so far from Denoqosa kebele administration and respondents from Andegna cheroko get most of the seedlings from Alemtena kebele. A majority of the respondents (44.4%, 36.64% and 35.2%) were not able to accept AF technology packages due to rainfall shortage, lack of awareness and small sized land holding respectively. The remaining farmers mentioned free grazing(33.%) lack of money (29.3%) and labor shortage (24.6%) as reason for not accepting AF technology package.

Table 7: Distribution of respondents with regard to reasons for not accepting AF package

Reason for not accepting AF package	Non adopters		
	n_1	n_2	Total
Free grazing	28	19	47
Seedling shortage	41	33	74
Money shortage	32	10	42
Labor shortage	17	18	35
Land holding shortage	29	21	50
Lack of awareness	31	21	52
Rainfall shortage	33	30	63

n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.2.3 Attending extension events

The data on the level of participation of the respondents in different extension events are presented in Tables 8, 9 and 10. The data show that from the total respondents, 55.5% (Table 8), 69.8% (Table 9) and 5.5% (Table 10) of them never participate in training, field day and extension meeting. The results in Table 8 show that of the total respondents surveyed, 37.9% and 6.6% of them participated in training sometimes and frequently respectively. Similarly, of the total respondents 30.2% of them participated some times in field day (Table 9) and 88.5% and 6% of them participated in Extension Meeting sometimes and frequently, respectively (Table 10).

Categorical analysis of the survey result given in Table 8 shows that 85% and 10% of the adopter farmers participated in training sometimes and frequently, respectively while, 5% of them never participated. Likewise, 24.7% and 5.6% of the non-adopter farmers participated in training some times and frequently, respectively while 69.7% of them never participated. The Chi-square test result shows highly significant relationship between participation in training and adopter categories ($P = 0.000$).

Further categorical analysis of the results given in Table 9 shows that 72.5% of the adopter farmers participated in field day sometimes while, 27.5% of them never participated. Likewise, 18.3% of the non-adopter farmers participated in field day some times while, 81.7% of them never participated.

The Chi-square test result shows highly significant relationship between participation in field day and adopter categories (P = 0.000).

Table 8: Relationship between participation in training and adoptiveness

Adopter category	Participation in Training										X^2
	Never			Sometimes			Frequently			Grand total	
	n_1	n_2	Tota	n_1	n_2	total	n_1	n_2	total		
Adopter	1	1	2	13	21	34	1	3	4	40	
Non adopter	49	50	99	20	15	35	4	4	8	142	
Total	50	51	101	33	36	69	5	7	12	182	54.441***

***, Significant at less than 1% level, (df = 2, CV = 0.547), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

Table 9: Relationship between participation in field day and adoptiveness

Adopter category	Participation in Field day						X^2
	Never			Sometimes			Grand total	
	n_1	n_2	total	n_1	n_2	total		
Adopter	5	6	11	11	18	29	40	
Non adopter	61	55	116	12	14	26	142	
Total	66	61	127	23	32	55	182	43.46***

***, Significant at less than 1% level, (df = 1, CV = 0.489), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

The results given in Table 10 clearly show that 72.5 % and 27.5% of the adopter farmers participated in extension meeting sometimes and frequently, respectively. Likewise, 93.0% of

the non-adopter farmers participate in extension meeting some times while, 7.0% of them never participated in the extension meeting.

The Chi-square test result shows highly significant relationship between participation in extension meetings and adopter categories (P = 0.000). This implies that farmers who participate in extension meeting frequent times are better in adoption than those of occasional.

Table 10: Relationship between participation in extension meeting and adoptiveness

Adopter category	Participation in Extension Meeting										X^2
	Never			Sometimes			Frequently			Grand total	
	n_1	n_2	total	n_1	n_2	total	n_1	n_2	total		
Adopters	0	0	0	12	17	29	4	7	11	40	
Non adopters	6	4	10	67	65	132	0	0	0	142	
Total	6	4	10	79	82	161	4	7	11	182	44.12***

***, Significant at less than 1% level, (df = 1, CV = 0.492), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.2.4 Access to extension services

Farmers were asked about their contact with extension services. The proportion of farmers that did not visit was slightly higher than those who visited the extension staff. 50.5% of farmers had never visited extension staff and 28.6% have never been visited by extension staff (Figure 2).

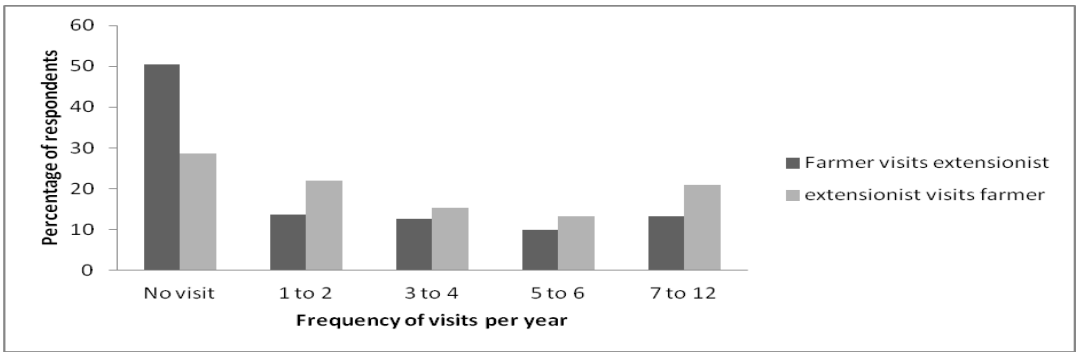

Figure 2: Frequency of visits between farmers and extension workers.

It can be seen from Figure 3 that 71.4% of the farmers had received one visit or more in a year from extensionists. In fact, over 40% of the farmers reported they received 1-2 and 7-12 visits per year.

When the survey results given in Table 11 are categorically analyzed it shows that 7.5%, 32.5%, 27.5% and 32.5% of the adopters were visiting extension staff 1 to 2, 3 to 4, 5 to 6 and 7 to 12 times per a year, respectively. Likewise, 15.5%, 7%, 4.9% and 7.7% of the non-adopters were visiting extension staff 1 to 2, 3 to 4, 5 to 6 and 7 to 12 times per a year respectively while, 64.8% of them have not visited. The Chi-square test result shows highly significant relationship between frequency of visits of farmers and adoptiveness (P = 0.000). This implies that farmers who visits extension staff more times are better in adoption than those of rare time and non visitors.

Table 11: Relationship between frequency of visits of farmers and adoptiveness

Frequency of visits	Adopters			Non adopters			Grand total	X^2
	n_1	n_2	total	n_1	n_2	total		
No visit	0	0	0	56	36	92	92	
1to 2	2	1	3	7	15	22	25	
3 to 4	5	8	13	3	7	10	23	
5 to 6	4	7	11	3	4	7	18	
7 to 12	5	8	13	4	7	11	24	
Total	16	24	40	73	69	142	182	73.949***

***, Significant at less than 1% level, (df = 4, CV = 0.637), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

When the survey results given in Table 12 are categorically analyzed it shows that 10 %, 17.5%, 20% and 52.5% of the adopters were visited by extensionists 1 to 2, 3 to 4, 5 to 6 and 7 to 12 times per a year respectively. Likewise, 25.4%, 14.8%, 11.3% and 12% of the non-adopters were

visited by extensionists 1 to 2, 3 to 4, 5 to 6 and 7 to 12, respectively while 36.6% of them were never visited.

The Chi-square test result shows highly significant relationship between frequency of visits of extensionists and adopter categories (P = 0.000).

Table 12: Relationship between frequency of visits of extensionists and adoptiveness

Frequency of visits	Adopters			Non adopters			Grand total	X^2
	n_1	n_2	total	n_1	n_2	total		
No visit	0	0	0	28	24	52	52	
1to 2	1	3	4	20	16	36	40	
3 to 4	4	3	7	9	12	21	28	
5 to 6	3	5	8	10	6	16	24	
7 to 12	8	13	21	6	11	17	38	
Total	16	24	40	73	69	142	182	44.5***

***, Significant at less than 1% level, (df = 4, CV = 0.494), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

Farmers were asked to indicate how much time it took them from their residence to the nearest extension location. Table 13 and figure 3 are an indication of the range of walking times from their residence to extension location. Over 47% of agroforestry adopters expressed at least 40 minutes to walk to extension location. The remaining ones such as 20%, 15% and 17.5% of the adopters were responded that it take 21 to 40, 11 to 20 and 1 to 10 minutes. Likewise, 46.5%, 12%, 9.2% and 13.4% of non adopters were responded that it take greater than 40, 21 to 40, 11 to 20 and 1 to 10 minutes respectively while 19% of the respondents were responded that we don't know. Although these walking distances might also be limited extension worker to visits farmers, they were provided with bicycles or motor cycles but maintenance and running costs were limiting factors to how much they could do. The Chi-square test result shows significant

relationship between time taken from their house to nearest extension location and adopter categories (P = 0.033).

Table 13: Relationship between time taken to the nearest extension location and adoptiveness

Time taken in minute	Adopters			Non adopters			Grand total	X^2
	n_1	n_2	total	n_1	n_2	total		
Don't know	0	0	0	14	13	27	27	
1to 10	2	5	7	12	7	19	26	
11 to 20	3	3	6	10	3	13	19	
21 to 40	3	5	8	8	9	17	25	
> 40	8	11	19	29	37	66	85	
Total	16	24	40	73	69	142	182	10.469**

**, Significant at less than 5 % level, (df = 4, CV = 0.24), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

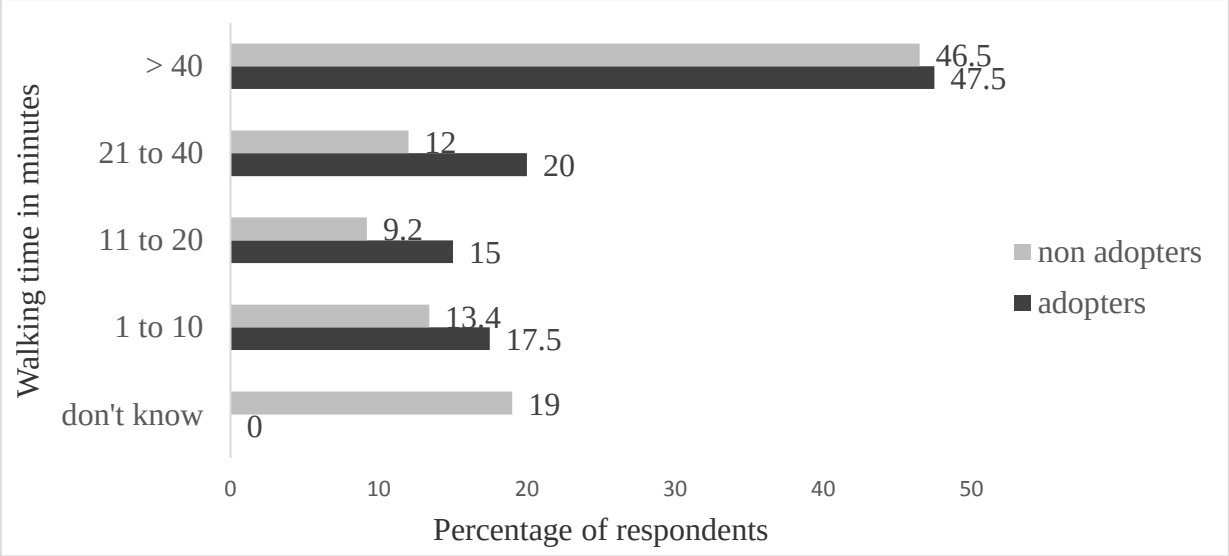

Figure 3: Walking time from residence to nearest extension location.

9.3 Legal rights on land and tree tenure, marketing, transfer and inheritance of land in Halaba special woreda

9.3.1 Land holding size

Land is the most important resource, as it is a base for any economic activity especially in rural and agricultural sector. The Land holding size in the study area varied from household to household. Categorical analysis of the result given in table 14 shows that 72.5% of agroforestry adopters and 37.3% of non adopters had medium to large farm size whereas 27.5% of agroforestry adopters and 62% of non adopters had small farm size.

The results on land holding and adoptiveness are given in Table 14. In this study, the average land holding of the surveyed farmers is 1.298 ha. The average land holding for adopters were 1.806 ha while those of the non adopters were 1.155 ha.

Table 14: Land holding size in the study area

Land holding size	AF adopters			Non adopters			Grand total
	n_1	n_2	total	n_1	n_2	total	
Small (0.25-1 ha)	2	9	11	48	41	89	100
Medium (1.25-2ha)	11	12	23	19	22	41	64
Large (2.25-3.5 ha)	3	3	6	6	6	12	18
Total	16	24	40	73	73	142	182

n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

The results of the t-test show that there is statistically significant relationship between farm size and adopter category of the respondents (P = 0.000). Accordingly, landholding of adopter farmers is larger compared with non-adopter farmers rejecting the hypothesis of the study. The finding in this study contradicts that by Pisanelli *et al*. (2008) who found little influence of farm

size on the decision to plant or trial improved fallows in western Kenya. From this we can understand that farmers who hold larger farm size are better adopters than those of smaller holders.

Table 15: Relationship between land holding size of the respondents & adopter category

Adopter category	N	Mean	SD	Min	Max	t-value
Adopters	40	1.806	0.754	0.5	3.5	
Non adopters	142	1.155	0.713	0.25	3.5	
Total	182	1.298	0.769	0.25	3.5	5.227 ***

***, Significant at less than 1%

9.3.2 Means of ownership of land in the study area

Farmers were asked how they had acquired their lands. Out of 182 respondents 49.5% owned land through inheritance, 30.8% through marriage, 18.1% through land allocation and 1.6% by renting from others (Table 16). According to the respondents all female headed household were acquiring land through inheritance when their husband is dying while male headed households were acquiring land either from their parents or from government bodies.

Categorical analysis of the survey result given in Table 16 shows that 55% and 47.9% of the adopter and non-adopter farmers owned land through inheritance, 17.5% and 34.5% through marriage, 25% and 16.2% through land allocation and 2.5% and 1.4% by renting from others respectively. The Chi-square test result shows there is no significant relationship between means of land gaining and adopter categories (P = 0.186).

Table 16: Relationship between means of land ownership and adoptiveness

Means of land gaining	Adopters			Non adopters			Grand total	X^2
	n_1	n_2	total	n_1	n_2	total		
By inheritance	8	14	22	25	43	68	90	
Through marriage	3	4	7	29	20	49	56	
Through land allocation	4	6	10	18	5	23	33	
By borrowing from others	1	0	1	1	1	2	3	
Total	16	24	40	73	69	142	182	4.812NS

NS, Not significant, (df = 3, CV = 0.163), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.3.3. Land security

Land holding size only may not be enough to influence AF technology adoption of the farmers. Land security may also substantially does (Bedasso, 2008).

Farmers are encouraged to exercise long-term strategies such as AF when they have strong belief that the land belongs to them. The confidence of farmers towards owned land may express land security. The data shown in table 17 demonstrates that 77.5 % of the adopters are those who believes that the land belongs to them.

Table 17: Relationship between respondents' feeling on owned land and adoptiveness

Do you feel that the land you owned belong to you?	Adopters			Non adopters			Grand total	X^2
	n_1	n_2	total	n_1	n_2	total		
Yes	10	21	31	45	51	96	127	
No	6	3	9	28	18	46	55	
Total	16	24	40	73	69	142	182	1.449NS

NS, Not significant, (df = 1, CV = 0.089), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

From the total respondents 69.8% of them expressed that the land belongs to them while the rest, 30.2%, expressed that the land does not belong to them. Among the total adopter and non-adopter farmers 77.5% and 67.5% perceived that the land belongs to them while the remaining, 22.5% and 32.4%, spoken that the land does not belong to them respectively.

The Chi-square test result shows there is no significant relationship between land security and adopter categories (P = 0.186). The results agree with the findings of Yohannes (2001), who stated that land security has little influence on innovativeness.

9.3.4 Market for land

Farmers were asked about their land selling or buying in their locality. Almost all of the respondents (99.5%) revealed that land cannot be sold or bought due to restriction from government while only 0.5% of the respondents expressed as possible (Table 18). Among the total adopters and non-adopters 100% and 99.3% revealed that land cannot be sold or bought due to restriction from government respectively while only 0.7% of the non-adopter expressed as possible. In contradiction to this result Ruheza et al; (2012) point out that 92% of the respondents said that the only way for acquiring extra farmland is through buying in Tanzania.

Few farmers blamed these restrictions as it prevents them to either buy or sale their land depending up on their need.

The Chi-square test result shows there is no significant relationship between absence of market for land and adopter categories (P = 0.595).

Table 18: Relationship between absence of market for land and adoptiveness

Are there any laws that restrict	Adopters			Non adopters			Grand total	X^2
you from selling or buying land	n_1	n_2	total	n_1	n_2	total		
Yes	16	24	40	72	69	141	181	
No	0	0	0	1	0	1	1	
Total	16	24	40	73	69	142	182	0.283 NS

NS, Not significant, (df = 1, CV = 0.039), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.3.5. Land Renting

The respondents were asked tree planting on land rented. Almost all of the respondents (99.5%) have expressed that planting of trees and perennial crops are not allowed on rented land while only 0.5 % of the respondents expressed as these are possible.

Among the total adopters and non-adopters 100% and 99.3% expressed that tree planting are not allowed on rented land while only 0.7% of the non-adopter expressed as possible (Table 19).

The Chi-square test result shows there is no significant relationship between trees planting on borrowed land and adopter categories (P = 0.595).

Table 19: Distribution of respondents' response with trees planting on rented land

Allowed to plant trees on	Adopters			Non adopters			Total	X^2
rented land	n_1	n_2	total	n_1	n_2	total		
Yes	0	0	0	1	0	1	1	
No	16	24	40	72	69	141	181	
Total	16	24	40	73	69	142	182	0.283 NS

NS, Not significant, (df = 1, CV = 0.039), n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.4. Attitude, needs and priorities of farmers towards integration of trees in their farms in Halaba special woreda.

9.4.1 Farmers' attitude towards agroforestry practices

Some respondents do not feel proud to be a farmer and consider farming as a last option. They generally prefer to go for other option than agroforestry. In contrast, some respondents are proud of their farms and their activities therein. Studies have shown that the latter to be the ones who are much adoptive than the former. Therefore, it was hypothesized that, favorable attitude towards agroforestry influences farmer adoptiveness positively. Attitude of farmers towards agroforestry was measured with the help of five point Likert scale. The scale contained six attitude statements which were fixed scores on the continuum as; strongly agree = 1; agree = 2; neutral = 3; disagree = 4; and strongly disagree = 5.

The results regarding attitude of respondents towards park land agroforestry practice is presented in Tables 20 and 20 cont. Out of six attitude statements, the majority of respondents showed strong agreement with that of agroforestry benefits that includes increased soil fertility (41.8%), increased farm income (31.9%), improved surrounding conditions (38.5%) and saved time on collecting fodder and fuel wood from forest (58.8%) while for the remaining two attitude statements the majority of respondents showed agreement and strong disagreement on that of agroforestry benefits that includes conserve soil and water (29.7%) and reduce crop pest (28.6%), respectively.

Categorical analysis indicates that out of six attitude statements majority of adopters showed strong agreement on that of agroforestry benefits that includes increased soil fertility (87.5%),

increased farm income (67.5%), reduced crop pest (28.6%) and saved time on collecting fodder and fuel wood from forest (95%) while for the remaining two attitude statements majority of respondents showed agreement on that of agroforestry benefits that includes conserve soil and water (55%) and improve surrounding conditions (55%). For none of the attitude statements except reduced crop pest (17.5%), none of the adopters showed strong disagreement, disagreement and neutral attitude. Majority of non adopters showed strong agreement on that of agroforestry benefits that includes increased soil fertility (28.9%), improved surrounding conditions (26.1%) and saved time on collecting fodder and fuel wood from forest (48.6%) while for the remaining three attitude statements majority of non adopters showed disagreement and strong disagreement on that of agroforestry benefits that includes conserved soil and water (25.4%), increased farm income (30.3%) and reduced crop pest (36.6%) the later two of attitude statements showed as strong disagreement.

Chi-square test was computed to see the relationship between adoptiveness and attitude of respondents towards agroforestry. The result shows that there is highly significant relationship between attitude towards agroforestry and adoptiveness (P = 0.000), this implies individual's outlook itself is a factor for low level of adoption of agroforestry. This result agrees with the hypothesis of the study which was made at the beginning.

Table 20: Relationship between attitude of farmers towards agroforestry & adoptiveness

AF practices	Attitude of farmers	Adopter category			X^2
		Adopters	Non adopters	Total	
		n	n	n	
Increased soil fertility (AFPISF)	Strongly disagree	0	34	34	
	Disagree	0	27	27	
	Neutral	0	22	22	
	Agree	5	18	23	
	Strongly agree	35	41	76	
	Total	40	142	182	49.069***
conserved soil and water (AFPCSW)	Strongly disagree	0	22	22	
	Disagree	0	36	36	
	Neutral	0	28	28	
	Agree	22	32	54	
	Strongly agree	18	24	42	
	Total	40	142	182	45.989***
Increased farm income (AFPIFI)	Strongly disagree	0	43	43	
	Disagree	0	23	23	
	Neutral	0	25	25	
	Agree	13	20	33	
	Strongly agree	27	31	58	
	Total	40	142	182	51.896***

AFPISF, ***Significant at less than 1% level (df = 4, P = 0.000, CV = 0.519), AFPCSW, ***Significant at less than 1% level (df = 4, P = 0.000, CV = 0.503), AFPIFI, ***Significant at less than 1% level (df = 4, P = 0.000, CV = 0.534).

Table 20 cont: Relationship between Attitude of farmers towards agroforestry & adoptiveness

AF practices	Attitude of farmers	Adopter category			X^2
		Adopters	Non adopters	Total	
		n	n	n	
Reduced crop pest (AFPRCP)	Strongly disagree	0	52	52	
	Disagree	7	43	50	
	Neutral	0	18	18	
	Agree	16	18	34	
	Strongly agree	17	11	28	
	Total	40	142	142	58.548***
improved surrounding condition (AFPISC)	Strongly disagree	0	31	31	
	Disagree	0	33	33	
	Neutral	0	18	18	
	Agree	7	23	30	
	Strongly agree	33	37	70	
	Total	40	142	182	48.982***
Saved time on collecting fodder & fuel wood from the forest (AFPSTWF)	Strongly disagree	0	12	12	
	Disagree	0	15	15	
	Neutral	0	0	0	
	Agree	2	46	48	
	Strongly agree	38	69	107	
	Total	40	142	182	27.919***

AFPRCP, ***Significant at less than 1% level (df = 4, P = 0.000, CV = 0.567), AFPISC, ***Significant at less than 1% level (df = 4, P = 0.000, CV = 0.519), AFPSTCFWF, ***Significant at less than 1% level (df = 4, P = 0.000, CV = 0.392)

9.4.1.1 Farmers' reasons for not planting trees on their crop land

Non adopters were asked if they had planted trees on their crop land. Examination of frequencies showed that they did not.

The data given in Table 21 shows that a majority of the non adopters i.e., 69 % were not willing to grow trees due to the fierce competition of trees for water and nutrients uptake with agricultural crops growing along with. The finding agrees with the work of Nouman *et al.* (2008) who indicated that a majority of the local community (68.8%) were not willing to grow trees due to competition of trees grown on farmland along with agricultural crops for water and nutrients uptake. A majority of the respondents (52.1%) were not able to plant trees due to seedling shortage. Below 50 % of the respondents were not able to plant trees due to insufficient rainfall. A minority of the respondents (35.2%, 33.1%, 24.6% and 23.9%) were not able to plant trees due to land shortage, free grazing after crop harvest, soil degradation due to trees and long span of trees respectively.

Table 21: farmers' reasons for not planting trees on their crop land

Reasons for not planting trees	Non adopters		
	n_1	n_2	total
No interest in trees	0	0	0
Land shortage	29	21	50
Soil degradation due to trees	18	17	35
Insufficient rainfall	36	34	70
Long span of trees	17	17	34
Competition b/n trees & crops for water and nutrients uptake	60	38	98
Seedling shortage	41	33	74
Free grazing	28	19	47

n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

None of the respondents was mentioned lack of interest for trees as a reason for not planting trees. The findings disagrees with study of HESS's (Household Energy Strategy Study) demand survey that studied the main reasons for farmers not to plant trees were lack of water (35%), not enough land (13%), bad for crops (12%) and the farmers' lack of interest in trees (15%).

9.4.2 Needs and priorities of farmers towards integration of trees in their farms.

9.4.2.1 Priorities of problems regarding to the agroforestry out puts

Farmers were asked about their problems and concern to agroforestry related issues.The result showed that majority of the respondents (54.9% and 54.4%) mentioned that soil erosion and food shortage as their serious problem, respectively (Table 22). 40.7%, 48.4% and 46.2% of the respondents expressed seedling, fodder and water insufficiency were their problems. The remaining ones 24.7%, 21.4%, 15.9% and 15.4% of the respondents expressed health, fuel wood, shade and lack of medicinal plants as their problems respectively

Table 22: Distribution of respondents' response on their problems

Items	Respondents			
	n_1	n_2	total	Rank
Fuel wood problem	25	19	44	7
Fodder shortage	44	40	88	3
Water shortage	55	29	84	4
Soil erosion	54	46	100	1
Seedling shortage	40	34	74	5
Food shortage	58	41	99	2
Health problem	21	24	45	6
Lack of medicinal plants	15	13	28	9
Shade problem	13	16	29	8

n_1, respondents of Denoqosa, n_2, respondents of Andegna choroko

9.5. Participatory rural appraisal findings

9.5.1 Historical analysis

Table 23: Important time line

Years	Description of major change	
	Denoqosa	**Andegna choroko**
Before 50	Dense forest and vegetation cover, population density was very low even not more than 40-50 people at a kebele, diverse wild life with high density, plenty of springs and streams.	dense forest and vegetation cover, population density was very low people at a kebele, diverse wild life with high density, plenty of springs and streams
30 - 50	Forest covers in the area has decreased severely due to shifting cultivation with highly increased population pressure, high crop yield.	Forest covers in the area has decreased severely due to shifting cultivation with highly increased population pressure, high crop yield
20 - 30	Shifting cultivation disappear due to lack of forest areas and shifting cultivators were forced to settle on their fixed land, provision of fertilizer, drought, famine, disappearance of some wildlife, trees and shrubs species like Podocarpus falcatus, *Rhamnus prinoides* 'Wella' *and* 'Sena*',* drying of water body such as springs and streams.	Shifting cultivation disappear due to lack of forest areas and shifting cultivators were forced to settle on their fixed land, provision of fertilizer, drought, famine, disappearance of some wildlife, trees and shrubs species like Podcarpus falcatus, *'Homa'*, drying of water body such as springs and streams,
10 - 20	Abnormal increase of population which leads to land shortage, food shortage, animal feed shortage since grazing land is changed into agricultural land, free grazing after crop harvest which facilitates erosion hazards.	Abnormal increase of population which leads to land shortage, food shortage, animal feed shortage since grazing land is changed into agricultural land, free grazing after crop harvest which facilitates erosion hazards.
Present - 10	Abnormal population pressure and shortage of land holdings force farmers to seek communal land, disappearance of wildlife except hyena which is challenged with lack of shelter and seen at a day.	Abnormal population pressure and shortage of land holdings force farmers to seek communal land, disappearance of wildlife except hyena.

9.5.2. Seasonality analysis

9.5.2.1 Rainfall distribution

Rain fall is distributed in different intensity and amount throughout the year. According to the informants, small rains occur from March to May and September and the big rains occur starting from June to August (Figure 4). According to informants' perception some seedling those planted in farms wilt due to low rain fall distribution.

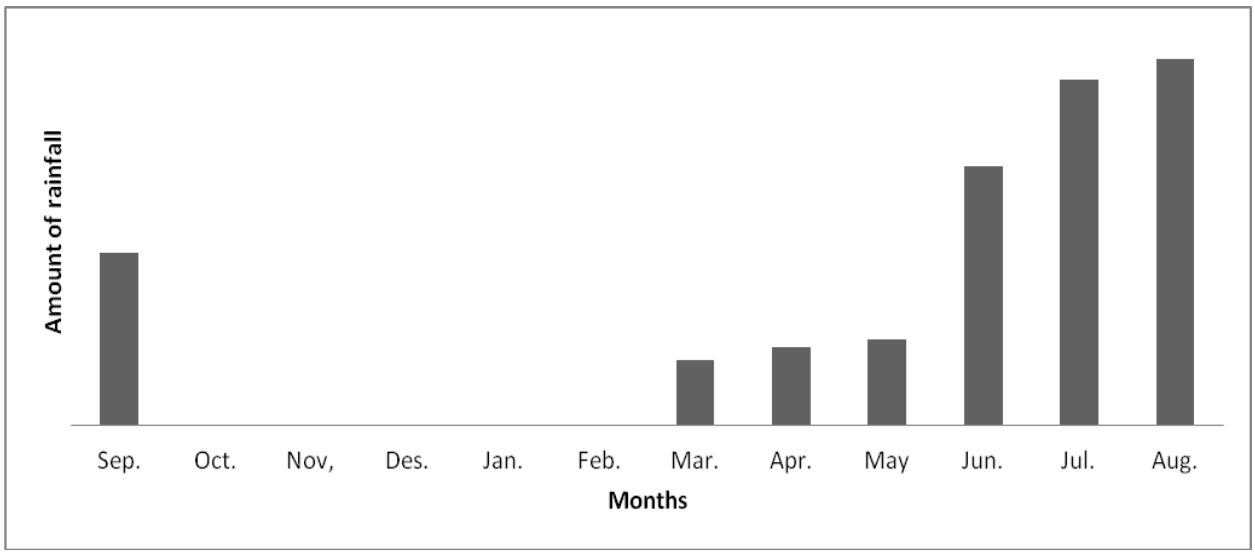

Figure 4: Annual rain fall distribution

9.5.2.2 Food availability

The major food crops of the area are maize, tef, haricot bean, millet, sorghum and wheat. Months of the year which are with high food availability includes September, October, November and December. March, April, May, and July are months of serious food shortage and the remaining months are neither high food availability nor serious food shortage (Figure 5).

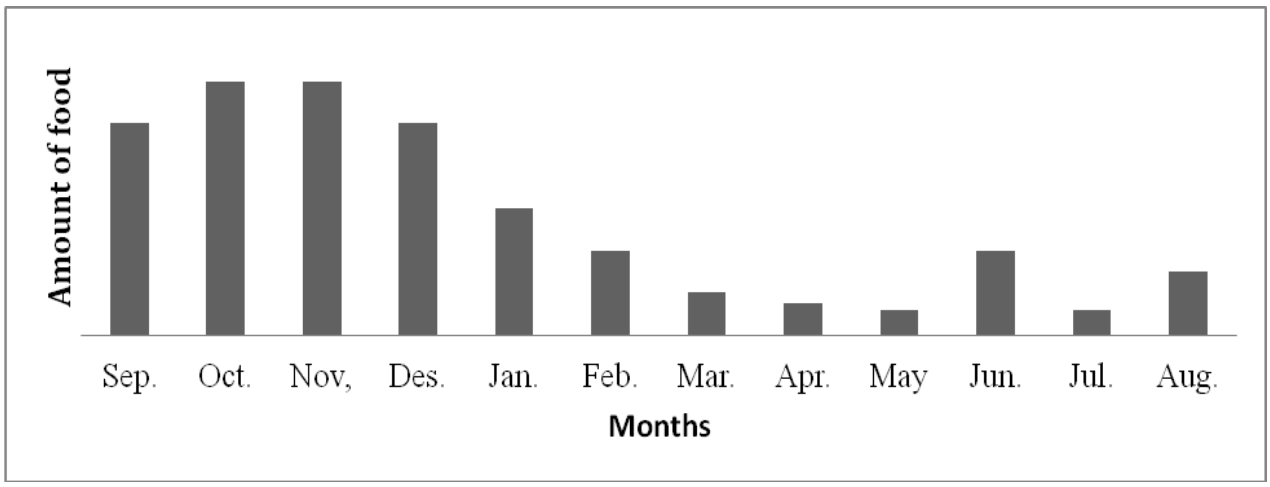

Figure 5: Annual food distribution

9.5.2.3. Animal feed availability

According to the informants, animal feed is available during big rainy season and serious problem at dry season since there is no fresh grass. During feed available season, animals are kept at home to be feed by cut and carry system while during feed shortage they feed on crop residue and free grazing on crop land. June, July, August, September, October and November are good months for animals and the rest months are hunger for them (Figure 6).

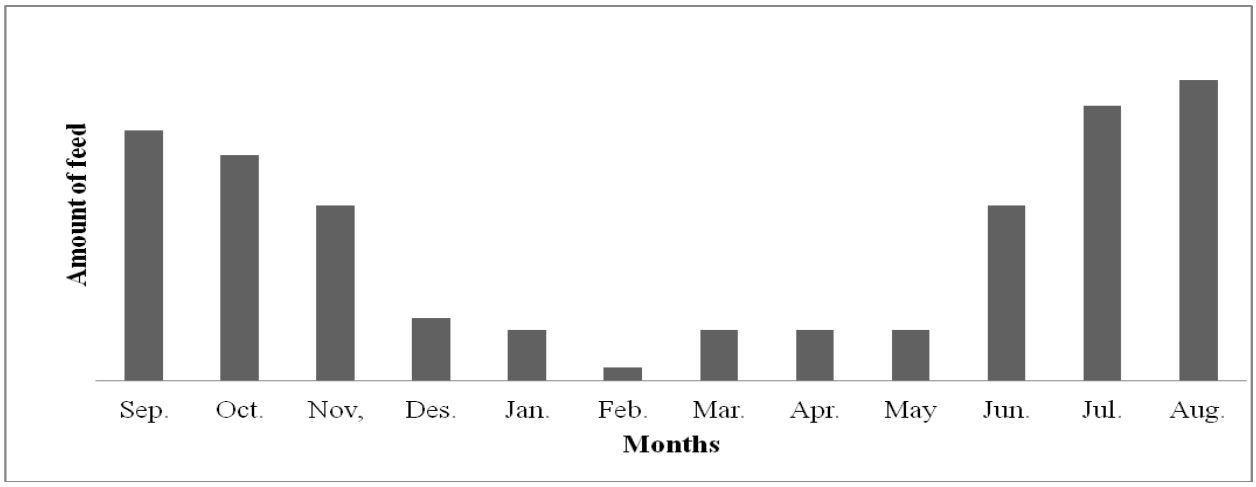

Figure 6: Animal feed availability

9.5.3. Trees/shrubs species identification and preference analysis with key informants

Key informants were identified about 13 trees and shrubs species. Preference were done by matrix ranking and scoring which is more stronger method of preference since it is a method of giving value (Table 24).

Table 24: Matrix Ranking and Scoring of Trees/ Shrubs; min point = 0 and max point =5

Ser. no	Tree/shrub species	FL	SWC	FI	HF	CM	FD	MC	SD	SI	Score	Rank
1	*Eucalyptus Camaldulensis*	5	-	5	-	5	-	-	2	5	22	1
2	*Acacia species*	3	4	1	-	1	3	-	4	3	19	2
3	*Cordia Africana*	1	2	2	-	2	2	1	5	1	16	3
4	*Croton macrostachyus*	1	1	1	-	1	-	-	2	-	6	10
5	*Grevillea robusta*	1	2	-	-	2	-	-	-	-	5	11
6	*Melia azadiracta*	-	1	-	-	-	1	-	5	-	7	8
7	*Ficus sur*	-	2	-	1	2	-	-	3	-	8	6
8	*Olea africana*	3	-	-	-	3	-	-	-	-	6	8
9	*Catha edulis*	-	2	-	-	-	3	-	-	5	10	4
10	*Euphorbia tirucalli*	-	2	-	-	-	1	-	-	-	3	12
11	*Entada abyssinica*	-	2	-	-	-	-	-	-	-	2	13
12	*S. sesban*	-	5	-	-	-	4	-	-	-	9	5
13	*L. lecosphala*	-	4	-	-	-	4	-	-	-	8	6

FL= Fuel SC = Soil and water conservation FI = Farm Implement HF =Human food

CM = Construction material FD = fodder MC = medicine SD = Shade SI = Source of income

9.5.4. Problem analysis with key informants

Key informants identified and ranked problems in the area. Similarities were observed with regard to listing the problems and differences were observed during prioritization. Even though these differences were observed, they have come to an agreement after extended period of discussion. Key informants confirmed household heads' ranking even though there were slight differences. A pair-wise ranking techniques were employed to prioritize the problems (Table 25).

Table 25: Pair-wise ranking of problems

Farmers' Problems	FWP	FSH	WSH	SE	SSH	FOSH	HP	LMP	SP	Score	Rank
FWP	—	FSH	WSH	SE	SSH	FOSH	FWP	FWP	FWP	3	6
FSH		—	FSH	SE	SSH	FOSH	FSH	FSH	FSH	5	4
WSH			—	SE	SSH	FOSH	WSH	WSH	WSH	4	5
SE				—	SE	SE	SE	SE	SE	8	1
SSH					—	FOSH	SSH	SSH	SSH	6	3
FOSH						—	FOSH	FOSH	FOSH	7	2
HP							—	HP	HP	2	7
LMP								—	LMP	1	8
SP									—	0	9

FWP = Fuel wood problem FSH = Fodder shortage WSH = water shortage SE = Soil erosion SSH = Seedling shortage FOSH = Food shortage HP = Health problem LMP = Lack of medicinal plants SP = Shade problem

9.5.5 Wealth ranking

Key informants were asked the criteria to categorize farmers into different wealth categories. They have their particular criteria to classify farmers in to different wealth rank which are described below.

1. Rich: 2 oxen, 2 or more cow, 1 donkey and more than 2ha of land

2. Medium: 1 ox, 1 cow, 1 donkey or no and greater than 1ha but equal to or less than 2 ha and who hold crop at July mainly maize.

3. Poor: no ox, no cow, no donkey and less than or equal to 1 ha of the land.

According to the key informants' rich farmers were better in agroforestry adoption than those of medium and poor.

9.5.6. Ranking preference for not incorporating trees on farmers' crop land.

Key informants identified major reasons of farmers to not incorporating trees on their crop land. Their identification includes free grazing, seedling shortage, long span of trees, land shortage, rainfall shortage, fear of competition between trees and crops and Soil degradation due to trees. Key informants rank them by saying 1st, 2nd, 3rd etc.

Major reasons	**rank**
Free grazing	1st
Seedling shortage	2nd
Long span of trees	6th
Land shortage	5th
Rainfall shortage	4th
Fear of competition	3rd
Soil degradation due to trees	7th

9.6 Responses of the extension staff

Four woreda experts such as agroforestery expert, forestry expert, SWC expert, land and environmental protection expert and two development agents were involved in giving responses.

a. All of the six respondents expressed that there is no policy problem but forestry expert expressed that there is an integrity problem in our organization. They also expressed farmers problem as shortage of food, shortage of land, shortage of seedling, shortage of fodder, lack of awareness, water problem since ground water is found at the 250 m excavation, road problem, low work habit and financial problem for transportation since nursery sites are far from them this may be due to wideness of the district which is also difficult for experts to manage.

b. All the six respondents have attempted to clarify the needs of the farmers but none of them rank their needs. According to the respondents, farmers need includes owning communal land to private, having sufficient food, reduction in cost of fertilizers, having farm implement, having sufficient seedlings, having adequate and pure water and having sufficient animal feed.

c. All except land and environmental protection expert expressed that majority of the farmers do not accept their advice while minority do. According to the respondents farmers were advised that acceptance of agroforestry packages like planting of nitrogen fixing trees, planting of fruit trees, planting of grasses and area closure with shrubs as a biological SWC measures while stone and soil bund, micro basins and fanya juu as a physical SWC. Adoptions of these technologies by farmers are slow for example some of the farmers disturb the bunds after construction. This is because farmers think that their farm land size is reduced since physical structures are occupying land makes the land unproductive.

d. Two of the development agents expressed the need for planning with active participation of the farmers rather than depending only on their interest but the woreda experts were depending on the organizations plane.

e. All of the respondents except land and environmental protection expert explained the factors that influence the rate and level of adoption of agroforestry packages by the farmers. According to the respondents, major factors that hinders farmers' adoption were lack of awareness, rainfall shortage, low water holding capacity of the soil, seedling shortage due to the Shortage of nursery sites in the district level that are found only at six kebele administrations from 76 rural kebele administrations. The six kebele administrations which produce seedlings in district level include Alemtenna, Chambulla, Aweshona, Wanja, Hantezo and Besheno. According to the development agents farmers of Denoqosa kebele administration get their seedlings from Aweshona kebele administration which is about 20 Km far from Denoqosa kebele administration and respondents from Andegna cheroko get their seedlings from Alemtena kebele administration exception for coffee seedling which is about 14 Km far from Andegna cheroko. In disagreement with farmers, agroforestry experts mentioned that there is no land shortage problems in the study area. Due to this farmers are interested in annual crops than paying attention for agroforestry.

The result in table 26 below discloses that 16.7% of the respondent responded no response for all packages. 83.3% of the respondents responded farmers' level of adoption of Mango, Avocado and Coffee are good. Also 16.7%, 50%, 16.7%, and 66.7% of the respondents responded farmers' level of adoption of seedling of Acacia species, seeds of Sesbania sesban and Acacia species respectively are good. The remaining percentages except for mango, avocado and coffee responded farmers' level of adoption is poor and very poor.

Table 26: Rating & leveling of adoption of AF technologies packages by extensionists

Agroforestry packages	Level of adoption					Total
	Very good	Good	Poor	Very poor	No response	
Seedlings	n	n	n	n	n	n
a. Mango	0	5	0	0	1	6
b. Avocado	0	5	0	0	1	6
c. Coffee	0	5	0	0	1	6
d. Acacia species	0	1	2	2	1	6
Seeds						
a. Sesbania sesban	0	3	2	0	1	6
b. L. lecosphala	0	0	1	4	1	6
c. Acacia species	0	1	1	3	1	6
Grasses						
a.Elephant grass	0	0	2	3	1	6
b. Desho grass	0	4	1	0	1	6

10. CONCLUSION AND RECOMMEDATIONS

10.1 Conclusion

The result reveals that adoption factors such as literacy level, awareness of AF technology packages, participation in training, participation in field day, participation in extension meeting, frequency of visits of farmers, frequency of visits of extension workers, and size of land holding are significant at less than 1% probability level while the relationship between gender of respondents and time taken from their residence to nearest extension location and the adopter categories is significant at less than 5% probability level. This implies the 8 factores mentioned above which accounts significant at less than 1% probability level are crucial factor to influence agroforestry adoption in Halaba special woreda.

The result of the descriptive analysis shows that land and tree tenure issues such as means of land gaining, land security, market for land and trees planting on rented land have no significant relationship with adopter categories. It can be concluded that tree tenure issues are not a factor for low level of adoption of agroforestry in Halaba special woreda since there is no significant relationship.

The result of the descriptive analysis shows that farmers' attitude towards agroforestry practices have significant relationship with adopter categories. This implies individual's outlook itself is a factor for low level of adoption of agroforestry in Halaba special woreda.

This study also identified various factors that may result in low adoption rates of agroforestry. According to the findings major reasons for low adoption rates were fear of competition between trees & crops for water and nutrients uptake, seedling shortage, rainfall shortage, lack of

awareness, land holding shortage, free grazing after crop harvest, money shortage, labor shortage, expecting trees as soil degrader and long span of trees, lack of need ranking of farmers and poverty.

Major problems of farmers of the study area concern to agroforestry issues were: soil erosion, food shortage, seedling insufficiency, fodder insufficiency, water insufficiency, health problem, fuel wood problem, shade problem and lack of medicinal plants. Key informants were confirmed household heads' problems identifications and ranking even though there were slight differences. Extension staffs have attempted to explain the needs of the farmers but none of them rank farmers needs.

10.2 Recommendations

- Kebele leaders should aware farmers to participate in extension events such as participation in training, participation in field day and participation in extension meeting. Likewise, the woreda bureau of agriculture should activate farmers to contact with extension services such as farmers visiting extensionists the vice-versa. In the similar way, DAs should create awareness about AF technology packages that are available in the woreda since it is ready for diffusion as an agroforestry technology.
- The woreda bureau of agriculture and non-government organizations (NGOs) should make the farmers aware about the land degradation and tree-crop competition concerns and its solutions by establishing counseling programs to facilitate the farmers in farm management issues.
- The woreda bureau of agriculture should introduce nursery sites at each kebele administrations and freely supply seeds and seedlings for the promotion of agroforestry.

- The community if possible should avoide free grazing after crop harvest.
- Although many NGOs and GOs were involved in soil and water conservation efforts in the Woreda, key informants' first ranked problem in the study area is soil erosion. From the findings of this study, major reason for soil erosion problem is disturbing of the bunds after construction by some farmers. Therefore, the woreda bureau of agriculture and other stake holders should teach farmers who disturb the bunds after construction.
- Extension staff only identifies farmers' problems but did not rank them in the order of their importance. This suggest that they should rank problems along with farmers and identify possible solutions for them.
- More research is needed encompassing more kebeles in Halaba special woreda for possible comprehensive intervention.

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12. APPENDICES

12.1 Questionnaires

12.1.1 Questionnaire for the household interview

I. Gender and literacy issues

1. The respondent's gender 1) Male 2) Female

2. Level of Education 1) Can't read and write 2) 1-4 3) 5-8 4) 9-10 5) 10^{+}

II. Extension issues

1. Do you know agroforestry technology packages that are present in the woreda?

1) Yes 2) No

1.1 If yes, in which year did you first hear about agroforestry technology packages? -------

1.2 Have you accepted or not accepted the agroforestry technology packages that are present in the woreda? 1) Accepted 2) Not accepted

Agroforestry packages	Reasons
Seedlings	
1. Mango	
2. Avocado	
3. Coffee	
4.Acacia species	
Seeds	
1.Sesbania sesban	
2. L. lecosphala	
3. Acacia species	
Grasses	
1.Elephant grass	
2. Desho grass	

1.3 What are the major reasons to not accept the agroforestry technology packages (Select all possible answers for each package)?

Agroforestry packages	Reasons
Seedlings	
1. Mango	
2. Avocado	
3. Coffee	
4.Acacia species	
Seeds	
1.Sesbania sesban	
2. L. lecosphala	
3. Acacia species	
Grasses	
1.Elephant grass	
2. Desho grass	

Codes: Reason: 1= Free grazing; 2=Seedling shortage; 3= money shortage; 4=labor shortage; 5 =land holding shortage; 6=Lack of awareness 7= rainfall shortage 8 other /specify /

2. Participation in different extension events

(Tick the response in the corresponding cell)

No	Extension Events	Frequency of Participation		
		Never (0)	Sometimes (1)	Frequently(2)
2.1	Training			
2.2	Field day			
2.3	Meetings			
2.4	Other (specify)			

3. How often did you receive a visit or go to visit extensionists per year?

(Tick the response in the corresponding cell)

Frequency of visits	Farmer visits to extensionists	Farmer receive visits from extensionists
0. No visit		
1. 1to 2		
2. 3 to 4		
3. 5 to 6		
4. 7 to 12		
5. More than 12		

4. How many minutes' walk is the nearest extension location to you?

1) Don't know 2)1to 10 3) 11 to 20 4) 21 to 40 5) > 40

III. Land and tree tenure, marketing, transfer and inheritance issues

5. Land holding size (in hectare) ----------

6. How did you acquire the land?

1) By inheritance 2) Through marriage 3) Through land allocation 4) By borrowing from other holders

7. Do you feel that the land you owned belong to you? 1) Yes 2) No

8. Are there any laws that restrict you from selling or buying land? 1) Yes 2) No

8.1 If yes, what are these restrictions? ----------

8.2 If no, how much is the price of a hectare of crop land (Land for cultivation)? --------

9. Are you allowed to plant trees on borrowed land 1) Yes 2) No?

9.1. If no, why are you not allowed to plant trees on borrowed land? ---------

IV. Attitude, needs and priority issues

10. To what extent do you agree on the following statement?

Statements	Degree of agreement				
	1	2	3	4	5
AF practices:					
Increased soil fertility					
Improved surrounding condition					
Increased farm income					
Conserved soil and water					
Took a long time to get income					
Reduced crop pest					

*1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

11. Have you tried integrating trees in your farmlands? 1) Yes 2) No

11.1 If yes, what are your objectives of integrating tree in your farm?

1. Soil fertility enhancement 2. For fuel wood and other wood requirements

3. Used for shade 4. As a source of income 5. As a live fence 6. For other purposes

11.2 If no what are the reasons for not planting trees in your farm?

1. No interest in trees 2. Land shortage 3. Soil degradation due to trees

4. Insufficient rainfall 5. Long span for tree growth & associated management problems

6. Competition between trees & crops for water and nutrients uptake 7. Seedling shortage

8. Free grazing

12. What are your problems regarding to the following? (Rank them)

1) Fuel wood 2) Fodder 3) Water 4) Soil erosion 5) Seedlings 6) Food shortage 7) Health problem 8) Lack of medicinal plants 9) Shade problem

12.1.2 Questionnaire for key informants

1. What changes you have seen in your area from previews 50 years to present based on crop, livestock, forest, wild life and population?
2. In which months have you received small and big rain, high and low food & feed availability?
3. Give value for the following agroforestry out puts for each identified trees/shrubs species (Min=0, Max=5)

Ser	trees/shrubs	Uses and services							Score	Rank
		FW	FD	MD	SH	SWC	HF	FI		
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										

FW= Fuel wood FD= Fodder MD= Medicine SH= Shade SWC= Soil and Water conservation HF= Human food FI= farm implement

4. What are the major problems in your area and rank them in the pair-wise form
5. What are the criteria to categorize the farmers in to different economic groups and how many categories exist?
6. What hinders farmers to not incorporate trees in their crop land? List and rank.

12.1.3 Questionnaire for local and woreda extension staff

Position in the extension organization----------

Date----------

1. What do you think about the farmers' problem? The management of your organization? Lack of appropriate laws and polices? Other
2. Have you ever talked with the farmers carefully about their needs and priorities? If your answer is yes what are their needs and priorities

3. Do farmers accept what you are advising them? What type of biological & physical SWC measures, have you ever been advised? How is the adoption of these technologies by the farmers? Slow? Good? Why? What is your option?
4. Do you work based only on your own plan? Have you ever started to plan with the farmers? Which type of planning you prefer? Why?
5. Explain the different factors that you think to influence the rate and level of adoption of agroforestry technologies packages by the farmers?

Agroforestry packages	Level of adoption				Reason
	Very good	Good	Poor	Noon	
Seedlings					
1. Mango	a	b	c	d	
2. Avocado	a	b	c	d	
3. Coffee	a	b	c	d	
4.Acacia species	a	b	c	d	
Seeds					
1.Sespania sespan	a	b	c	d	
2.L. lecosphala	a	b	c	d	
3.Acacia species	a	b	c	d	
4. Cow pea	a	b	c	d	
Grasses					
1.Elephant grass	a	b	c	d	
2. Desho grass	a	b	c	d	

6. Other opinions, comments and suggestions relevant to the above mentioned issues.

13. BIOGRAPHICAL SKETCH

Mihretu Erjabo was born in1987 in Soro Woreda, Hadiya Zone, Southern Ethiopia.

He attended his primary school at Omoshora. He completed his secondary education at Wachamo comprehensive high school in 2005. He joined Hawassa University, Wondo Genet College of Forestry and Natural Resources in October 2006. He obtained his B.Sc. degree in Natural Resource Management in July 2008. He was then employed as an expert in Soil and Water Conservation in Soro Woreda, Hadiya Zone, Southern Nation Nationality and People Regional State. In October 2010, he joined school of graduate studies at Hawassa University, College of Agriculture for his M.Sc. study under the program of Agroforestry.