TRADITIONAL MANAGEMENT AND DRIVING FACTORS OF WOODY SPECIES DIVERSITY ON FARMLANDS: THE CASE OF HULBAREGE WOREDA, SILTE ZONE, SOUTHERN ETHIOPIA

M.Sc. THESIS

BY: MESFIN GORSAMO ABE

JANUARY, 2017

JIMMA, ETHIOPIA

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MESFIN GORSAMO ABE

M.Sc. THESIS

Submitted to the School of Graduate Studies, Jimma University, College of Agriculture and Veterinary Medicine Department of Natural Resource Management in Partial Fulfillment of the Requirements for the Degree of Master of Science (M.Sc.) in forest and nature conservation

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I have incorporated the suggestions and modifications given during the internal defense and got the approval of my advisors. Hence, I hereby kindly request the Department to allow me to submit my thesis for external thesis defense.

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We the thesis advisors have verified that the student has incorporated the suggestions and modifications given during the internal thesis defense and the thesis is ready to be submitted hence, we recommended the thesis to be submitted for external defense.

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DEDICATION

I dedicate this thesis to my mother Demekeche Sebato for her dedicated contributionin the success of my life.

STATEMENT OF THE AUTHOR

First I declare that this thesis is my work and that all sources of the materials used for this thesis have been duly acknowledged. This thesis has been submitted to partial fulfillment of the requirements for M.Sc. degree at Jimma University, College of Agriculture and Veterinary Medicine and is deposited at the University Library to be made available to browsers under the rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

Name: Mesfin Gorsamo Abe

Signature_____

Place: Jimma University

Date of submission: _____

BIOGRAPHICAL SKETCH

Mesfin Gorsamo Abe was born on September 18, 1988 in Enseno town, Gurage Zone, Southern Ethiopia. He attended his education at Enseno Primary School and Butajera Secondary and Preparatory School. Mesfin has attended his undergraduate study at Hawassa University, Wondo Genet College of Forestry and Natural Resource and received BSc degree in Natural Resource Management (General Forestry) in June 2010. After graduation, he was employed in Bureau of Agricultural and Rural Development in Hulbarege Woreda of Silte Zone and served there until he joined the School of Graduate Studies at Jimma University College of Agriculture and Veterinary Medicine in September 2015 to pursue his M.Sc. degree in Natural Resource Management specialization in Forest and Nature Conservation.

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LIST OF ABBRIVIATIONS AND ACRONYMS

CSA	Central Statistics Authority
DAs	Development Agents
DBH	Diameter at Breast Height
EFAP	Ethiopian Forestry Action Plan
FAO	Food and Agricultural Organization
FG	Focus Group
GPS	Global Positioning system
HW	Hulbareg Woreda
HWARDO	Hulbarege Woreda Agriculture and Rural Development Office
HWFEDO	Hulbareg Woreda Finance and Economy Development Office
KAP	Knowledge, Attitude and Practice
LI-BIRD	Local Initiative for Biodiversity, Research and Development
NGO	Non-Governmental Organization
SPSS	Statistical Package for Social Sciences

ABSTRACT

Woody species are found in farmland in various forms of spatial and temporal arrangements with other agricultural components, and have ecological and socio-economic roles to the farmers. To assess farmland woody species diversity and traditional management at Hulbarege woreda insouthern Ethiopia, this study was conducted. Atotal of 24 key informants (KI), 3 from each village were selected by ranking and were used to categorize the village households (HH) in to three wealth categories. Moreover, simple random sampling within wealth category was used to select a total of 120 sample of HHs for interview. Data on woody species diversity in the homestead, crop fields and grazing/pasture land use system were collected. A complete enumeration of woody species in homegarden which has the average area of 0.27 ha, Whereas, 50 m × 100 m sampling quadrates in crop field, and 40 m × 40 m sample quadrates for grazing lands were used. Number of individuals per plot, DBH, and plot area were measured and recorded. The structure and composition of woody species through important value index (IVI), basal area, and diversity indexes were calculated. The result of the study showed that a total of 29 trees species and 2 shrubs species belonging to 18 families were recorded from homegardens, crop fields and grazing/pasture land use system in the study sites. The total number of tree species in the homegardens, crop fields and grazing land were 24, 18 and 10 respectively. The family Fabaceae 10 species (32.3 %), Moraceae 3 species (9.7 %) the least frequent families were Anacardiaceae, and Myrtaceae represented by 2 species each (6.5%). However, many of the families were represented by single species. From this species, 18 species (58.1%) were indigenous and 13 species (41.9%) were exotic. Generally the study revealed that the woody species Shannon and Evenness diversity indices were higher in homegardens, than crop fields and grazing/pasture land. At the study sites,there was a labordivision in woody species management activities, manage woody species in their farmlands for the purpose of improving soil fertility, fodder, fuel wood, timber, shade, construction, etc. The management practices employed at different land use includes branch pruning, pollarding, lopping, protection and coppicing. The socio-economic factors that influence management of woody species in farmlands across the study were found to be educational background, wealth status, sizes of homegarden were significantly positively correlated ($P < 0.05$) with the woody species richness. Therefore, based on this study it can be concluded that woody species retaining/management practices such as in grazing land must be promoted where species diversity is very limited due to free grazing

Key words: Farm lands,SpeciesDiversity, Species Richness, woody species.

1. INTRODUCTION

1.1. Background Information and Justification

The origin and ecological roles of on-farm trees in natural ecosystems have been intensively studied in many parts of the world (Fischer *et al* 2010; Ozolins *et al.*, 2001). Tropical ecosystems are renowned for their rich biological diversity. But, population growth and the resulting increase of cultivated land are threatening the sustainable management and use of the rich biological resources in the tropics (Ayele, 2003). Woody species can be found in farmlands in various forms of spatial and temporal arrangements for different purposes. One of the features of woody species management is that the biological characteristics of trees are often taken in to account to determine where it should be grown (Abebe, 2005).

Forest ecosystems in Ethiopia are facing rapid deforestation and degradation by a rapid population growth of a country,population has now, the second largest population in Africa (WB, 2015; WRI, 2001). The combination of the rapid growing world's population, slow economic growth and limited amount of natural resources, especially in many developing nations like Ethiopia has resulted in the unsustainable use of natural resources (FAO, 2008). Majority of the population are engaged in subsistence farming, while agriculture is the basis of the economy. Productivity is significantly limited because of severe land degradation (Alemneh, 2003). Rapid and intense human activity and inappropriate farming as well as poor management have created serious pressure to the sustainability of the natural resources and maintenance of ecological balance(Amsalu,2001). The natural resources have been negatively affected the agricultural sector to a larger extent and the over- all economy as well as the livelihood of people (Amsalu,2001). These factors often interact with one another resulting in poverty that is indicated as deep and structural, food insecurity and natural resource degradation (Alemneh, 2003). This increasing population needs, among other things, more food, energy including firewood, construction wood and arable land (Zeleke, 2006).

Most forest clearance has been driven by agricultural expansion which opens opportunities for households to collect firewood and most firewood is collected from outside of forests and

usually consists of dead wood and not felled tree in farmlands (Boucher *et al*, 2011).To satisfy these needs, farmers in Ethiopia have frequently been harvesting the remnant woody tree all over the country, energy consumption is predominately based on biomass energy sources i.e. (94%) traditional Energy sources are fuel wood, charcoal, and dung (Teka, 2006). This biomass energy comes from the natural forests, woodlands and scattered tree on farmlands. This has led to degradation, diminishing the microclimate, increasing soil erosion, increasing the occurrence of wind and biodiversity losses (Zeleke, 2006).

Still, there arelittle written documents of history that shows communities' traditional resource management practices applied in Ethiopia, it is clear that a number of communities had traditional resource management practices. This includes some elements of biodiversity conservation (Domoz, 2007).Earlier studies have documented local knowledge associated with trees and shrubs in the Ethiopian highlands and reported that woody plant diversity is important to farmers' livelihoods (Negash, 2007).

Some studies have shown that farmland in different parts of Ethiopia are characterized by a high diversity of woody species and thus make available a shelter for native woody species (Asfaw, 2003; Abebe, 2005). Therefore people managed trees intentionally to obtain different economic and social benefits from the trees. Major benefits they obtain from trees managed on their own land include fuelwood, soil fertility, construction, fodder, fencing, farm tools, shade, fruit, medicine and income from fruit and planted commercial trees with ecosystem services (Jama and Zeila, 2005). In order to support the conservation of useful woody plants, it is essential to compare local knowledge and values of woody plants with their abundance and distribution in the farmlands.

Factors that affects when planting and managing trees on farmlands were mostly drought, animal damageby free grazing, thief, labor shortage, land shortage, seedling shortage, lack of capital and utilization of different woody species in farm land, (Jaleel *et al.*, 2009)

Most studies that have considered the role of woody species in farm land in Ethiopia have focused on their impact on soil properties and crop production (Asfa, 2003). Only one of

studies was conducted in Hulbarege woreda Silta zone on the area exclosure as a strategy to restore soil fertility status in degraded land (Abebe*et al.*, 20014). But none of these studies were conducted on traditional managementand driver's factors of woody species management on farm land in Hulbareg Woreda Silta zone.

The result of this study provides information on type of tree species, their relative abundance and distribution on farmland. It ultimately contributesto achieving the sustainable management of the tree resources on the farmlands and necessary to design suitable conservation and sustainable use approaches. Moreover, the outcome could serve as an input for future ecological studies in the area. The gender roles in traditional woody species management were assessed, the major threats to woody plants, was identified to provide information about traditional management and drivers of woody species diversity on farm land.

1.2 Objectives of the Study

1.2.1. General Objective

The general objective of the study was to investigate traditional management and major driving factors affecting woody species diversity on farm land..

1.2.2 .Specific Objectives

- To assess woody species diversity on the farmlands in study area.
- To assess the traditional management practice on the farmlands in study site.
- To identify different factorsthat can influencing woody species management practices in the study area.
- To identify gender roles in woody species management practices in the study area.

1.2.3. Research Question

The study has tried to address some research questions, which include the following

- What is the woody plant species diversity on the farm land of the study area looks like?
- What are the traditional practices employed by local farmers in the management of woody species on farm land?

- What are the different factors that can influence woody species diversity and their management practices in study area?
- What are the roles of gender in woody species management practices on farmlands?

2. LITERATURE REVIEW

2.1. Concept of Woody Species onFarmlands

Woody species can be found in agricultural land in various forms. For instance, trees that contribute positively to agricultural crops are grown dispersed in crop fields while trees that compete with crops are planted separately in block arrangements. One of the features of on-farm tree management is that the biological characteristics of trees are often taken into account to determine where it should be grown (Abebe, 2005). Isolated trees grown in farmlands characterize a large part of the Ethiopian agricultural landscape. Trees would be grown in a scattered form over a crop field, usually between 1–20 trees per hectare to minimize impact on the companion crop. Some of the species for this practice include*Cordiaafricana* intercropped with maize in western Ethiopia; *Faidherbia albida* based agroforestry in the Hararghe Highlands (Hoekstra *et al*. 1990).

The landscape-scale function of scattered trees is that they contribute to the overall amount of tree cover in a landscape. In addition to the local-scale ecological functions of a given individual scattered tree, in combination, multiple trees scattered throughout a landscape provide additional ecological functions. The density of trees is of considerable scientific and conservation interest in natural landscapes (Mistry, 2000). Scattered trees make an important contribution to overall tree cover in many cultural and recently modified landscapes. Modified ecosystems such as grazing landscapes and often contain a large proportion remnant tree cover as scattered trees or small clumps of trees (Gibbons, 2002). The system has much potential for supplying fodder, poles, farm equipment, and fuel wood and contributes to agricultural production (Abebe, 2000). Some possible research needs include soil-plant interactions, soil fertility and N-fixation studies on wide range of species, crop tree yield studies and optimum tree density, socioeconomic studies, and species selection and screening including seed tests, establishment, and management.

2.1.1.Threats of Woody Species Diversity onFarmlands

Scattered trees in natural, cultural and recently modified landscapes face some similar threats, as well as some threats that are unique to particular ecosystems. The most direct threat to all scattered woody trees is clearing by humans. For evidence, the legal and illegal removal

ofscattered trees is widespread (Gibbons, 2002). A slower, but equally problematic, threat to scattered trees is the lack of natural regeneration. Recruitment failure is often related to high grazing and cultivation pressure, and may be a problem in natural, cultural and recently modified landscapes with scattered trees (Graham, 2001: Pulido*et al*., 2001).

Some of the current contributing reasons that accelerated the decline of woody species diversity in Ethiopia are, the size and distribution pattern of human and domestic animal populations, the level of resource consumption, market reasons and policies. Understanding and the attention on woody species conservation and sustainable use has so far been inadequate. This degradation is the result of population force that adds to crop cultivation and livestock grazing in marginal areas. In addition agricultural investment, resettlement schemes, charcoal, production and expansion of forceful invasive alien species are having a profound and determinant effect on the woody plant resource availability (Awas, 2007).

2.1.2. Agriculture and Woody Species

In farmlands scattered trees play a number of protecting functions, among others they participate in pollution control of the environment, modify the energy flow and matter circulation, and curb soil erosion (Orłowski, 2003). The presence of wood species diversities improves soil conditions in the surrounding crop fields, as a result of increase of organic matter in the soil and number and activity of soil microorganisms (Karg*et al.*, 2003; Wojewo da and Russ *elal*., 2003). For instance, intensive commercial mono cropping is likely to result in low species diversity, while some of the traditional farming practices familiar to the tropics are known to maintain a high level of diversity (Abebe, 2005).Agriculture has influential role in facilitating and stimulating growth of other sectors of the economy the land use changes natural forest to crop land. This is one of the major causes of species losses in the tropics over the last few centuries. Land use in Africa has been differentiating by a significant amount of land degradation and conversion to agricultural land use system (Barbier, 2000).

Successful management of agricultural filed requires a decline of habitat loss and degradation whilst providing an adequate supply of food for a growing human population. Sustainable agriculture has received increasing attention because expanding agriculture is globally the principal driver of biodiversity decline (Brussaard*et al.* 2010; IAASTD, 2009). In recent years

attention has been given to a new paradigm of eco-agriculture or integrated conservation agriculture, which seeks to integrate biodiversity conservation with rural development. This paradigm is being explicitly considered in shaping conservation strategies with clearly identified economic and ecological relationships that include ecosystem services (IAASTD, 2009; Scherr and McNeely, 2008).

2.1.3. Woody Species Diversity in Homegardens

To meet the current diverse and growing population requirement with fixed land in the world in general and in Ethiopia in particular. One of the possibilities is through the application of agroforestry which is more advantageous than mono cropping (Mcneely and Schroth, 2006). Land around the farmers house with trees are one of agroforestry practices known to be ecologically sustainable and diversifies livelihood of local community. Homegarden is commonly defined as; land use system involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses, the whole tree-crop, and animal unit is being intensively managed by family labor (Kumar and Nair, 2006).

Homegardens can be found in many parts of southern and southwestern regions of Ethiopia. In many parts of Ethiopia, rural people traditionally manage plant species diversity in homegardens for different household uses (Asfaw, 2002). Local knowledge is an indigenous knowledge that is unique to a particular culture and society which people used as a base for local decision-making in agriculture, health, natural resource management and other activities (Chikaire*et al.*, 2012).

Trees like *Cordiaafricana, Milletiaferruginea, Albezziagummifera, Ficus* species, and *Acacia* species are among the species that form the upper story of homegardens. The structural complexity in the Ethiopian homegardens is varied and ranges from complex and diverse forms containing many species and strata, as in Sidama southern Ethiopia, to the less complex forms, with one or two crop/tree mixtures, as in the Gurage southern Ethiopia. Homegardens provide much of the basic needs of the local population and help decrease the environmental deterioration (Getahun, 1988; Abebe, 2000).

Multi-disciplinary biophysical studies, including soil-plant connections and socioeconomic studies on homegardens, are required for better understanding and use of these ecologically sound agro forestry systems. Homegarden species have high diversity of wide socioeconomic and agro-ecological roles including production of food and a wide range of other products such as food, income generation, fodders, firewood, spices, medicinal plants and ornamentals (Ewuketu*et al*., 2014).Regardingnutritional benefits, homegardens provide potential for ensuring food security to the households. Since the diverse mixture of crops is harvested at different times, a constant supply of food in some or the other is available from these homegardens at all times or the year (Mekonen, 2010). Even though animal yield are the best source of micronutrients, vegetables and fruits may be the only source of micronutrients that are reliably available to poor households (Talukder*et al.,* 2000).

2.1.4. Woody species in Crop Fields

The woody species diversity and density which exist on the crop fields may change over time due to changes in values which farmers attach to different woody species at different times.The value of a species may change with changes in the market values. Another determining factor could be the decline of natural forests, which could create scarcity of woody species.Consequently, crop fields which has been converted when there was enough natural forest area and less restriction of utilizing wood resources from the natural forest may have had a low initial diversity and density of woody species as compared to the newly converted crop fields.(Tolera, 2006).

The presence of diverse tree species on farms that serve different socio-economic and ecological functions could contribute to the sustainability of agricultural systems (Abebe, 2005). At the same time, the diversification of on-farm trees provides biological assets for maximizing on-farm resources, thus lowering the cost of production. Trees on-farms, in the form of agroforestry, are uniquely suited to provide eco-agricultural solutions that successfully combine the objectives of increased food security and conservation gains, especially by promoting the greater use of native tree species (Atta-Krah *et al.,* 2004). Diversifying the composition of on-farm tree species also enhances the stability and productivity of agro-ecosystems (Kindt and Coe, 2005) and combines the objectives of

attaining gains in food security and in conservation of biodiversity (Atta-Krah *et al.*, 2004; Garrity, 2004).

2.2. The Roles of Gender in Woody Species Management onFarmlands

Indigenous knowledge of natural resources in a community varies according to individual characteristics of age, education, gender, ethnicity, social and economic status, roles and responsibilities in the home and community, profession, aptitude and intellectual ability, and control over natural resources (Antweiler, 1998; Holt, 2005). Gender specificity of local knowledge stems from economic and political structures in a community. Thus, women's and men's knowledge reflect their upbringing and labor responsibilities. Generalization in the past has been blamed for the failure of many development interventions because most technologies and technology transfers are not gender neutral (Grenier, 1998). Local knowledge can be differentiated along ethnic lines and gender (Turner and Hiernaux, 2002).

Women are responsible for woody species management in homegarden and cultivated land where they play a key role in growing activities of timber, fuel wood, fruit trees, and other species as well as in domesticating the various wild species in their homegardens. Due to women's dominancy in homegarden production, the related indigenous knowledge on multiple uses of plants is more in the hands of women. Passing down of this knowledge from one generation to another is seen to be threatened owing to lack of proper documentation and its confinement to specific locations or communities. Women's particular responsibility for the management of homegardens has been extensively documented in different study (LI-BIRD and IPGRI, 2002).

2.2.1.Traditional Management of Woody Species onFarmlands

In order to manage tree cover in farmlands for both conservation and production goals, it is important to understand the existing patterns of tree cover, It is also important, how farmers manage the trees within their farms, and the roles that trees play with in production systems. Furthermore, understanding of the roles of trees on farms and diversification of the farm in terms of species richness, and evenness is important (Kindt *et al.*, (2005).

The most common management activities that exercised were branch pruning, protection, pollarding, coppicing and lopping. Mengsitu (2008); Mekonen (2010)reported that most part of the rural people uses different management practices. Likewise, Zeleke (2006) noted that coppicing; pollarding, pruning and thinning are among the most important tree management practices. Farmers not only have the knowledge of different trees /shrub management practices, but also which woody species require the different set of management practices and appropriate time.

2.3. Socioeconomic Uses of Woody Species in Farmlands

In many rural areas farm trees play an important role in household food security. Forests and trees provide critical support to agricultural production, they provide food and fuel, and they provide cash income they provide insurance against drought and crop failure. Thus, both directly and indirectly, many forestry activities have an impact on rural people's food situation. According to the study of Abebe (2005), farm trees of diverse tree species serve different socio-economic and ecological functions. Farmers have historically protected, planted and managed trees on their land in order to maintain supplies of ought-after products no longer readily available from the natural forest which is cleared, degraded or is no longer accessible.

Woody species in farmland provide basic food products and variety of other products including traditional medicines, fodder, spices, gums, resins, fuel wood, construction wood and wood for making farm implements for a large number of people, in sub-Saharan Africa (Teklehaimanot, 2004). Woody species on farmland can have an important indirect influence on food production. By maintaining and improving soil fertility, trees grown on farmland can help sustain yields. Topsoil beneath canopies of *Cordia africana* and *Millettia ferruginea* in relation to open fields had higher pH, higher exchangeable base, increased total nitrogen, organic carbon and available phosphorus (Asfaw and Hulten, 2003).

Trees significantly facilitate the fertility of soils by maintaining soil organic matter. The integration of woody species into crop fields, has been proposed as one way of diversifying agro-ecosystems in a way that is beneficial to the environment and can maintain and perhaps enhance biodiversity (Mugendi *et al.,* 2007). The relevant services of woody species are those

that increase the crop yields (nitrogen fixation, increased soil organic matter content, nutrient cycling, soil conservation, etc.), create environmental resilienceby niche diversification, food-web complexity, reduced greenhouse emissions through carbon sequestration, etc. However, the multiple functions of the woody species can only be fulfilled if species diversity is adequately managed.

2.4. Factors Affecting Diversity of Woody Species in Farmlands

Socio-economic factors influence farm level woody species diversity (Asfaw, and Hulten, 2003; Kindt *et al*., 2004; Abebe, 2005). Moreover, socioeconomic factors such as farm size, wealth status of the household, proximity to farmlands, access to market, and availability of labor also determine the diversity of woody species. For example, study in Western Kenya by Kindt *et al*. (2004) indicated low species richness of fruit, medicine and construction trees for wealthier households as they prefer to purchase these products rather than producing on their own farms. The same study also indicated lower abundances of construction and timber trees in the villages closest to farm land and market. Kindt *et al*. (2004) also indicated that woody species diversity increases with increasing farm size. Similar results were also reported by Asfaw and Hulten (2003) and Abebe (2005) from southern Ethiopia. Less species diversity was reported for households with more access to local markets as compared to farmers with less access to market in the highlands of Sidama (Asfaw and Hulten, 2003). On the other hand, Abebe (2005) found a non-significant relationship between woody species richness and distance to market.

As reported by Ogweno*et al.*(2001) one of the woody species management constraints to nursery is lack of capital for the purchase of potting materials, tools and equipment (mainly watering cans, wheelbarrows and spades),. The other problem as indicated in the same source is associated with seed procurement of certain species, mainly *Greville arobusta, Hakeasaligna, Olea africana* and *Terminalia mentalis*. Several studies have reported the influence of lack of capital on the tree density and tree species-richness on agricultural field (Asfaw, 2003; Abebe, 2005). There can also be more fundamental economic pressures that prevent or discourage farmers from managing trees into their agricultural practices.

2.4.1. Drought

Drought is defined as the absence of rainfall for a period of time long enough to result in depletion of soil water and injury to woody species. The drought stress is a very important limiting factor during early seedling growth and establishment (Jaleel*et al.,* 2009). It affects both elongation and expansion growth of woody species in parkland agroforestry (Shao *et al.,* 2008). It indicates that water-deficit stress reduced the growth of woody speciesby restricting leaf formation. Furthermore, the effect of drought stress indicating that shoot growth is more sensitive to water availability than root growth (Ashraf and Foolad, 2007). Since drought is a reoccurring phenomenon in these agricultural field, management strategies aimed at facilitating regeneration of mature trees/shrub must include the influence of these decadal scale disturbances on the composition and structure of series woody species communities in tropical highland in agricultural field and its suppression has been implicated as a potential cause of reduced woody species regeneration (Johnson *et al.,* 2002).

Drought stress is considered to be the main environmental factor limiting woody species growth and yield of many agronomic and horticultural crops, especially in semi-arid areas. In Mediterranean-type ecosystems, seasonal water shortage is the main factor constraining survival and growth of woody species (Johnson *et al.,* 2002).

3. MATERIAL AND METHODS

3.1. Description of Study Area

The study was conducted in Hurbarag Woreda, Siltie Zone, Southern Nation Nationalities and Peoples National Regional State (SNNPRS). Geographically the area is located at 7°47'N latitude and 38°08'E longitude. The study site is 182 kms away from Addis Ababa, capital city of Ethiopia, and 215 kms from Hawassa, the regional city of SNNPRS (Fig, 1). The woreda covers an area of 43,140 hectare and bordered by Hadiya Zone in the North, Sillte woreda of Silte Zone in the South, Mesrake Azernet of Silte Zone in the North West, Sankura Woreda of Silte Zone in the East and Shashogo Woreda of Hadiya Zone in the North East (HWARDO, 2013).

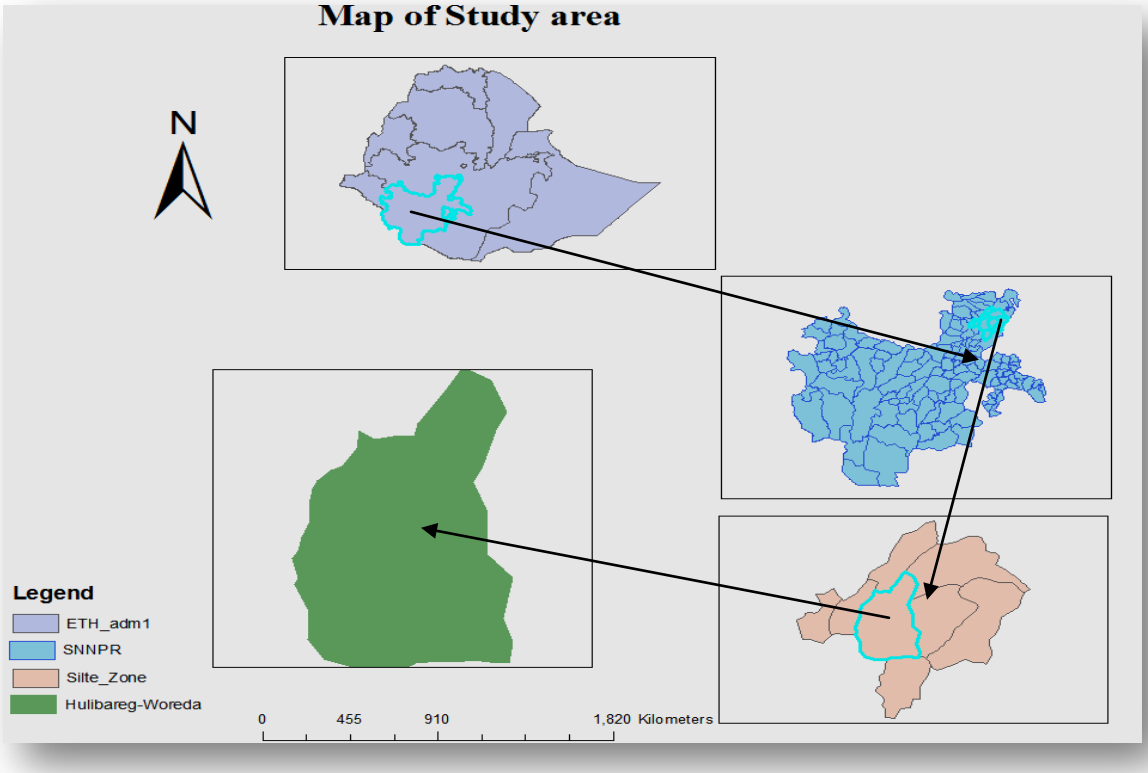

Figure 1; Location Map of study area

3.1.1. Topography, Vegetation and Climate

Thetopography of the study area are flat (47.5%), hilly (8.5 %) and undulating land(44%). The altitude of the district ranges between 1800 to 2426m.a.s.l.(Abebe*et al.*, 20014). The common species in the area include *Ficus sur, cordia africana, Croton macrstachyus, Acacia abyssinica, Hageniaabyssinica, Podocarpus falcatus, Albizia gummifera, Olea africana, Faidherbia albidaand Millettia ferruginea*, which are found as scattered form in agricultural landscape of the study area. While Eucalyptus species are grown as boundaries, live fences and woodlots. The climate ofthe woreda has a bimodal rainfall distribution where the major annual rain fall season occurs in Maher (May to end of September) and short rainy season occur in Belg (beginning of January to April). The mean annual precipitation varies between 900 - 1400mm and a mean annual temperature ranges 11 $^{O}_{C}$ to 23°C (HWFEDO, 2013).

3.1.2. Soil

Hulbarege Woreda classified soils into various textural classes. Most of the soils have low bulk density and weak structure, which render them vulnerable to erosion. Generally, Woreda has been identified by three types of soil, comprising of red, brownand dark brownish black. Dark brownish black soil is the most fertile of all soils found in the study area, and is mainly found at the bottom of the field if sloped and easily eroded, found at the bottom of the fields on sloped areas as a result of deposition from upper areas due to surface runoff(HWARDO, 2013).

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3.1.3. Population

Hulbarege Woreda has 13 Kebeles (KAs) with a total population of 95,932; with 47,734males and 48,198 females (CSA, 2013). The population density of Hulbarege Woreda is about 250 persons per square kilometer.

3.1.4. Economic Activities

Agriculture is the dominant economic activity in the district. The livelihood of the people in the district depends mainly on mixed agriculture i.e. crop and livestock production. It is

characterized by subsistence farming. The annual crops grown are wheat, teff, sweet potatos, barley, maize, faba beans, pea, cabbage, carrots, and onions. The perennial crops grown in the district are enset, coffee, chat, sugarcane, avocado, mango and timber trees**.** Enset and maize are the main perennial and annual crops respectively in HulbaregeWoreda, which are sources of food all year round (HWARDO, 2013).

3.2. Methods

3.2.1. Study site selection

At the initial stage Hulbareg Woreda was purposively selected for the study, from 8 districts of Silte zone based on market access, road access, farm size and educational affecting traditional management woody species on farmlands. In the second stage, four kebeles were selected randomly by using simple random sampling techniques amongst the thirteen kebeles of HulbaregWoreda based on traditional management practices of woody species. For the selection of the site, reconnaissance survey was made with help of development agents and agricultural office of the district.

3.2.2. Woody species sampling strategy

Before field data collection, a reconnaissance survey was conducted to collect base line information and observe woody species distribution in farmlands. For assessed woody species on farmlands in the four study sites, the line transects survey and direct counting method was used. Once the number of transects and sample size is determined, the transect line was laid out along altitudinal gradient. The distance between consecutive transects was 1km and between quadrate 300 m. At each study site, transect length was set in targeted habitats (e.g, Crop field and grazing land). The sampling plots per land use practices were found sufficient according to the plot number-species accumulation curve done after data collection. No quadrates were laid in homegarden; rather a complete enumeration of woody species with average area of 0.27 ha followed Bajigo and Tadesse, (2015) and Tolera, (2006). In crop fields vegetation data was collected from 50 m × 100 m sample size quadrants Nikiema, (2005) and for grazing lands 40 m × 40 m sample quadrants were taken Asefa*et.al*, (2014) and twenty (20) transect line and eightyeight (88) quadrate was laid out in four selected kebele (four transect line and twenty plots in each kebele in crop fields and grazing land). The first

transect line and plot was set randomly. In each plot, and Diameter at Breast Height (DBH) was measured for any woody plant species with tree height≥ 5 m and DBH ≥ 5cm (Abed and Stephens, 2003). Caliper was used for diameter measurement. Physical information on various aspects of the study area was recorded including the geographic location and elevations of each plot were taken from the center using GPS. Woody species data include tree species abundance, diversity, richness, basal area, frequency,dominance, importance value index and traditional management practices on farmlands at different land use. Woody species identification was done in the field by using local names with the help of KIs and field guide book. Plant specimens were collected, dried and pressed. Specimens were deposited at Wachamo University Department of Biology for further identification, and use book of flora in Ethiopia and Eritrea (Edward*et al*. 2000; Hedberg *et al*. 2003; Hedberg *et al*. 2006;Bekele, 2007).

3.2.2. Socio-Economic Data Collection

Primary data was obtained through plot sampling, about woody species diversity and household interviews to obtain information about population characteristics/ personal that is Age, gender, educational status, marital status, family size, occupation, and, market and distance factors of woody species diversity management's. Economic characteristic that is wealth status and land holding of the users were collected by focus group discussion in order to know their knowledge of woody species management bydiscussion. The key role of KIs was to categorize sample household by wealth categories into rich, medium and poor farmers. Secondary sources of information were collected from published and unpublished materials such as scientific reports, official records, census records, project reports.

Key Informant Interview

These key informants are individuals who are assumed to have adequate knowledge of their locality and who have lived continuously in the area for 30 years and above. To select individual farmers who could identify key informants, kebeles tour was made with kebeles council members and development agents. During the tour, at least three farmers were asked to identify and give names of five key informants as defined above. Then the identified key informants were ranked and the most frequently appeared top three persons were assigned as key informant in each selected villages. Three key informants (KIs) were selected from each

villages. One kebele has two villages and for the study a total of 24 KIs were selected. The key role of key informants are to categorize sample household by wealth categories into rich, medium and poor farmers which represent HHs with high income, medium income and less income, respectively based on number of cattle, amount of annual crop production, land holding size, standard of transport system(e.g by feet, mule, hors, bicycle and motor bicycle)and type/standard of housing, (Newing, 2011). This hint to general information in traditional management practices of woody species on farmlands

Focus Group Discussion

For focus group discussions, individuals were included in the categories that contain both men and women in groups and discussed the topic in a mixed gender group, age (young and older), wealth (poor, medium, and rich levels) of the kebele who are involved in natural resource conservation and management practices. In each kebele containing one focus group the total number of FG are four, with group of farmers comprising 6-10 members in each FGD that consists of Kebeles leaders, religious leaders, elders, and targeted farmers with traditional knowledge of woody species managements (Gebre *et al.,* 2013).

3.2.3 Sample Size Determination of Household

In this study, a household (HH) is defined as a small group of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food (UN, 1993). The list of names of all HHs living in the kebele was obtained from the kebele's office and cross checked with key informants at each kebele. As a consequence, this study was carried out by categorizing households into different wealth groups at each site; Farmers with different wealth status manage and use woody species diversity differently through the traditional management. Therefore, in this study simple stratified random sampling method was employed to characterize households in each kebeles into different wealth categories. The number of sample households for interview was determined by using the proportional probability sampling technique as has been used by, (Daniel, 1999).

$$n = \frac{Z^2 p(1-p)}{d^2} \rightarrow n' = \frac{NZ^2P(1-P)}{d^2(N-1) + Z^2P(1-P)}$$

Where:

n = sample size,

n'= sample size with finite population correlation

N = Population size,

Z = Z statistic for a level of confidence for 95% at 1.96

P = expected prevalence or proportion of population to be included in sample i.e.(10%) and

d = degree of accuracy desired (0.05)

Table 1: Sample size determination of the house hold from site

NO	Name of kebeles	Total number of HHs	Sample size
1	Belwanja	615	34
2	Demeke	545	31
3	Werabet	523	28
4	Wacho	515	26
	Total	2198	120

Based on Daniel (1999) formula, a total of 120 sample households were selected randomly from the total households of 2198. The allocations of the number of sample households to each Kebeles were proportional to the number of households to each kebele. A total of 120 households were selected randomly from the various wealth categories. The numbers of sample households from each village, 58 households from poor, 39 from medium and 23 households from rich were selected from each village to get a representative sample of the study area (Appendix.2 and 3). Thehomegardens of sample households were used for questionnaire and as a sample plot for inventory. Accordingly, woody species inventorywere carried out on thehomegardens of 33.3% households located in the kebeles.

3.3 Data Analysis

3.3.1VegetationData Analysis

Species accumulation curve

The total numbers of plots were checked by drawing the species area curve. The species accumulation curve is concerned with accumulation rates of new species over the sampled area and depends on species identity. The Accumulation Curve is a Microsoft Excel 2003 based program calculating various accumulation curves for a set of samples containing more species (Drozd and Novotny, 2010).

3.3.2. Woody species diversity indices

Woody species diversity was analyzed using Shannon diversity index (*H'*) and Shannon equitability/evenness index (*E*). These diversity indices provided important information about rarity and commonness of species in a community.

Shannon Diversity Index (H')

Shannon diversity index was used to characterize species diversity in a community. The Shannon diversity index of specieswas calculated by the following equation (Magurran, 2004):

$$H' = -\sum_{i=1}^{s} P_i \, lnP_i$$

Where:

H' = Shannon diversity index

Pi= proportion of individuals found in the i^{th} species

Shannon evenness (E):Evenness was calculated to compare the observed distribution with the maximum possible even distribution of the number of species in the studied woody species, (Pielou, 1975) or it is the distribution of individuals among the species in a studied woody species. Evenness is maximum when all the species have same or nearly equal number of individuals. Evenness (Shannon equitability) index was calculated as described by Kent and Coker (1992) to estimate the homogeneous distribution of species:

$$E = \frac{H'}{H'_{max}} = \frac{\sum_{i=1}^{s} P_i \, lnPi}{lns}$$

Where:

E= Equitability (evenness) index which has values between 0 and 1

H' = Shannon Diversity

$H'_{max=}$Maximum level of diversity possible within a given population

Pi= Proportion of individuals found in the i^{th} species

S = Total number of species (1, 2, 3…..s)

3.3.3. Important value index (IVI).

The Importance Value Index (IVI) is a composite index based on the relative measures of species frequency, abundance and dominance (Jose*et al.*1994) and signifies the relative importance of an individual tree species occurring in the farmlands.

$$\text{IVI} = \text{Relative dominance} + \text{Relative frequency} + \text{Relative density}$$

Basal area

Basal area is the cross-sectional area of tree stems at breast height. It is measured through diameter, usually at breast height that is ≥ 5m ground level. It measures the relative dominance (the degree of coverage of a species as an expression of the space it occupies) of a species in a forest (Mueller-Dombois and Ellenberg, 1974). It is calculated as:

$$BA = \frac{\pi \times DBH^2}{4}$$

Where, BA= basal area (m^2), DBH= diameter at breast height (cm);$\pi = 3.14$

Dominance

It refers to the degree of coverage of a species as an expression of the space it occupied in a given area. Usually, dominance is expressed interms of basal area of the species (Kent and Coker, 1992). Two set of dominance were calculated in this case: dominance (the sum of basal areas of the individuals in m^2/ha), and relative dominance, which is the percentage of

the total basal area of a given species out of the total measured stem basal areas of all species.

$$\text{Dominance} = \frac{\text{Total basal area}}{\text{Areas ampled}}$$

$$\text{Relative dominance} = \frac{\text{Dominance of species A}}{\text{Total dominance of all species}} * 100$$

Frequency

Frequency is defined as the probability or chance of finding a species in a given sample area or quadrant (Moreno-Casasola*et al.,* 2011).Thus, it shows the presence or absence of a given species within each sample plot. Frequency was computed for each woody species encountered within the study plots:

$$\text{Frequency of species} = \frac{\text{Number of plots in which that species occurs}}{\text{Total number of plots}} * 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of species A}}{\text{Total frequency of all species}} * 100$$

Abundance

Abundance values were calculated in this study. These were (i) average abundance per plots, calculated as the sum of the number of stems of a species from plot divided by the total number plot, (ii) Relative abundance, calculated as the percentage of the abundance of each species divided by the total stem number of all species (Magurran,2004).

$$\text{Relative abundance} = \frac{\text{Number of individuals of species}}{\text{Total number of individuals}} * 100$$

Density

The density of woody species was calculated by summing up all stems across all sample plots and converting into hectare basis (Mueller-Dombois and Ellenberg, 1974).It is calculated by following formula:

$$\text{Density} = \frac{\text{Total number of individuals}}{\text{Sample area in hectare (ha)}} * 100$$

4. RESULTS AND DISCUSSION

4.1 Demographic and Socio-Economic Characteristics of Households

The result of this study showed that from the total respondents, 75.8 percent were male and 24.2 percent were females and found between age ranges of 25 to 71 years (Table 2), This implies that about half of the sample respondents were found in the adults age category. Regarding the marital status of the respondents 84.2 percent were married, 11.6 percent were widowed, and 4.2 percent were Unmarried. Education status of the respondents directly or indirectly influences the conditions of woody species management in the study area. Education level also has strong positive correlation to the socio-economic status. Similarly, Cutter *et al. (*2009) reported the education statuses of households were positively correlated with socioeconomic aspects. Generally, the low educational backgrounds were found to hinder households from access to different services like extension service and training. The result indicated that 30.8 percent of the respondents have had access to education that enabled them to read and write while about 69.2 percent of the respondents did not attend formal education (Table 2).

The percentage distribution of farm activities of the respondents reveals that 95.8 percent of the respondents were engaged in on- farm activities while only 4.2 percent off-farm activities accounted those farmerswho have their own land but they rent the lands. Concerning land ownership, farmers with larger farm sizes practiced better woody species management practices. This is because when farmers have larger farm sizes, they can plan different management practices due to the large land holding size, about 46.7 percent land holdings ranging from 0.5 to 1.5 ha, while 27.5 percent of the household lands holdings ranging from 1.5-3 and 10 percent of the household were above 3 hectares of land holding size (Table 2). Temesgen (2007) reported that the demographic and socio-economic characteristics of the respondent affect the traditional management of woody species diversity on farmlands.

Table 2: Respondents Demographic and Socio-economic characteristics in study area

HH characteristics		**Frequency**	Percent %
Sex			
	Male	91	75.8
	Female	29	24.2
Age			
	[25 – 40)	35	15.8
	[41 – 50)	64	53.3
	[51 – 60)	19	29.2
	> 60	2	1.7
Religion			
	Muslim	115	95.8
	Orthodox	4	3.4
	Protestant	1	0.8
Education			
	Illiterate	83	69.2
	Read and write	21	17.4
	Primary 1st cycle (1-4)	11	9.2
	Primary 2nd cycle (5-8)	5	4.2
Farm size			
	(>0.5)	19	15.8
	[0.5-1.5)	56	46.7
	[1.5 –3)	33	27.5
	> 3	12	10
Marital status			
	Married	101	84.2
	Widowed	14	11.6
	Unmarried	5	4.2
Occupation			
	Agriculture	115	95.8
	Agriculture and other	5	4.2
Wealth status			
	Rich	24	20
	Medium	39	32.5
	Poor	37	47.5
Family size			
	[>3)	17	14.2
	[3-6)	51	42.5
	[7 – 10)	43	35.8
	> 10	9	7.5

4.2. Woody Species Composition and Diversity

4.2.1. Species Area Curve

In this study, the species area curves were constructed for three land uses system, Species accumulation curve was drawn to determine the total sample size required for the assessment of woody species. The result shows that it levels after 27th plot for the homegarden, the 23th plot for the crop field and 13th for the grazing land (Figure 2). This implies that the total number of samples taken for this study were sufficient. This finding is in line withGotelli and Collwell, (2001), the species area curve is accumulative curve that relates the occurrence of species with the area sampled. When the curves grow up and flattened at the end, this indicates that the number of plot taken is sufficient

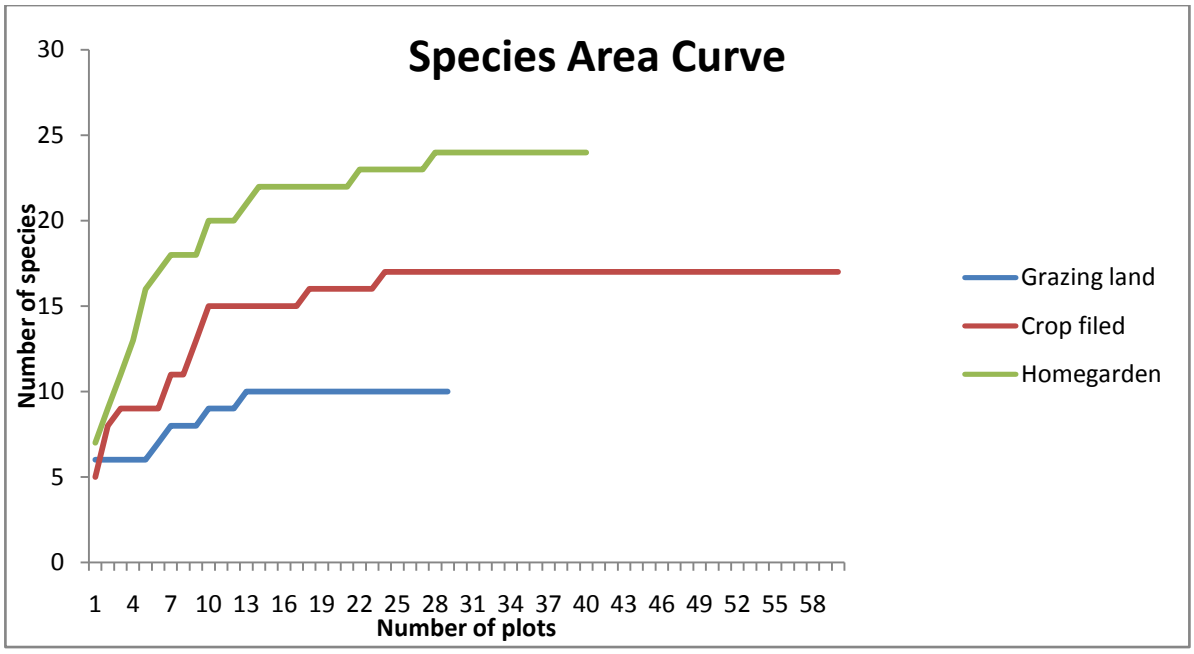

Figure 2: Species accumulation curve of homegarden, crop filed and grazing land

4.2.2. Woody Species Composition

Woody species composition assessment result showed that a total of 29 trees and 2 shrubs species belonging to 18 plant families identified and24 woody species from homegardens, 17 woody species from crop fields and 10 woody species from grazing land were recorded. Fabaceae familyis 10 species (32.3 %,) and it is the dominant family of the woody species recorded in the study area. Following this, Moraceae is 3 species (9.7 %,) which is the commonly observed family among woody species.The least frequent families areAnacardiaceae, and Myrtaceae represented by 2 species each (6.5%).This finding is in line with Bajigo, and Tadesse,(2015). A total of 32 woody species belonging to 19 families were recorded in the three different land uses in Gununo Watershed in Wolaita Zone, Ethiopia. However, many of the families were represented by single species. From this species, 18 species (58.1%) are indigenous and 13 species (41.9%) are exotic (Table 3). The family of Fabaceae represented the majority of woody species in crop fields, grazing land, and homegardens. This study is in line with that of Bajigo, and Tadesse, (2015) who reported that the family Fabaceae as the dominant family of the woody species recorded in the Wolaita zone Ethiopia. Species in Fabaceae family were dominant in the southeastern rift valley escarpment of Ethiopia (Negash *et al*., 2012). Dominance of Fabaceae observed in woodlands of Ethiopia due to adaptation potential of Fabaceae families' to wider agro-ecologies (Teshome *et al*., 2004).

Table 3**:** List of woody species recorded in the study sites E and I where exotic and indigenous

Scientific Name of Species	**Family Name**	**Local Name**	**Growth Habit**	**Origin**
Acacia abyssinica Hochst ex Benth.	Fabaceae	Lafto girar	Tree	I
Acacia albida(Faidherbia albida) Delile A.chev.	Fabaceae	Hamer keba	Tree	I
Acacia decurrens. willd.var.	Fabaceae	decurrens	shrub	E
Acacia nilotica (L) Wild. ex Del	Fabaceae	*Busha girar*	Tree	I
Acacia saligna (Labill.) Wendl	Fabaceae	Saligena	shrub	E
Acacia seyal Del	Fabaceae	Wacho girar	Tree	I
Acacia toritilis(Hochst.ex A.Rich)	Fabaceae	Teme girar	Tree	I
Albizia gummifera (G.F.Gmel.).C.A.Sm.	Fabaceae	Menzochelal	Tree	I
Allophylus abyssinicus(Hochst.) radlk	*Sapindaceae*	Kuchucha	Tree	I
Azadirachta indica	*Meliaceae*	Neem	Tree	E
Balanites aegyptiaca (L.) Del	*Balanitaceae*	Bedeno	Tree	I
Casimiro aedulis Llave&Lex.	*Rutaceae*	kazemir	Tree	E
Casuarina equisetifolia L.	*Casuarinaceae*	Shewshew	Tree	E
Cordia africana Lam.	*Boraginaceae*	Wedesha	Tree	I
*Croton macrostachyus*A.Ric	*Euphorbiaceae*	Mesna	Tree	I
Cupressus lusitanica Mill.	*Cupressaceae*	tsid	Tree	E
Eucalyptus camaldulensis Dehnh	*Myrtaceae*	Behr zafe	Tree	E
Ficus sur Forssk.	*Moraceae*	Shola	Tree	I
Ficus sycomorus L.	*Moraceae*	Ofenda	Tree	I
Ficusvasta Forssk.	*Moraceae*	Oda	Tree	I
Grevillea robusta R. Br.	*Proteaceae*	Grevillea	Tree	E
Jacaranda mimosifolia D. Don	*Bignoniaceae*	Jacaranda	Tree	E
Mangifera indica L.	*Anacardiaceae*	Mango	Tree	E
Milletia ferruginea (Hochst.) Bak.	*Fabaceae*	Mukerba	Tree	I
Olea africana Mill.	*Oleaceae*	Weger	Tree	I
Persea americana Mill.	*Lauraceae*	Abokkado	Tree	E
Podocarpus falcatus (Thunb.) R.Br.ex Mirb	*Podocarpaceae*	Zegeba	Tree	I
Schinus molle L.	*Anacardiaceae*	Turmantri	Tree	E
Sesbania sesban (L.) Merr.	Fabaceae	Sesbania	Shrub	E
Syzygium guineense (Wild.) DC.	*Myrtaceae*	Lumeya	Tree	I
Vernonia amygdalina Mesfin	*Asteraceae*	Heba	Shrub	I

4.2.3 .Woody Species Richness and Diversity in Farmlands

Shannon diversity and evenness index the Woody species in the study area revealed that there is a number of woody species recorded during assessments ina total of 24 woody species homegardens, 17 woody species crop fields and grazing land 10 woody species. The evidences from this study suggest that farmlands inhomegardens and crop fields support higher species richness.Hencethe highest woody species richness was recorded in homegardens as compared to crop fields and the grazing lands.

Introduction of different exotic and native woody species in the homegardens lead to higher species richness.A total of 24 woody species were recorded on the homesteads. Shannon diversity index values in the study area was H'= 2.723 indicating the highest value for the homegardens, which is associated with the high evenness in the abundance of species in the homegardens as compared to other land use (Table 4). These results are in line with the previous findings of Lemenih*et al.*(2005); Nikiema, (2005); Tolera*et al*, (2008). The diversity index for tree species generally showed that few species are more abundant than the others. The evenness (E) values of the species values in the study area was 0.43 indicated dominance of some woody species in homestead land use of the study sites (Table 3). The evenness values obtained are comparable to values reported by Abebe (2005) for the homegarden of Sidama Evenness values of 0.37, and reported by Kumar*et al*. (1994) for the homegardens, the reason for highest diversity around homesteads due to proximity and presence of favorable condition for management.

Figure 3**:** Woody Species diversity on homegarden

Woody species diversity and density which exist on the crop fields may change over time due to changes in values which farmers attach to different woody species at different times. The value of a species may change with changes in the market values. Another determining factor could be the population growth, which could create scarcity of woody species in the study area because of high consumption. A total of 18 woody species were recorded on the crop field. From those woody species composition 57.7% was Fabaceae and it was the dominant one. Shannon diversity index values in the study area was showed H'= 2.35 which is the highest value for the crop field as compare to grazing land and associated with the high evenness in the abundance of species in thecrop field as compared to grazing land. The evenness (E) values of the species 0.427 in crop filed (Table 4).

In grazing land a total of 10 woody species richness were recorded in the grazing/ pasture land use system. Whereas, diversity in grazing lands was relatively low due to the fact of shortage of land to leave lands as grazing land and presence of disturbance by human and animal interference. Shannon's diversity index of woody species in grazing land was H' = 1.88 and the evenness (E) values of the species were 0.38 (Table 3). This result is similar with the findings of other researchers who did comparison of woody species diversity between homegarden, cropland and grazing land (Guyassa, and Raj, 2013)

Table 4: Diversity indices of woody species on farmland in the study sites

Land use type	**Species diversity index**	
	Shannon	**Evenness**
Homegaredn	2.723	0.431
Crop field	2.350	0.427
Grazing land	1.883	0.378

4.2.4 Important value index (IVI)

To evaluate the importance of each species, the important value index (IVI) was estimated for the tree species recorded in the homegardens, crop fields and grazing land/pasture land use of study sites.The IVI is a total index that summarizes the dominance, density and frequency of a species, (Appendix 6, 7 and 8) respectively. Accordingly, the five leading dominant and ecologically important woody species in the homegardens, crop fields and grazing land/pasture land use were given in descending order in (Table 5). The species with the highest IVI were *Cordia africana, Croton macrostachyus, and Casimiroa edulis,* followed by other species in homegardens. Whereas in crop fields highest IVIs were *Croton macrostachyus,Cordia africana* and *Faidherbia albida,*followed by other species. Whereas in grazing land highest IVIs were*Croton macrostachyus, Faidherbia albida*and *Cordia Africana*followed by other species, IVI shows the overall importance of a species and gives an indication of the ecological success of a species in a particular area.

Table 5: Importance value index of woody species in homegardens, crop fields and grazing land/pasture land

Homegarden		Crop fields		Grazing land	
Botanical Name	IVI	Botanical Name	IVI	Botanical Name	IVI
Cordia Africana	33.80	*Croton macrostachyus*	37.79	*Croton macrostachyus*	54.93
Croton macrostachyus	27.06	*Cordia Africana*	36.25	*Faidherbia albida*	54.87
Casimiroa edulis	26.65	*Faidherbia albida*	28.71	*Cordia Africana*	47.63
Eucalyptus camaldulensis	22.10	*Acacia abyssinica*	28.05	*Acacia seyal*	35.54
Persea americana	18.76	*Acacia seyal*	27.17	*Acacia tortilis*	33.14

Croton macrostachyus has the highest important value index in Crop fields and Grazing land. For this reason, *Croton macrostachyus* was the most dominant trees in two land use system in study sites for local community by providing different uses like medicinal, shade and fencing purposes,one of the opportunities with this tree is its good germination capacity. Furthermore,

the practice of managing this species in farmlands might be a positive contribution to the conservation of valuable crops. Abebe (2005) reportedthat*Croton macrostachyus* was also to be among the important tree species in agroforestry homegardens of southern Ethiopia

Cordia africana is a very important woody species ranked in top five in three different land uses(its good quality timber is widely marketed in urban areas.Similarly, the tree in the crop fields and homegarden were seen as a source of income to be utilized whenever there is a critical shortage of money for the household, bee keeping and also improves soil properties in homegarden, crop field and grazing land).Yakob *et.al*(2014): Abebe, (2000), also reported that,thus socioeconomic and ecological benefit of the woody species has made it popular among farmers. It is also one of the fast growing native tree species. Similarly species with high IVI values are regarded as more important ones than those with low IVI values (Zegeye *et al*., 2011). Therefore, the IVI values can be used to species conservation and species with low IVI value need more conservation efforts, than those having high IVI value. The IVI values are used in conservation programs, where species with low IVI values are prioritized for conservation.This finding are in agreementof Gurmessa*et al.*(2012) Shibru and Balcha (2004)species with high IVI value need less conservation efforts, whereas those having low IVI value need high conservation effort and those with high IVI values need monitoring and management because of the farmers are one's harvests some of the species can't regenerate easily such as *Podocarpus falcatus* and *Syzygium guineense.*

4.3. Frequency of Woody Species on Farmland

The frequency of occurrence woody species in homegarden, crop field and grazing land were recorded (Figure 4, 5 and 6). In the homegarden*Cordia africana,Casimiroa edulis,Eucalyptus camaldulensis, Croton macrostachyus, andPersea Americana* were among the most frequent recorded woody species in homegarden. On the other hand, *Podocarpus falcatus* and *Ficus sur* were among the least recorded woody species homegarden (Figure 4).In the crop field *Croton macrostachyus, Cordia africana, Acacia abyssinica, Acacia seyal, and Faidherbia albida*were among the most frequent tree species. On the other hand, *Ficus sycomorus and Podocarpus falcatus* were among the least recorded woody speciesincrop field (Figure 5).In the grazing land *Croton macrostachyus,Faidherbia albida, and Cordia africana* were among

the most frequent tree species. On the other hand, *Syzygium guineense*was among the least recorded woody species in grazing land (Fig, 6).

Croton macrostachyus and*C.Africana* were the highest frequent woody species when recorded across the study sites. This is because; it is easily grown or regenerated in the study sites. This finding is in agreement with the study reported by Biruk (2006) in south eastern Langano, Oromiya. (These results in corroborate with the result of Tolera (2006) who reported *Crotonmacrostachyus* as the most frequent tree species encountered in the plots of the crop field at Beseku, in Arsi Negelle.)Yeshanew*et* al. (1999) who reported *Croton macrostachyus* is very important shade tree in farmlands and determine the impact of *Croton macrostachyus* on soil fertility and surface soils from under canopy of *Croton macrostachyus* trees had significantly higher nutrient levels than the open fields.Gebeyehu (2010) also reported that *Cordia africana* as the most frequent tree species in sampled farms in Bahir Dar Zuriya District. *Crotonmacrostachyus* and *cordia africana* frequency in the study sites occurred, due to more or less preferable by farmers than others. Farmers retained and plant these woody species on their ownfarm rather than other species. For the reason that, these tree species provide productive and services for local community.

Podocarpus falcatusSyzygium guineense and *Ficus* species were among the least recorded woody species but *Podocarpus falcatus*is a timber producing species, it used for construction, fuel wood, tools and shading. One of the problems with this tree is its poor germination capacity.

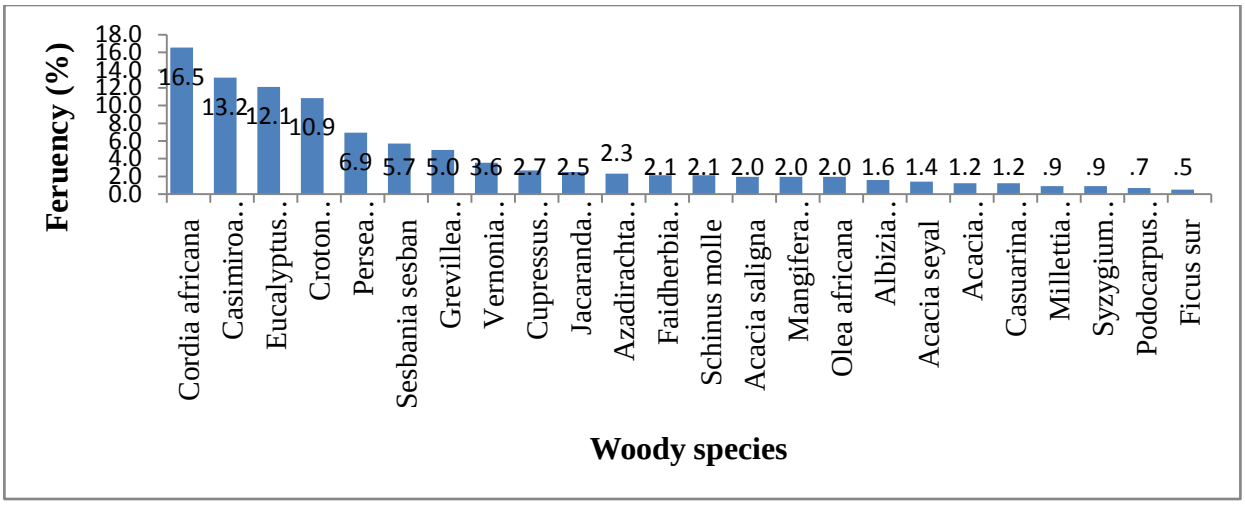

Figure 4: Frequency occurrences of woody species in homegarden,

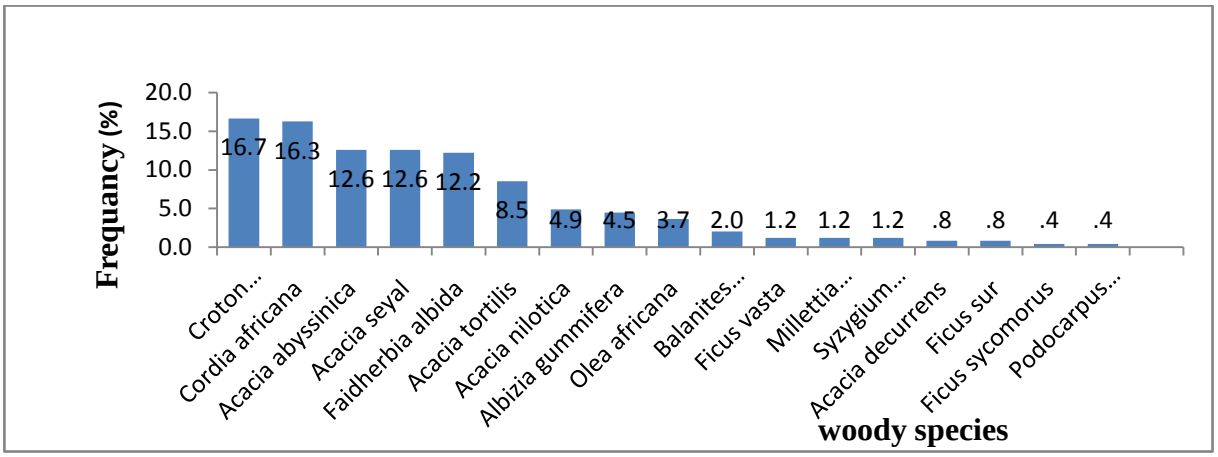

Figure 5: Frequency occurrences of woody species in crop field,

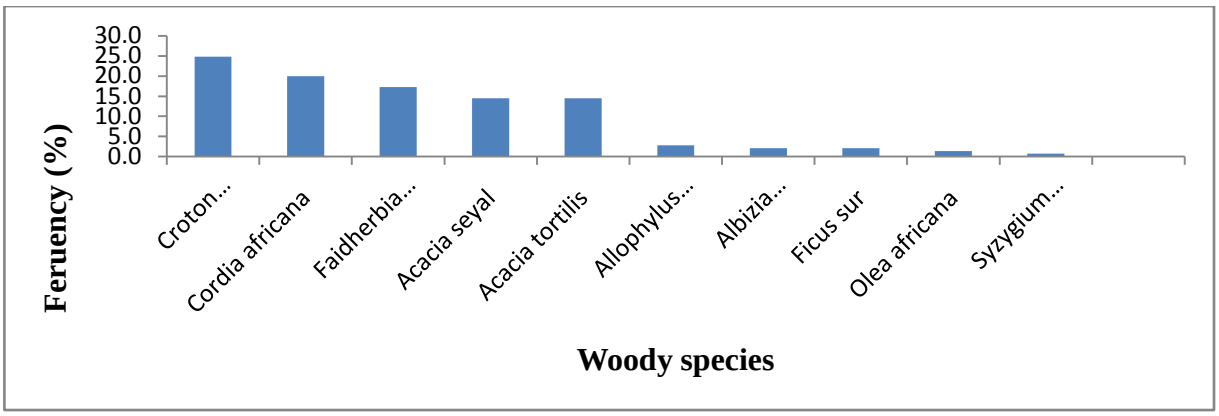

Figure 6: Frequency occurrences of woody species in grazing land,

4.4. Role of Gender on Woody Species Management,

4.4.1. Management practices in farmland:

There were different kinds of management observed in farmland of study area. About 100% (n=120) respondents mentioned an existence of management. The common management practices include fertilizer application (mainly manure, but also some time remaining from agricultural input like DAP and urea), branch pruning and coppicing, thinning, pollarding, loping, weeding and cleaning, and watering. These managements are shown in Figures 7.

Across the study sites, one of woody species management practices used by respondent was coppicing. Farmers used this practice to harvest tree species for timber, for construction, for pole, for fuel wood and in small amounts to regenerate trees. The majority of respondent were practicing coppicing and thinning for *Eucalyptus camaldulensis* planted in their road side, as fence, wind wreak and woodlot.The other most important management practice was lopping. The trees managed by this practice were *Croton macrostachyus*, *Cordia africana, Faidherbia albida, Albizia gummifera*, *Olea africana*. Respondents mentioned an existence of managementused as to reduce shade, for fencing, fuel wood, growth and regeneration. The present finding is in agreement with Workneh(2002) who figured out that pruning of trees on croplands by farmers is common to reduce competition and to obtain fuel wood and construction wood.

There was a division of labor in woody species management activities. Women's involvement was higher than that of men in weeding and cleaning, (33.3%), watering (18.3%), and fertilizing (28.3%), activities. Men's involvement was higher pollarding (27.5%), lopping (21.7%) coppicing (17.5%), thinning (11.7%), and pruning (10.8%) than that of women in those activities. Women are also responsible for farmlands management where they play a key role in growing activities of timber, fuel wood, fruit trees, and shad tree. This study agrees with the study of Das and Mohiuddin(2012) Women's involvement was significantly higher like weeding and cleaning, watering, and fertilizing (72.0 – 95.0%) than that of men in those activities. Like lopping, activities. Men's involvement was significantly higher (78.0%) than that of women.

The application of these management practices varied among woody species and age class, with higher difference in farmlands, in group discussion similarly, crop residue, grass mulch application and watering were given mostly in dry seasons to increase the moisture content of the soil. These results in line with major management activities of the preceding result of Mengsitu (2008) Tadesse *et al.* (2014) Mekonen(2010) who reported in most part of the rural people uses different management practices. Similarly,Zeleke(2006) in Lay-Gayint district of south Gonder, he noted that coppicing; pollarding, pruning and thinning are among the most important tree management practices identified in the area. Farmers not only have the knowledge of different trees /shrub management practices, but also which woody species require the different set of management practices and appropriate time,and similarlyHunde, *et .a.l* (2015).Women are the major players in managing, planting, weeding and harvesting medical plants and mange local resources such as around homegarden areas

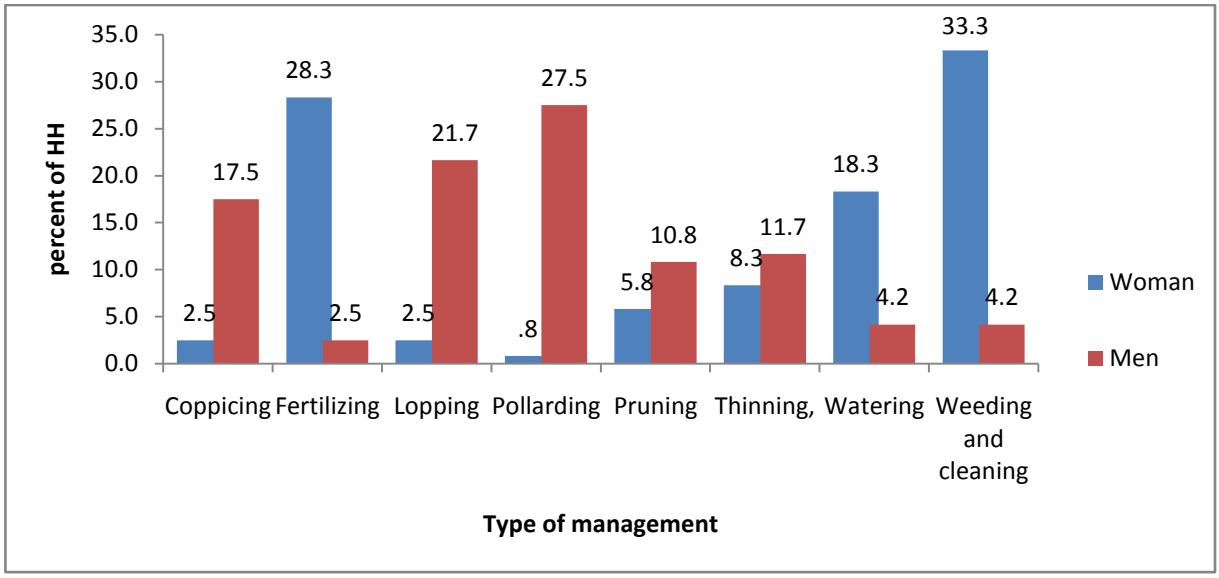

Figure 7: Percentage of Men and Women Involvement in Various woody species Management Activities in farmlands

4.5. Factors that Affects Management of Woody Species on Farmlands

Farmers plant/retain trees and shrubs on their and manage them for a wide range of uses though their achievements are not without obstacles. Majority of the interviewed farmers reported that they encountered problems when planting and managing trees on their farms. These problems are population growth, shortage of capital, drought, free grazing or animal damage, thief, land shortage, seedling shortage and utilization of different woody species in the study area (Figure6).This result is in agreement with, the result of Jaleel *et al.*(2009);Ogweno *et al. (*2001)who report that drought is important limiting factor during early enlarging species. This study indicated that Population growth accounts for 23.3%, shortage of capital 14.2%, drought 12.5%, animal damageby free grazing 11.7%, farm size 10.0%, thief8.3%, settlement5%, and fire wood problem 6.7 %, were the most important constraints in farmlands.For instance, free grazing animals were feeding and breaking sprout/seedlings of woody species in study site. This free grazing could be a cause for destruction of woody species at both young and old stages. Destruction of woody seedlings, widespread soil disturbance and establishment of weeds, as result of these, once a tree was cut or dies there is no replacement, because, seeds/seedlings for different tree species such as *Podocarpus falcatus, Albiziagummifera,* and Syzygium guineense, were not easily produced at local level.This result is in agreement with Belsky *et al.* (1999) who reported that overgrazing could be causes for total elimination of native herbaceous vegetation cover.

The other most important constraint was drought across the study sites. Because of this, farmers in the study siteswere struggling to address the drought problems through supplementary watering and planting of drought-tolerant trees/shrub species same of the acacia species. Farmers in the study area are managing woody species in farmlands using traditional knowledge accumulated through time. This is because; there are a gap of extension services provided by the office of rural and agricultural development concerning on-farm tree practices. This would be an important condition helping to disseminate existing practices to the other communities through extension activities taking those farmers as a model. According to the key informant discussion held remnant trees species on farms: in each village intentional retaining trees on the farm land is a recent practice for the area. This is one form of farmlands woody species practices.Since the local farmers are becoming familiar with

the importance and benefit of trees forsustainability and development of traditional management practices,Neupane (2001) confirmed that farmers recognized soil and crop enhancing role of trees as most farmers preserve some trees to maintain the soil structure, enhance soil fertility and soil nutrient cycling and the exhibition of favorable interaction with crops. Therefore, for the development of farmlands woody species practices, it is simply educating and helping the farmers to utilize the full potential of the system as there are no traditions that forbid tree planting in the area.

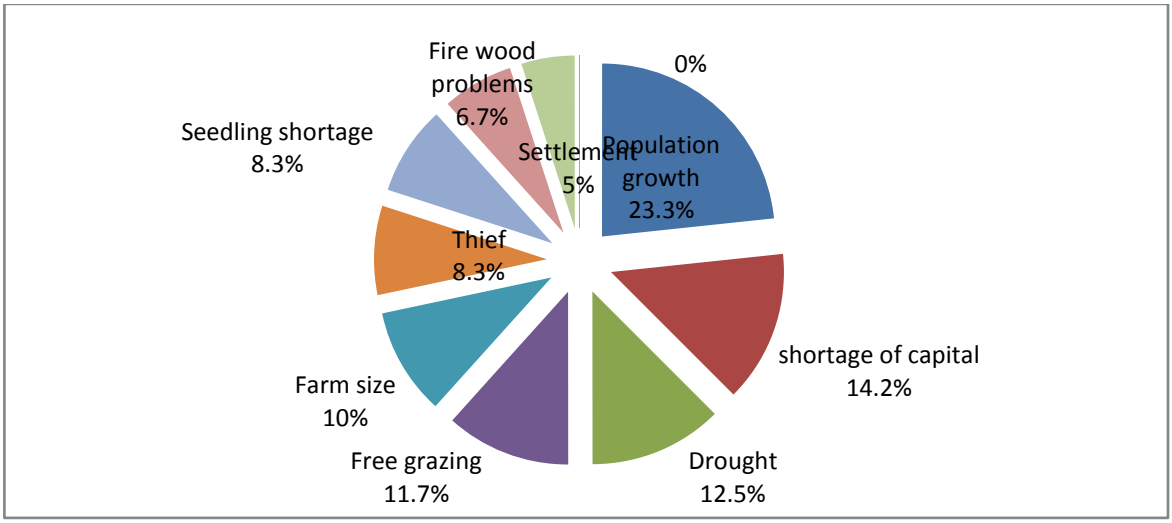

Figure 8: Percentage of households in different land use who mentioned major constraints to manage woody species in Hulbarege District, Ethiopia

4.5.1. Woody Species Consumption

A total of 120 respondents mentioned that they have been obtaining diverse types of benefits from their woody species maintaining/planting. There was much variation between men and women in the utilization of different major categories of plant resources.The major reasons for planting woody species in the study area is in the order of its use as bee keeping, charcoal production, firewood, fruit, cash generation, medicinal, shade, soil fertility, and farm tools, According to the respondents in the entire land use system of the study area, from those the women utilization percent are listed (3.3%) uses for bee-keeping, (2.5%) for charcoal, (27.5%) for firewood, (19.2%) for fruit, (11.8%) incomes, (8.3%) for medicinal value, (9.8%)

for shade, (5.0%) for soil fertility, (2.5%) for construction and (5.8%), for farm implement And although men's utilization percent are listed (3.3%) uses for bee-keeping, (2.5%) for charcoal, (27.5%) for firewood, (19.2%) for fruit, (11.8%) incomes, (8.3%) for medicinal value, (9.8%) for shade, (5.0%) for soil fertility, (2.5%) for construction and (5.8%), for farm implement purpose to manage the trees in farmlands of the study sites.This is in agreement withfindings ofDas and Mohiuddin (2012) Men's indigenous knowledge was more (68.4%) in the utilization of tree resources than that of women. The maximum indigenous knowledge of women was in utilizing for medicine (94.0%), fuel wood and fruit. Similarly Tewodros (2008) reported that females were more involved in collecting fire wood and charcoal than male.

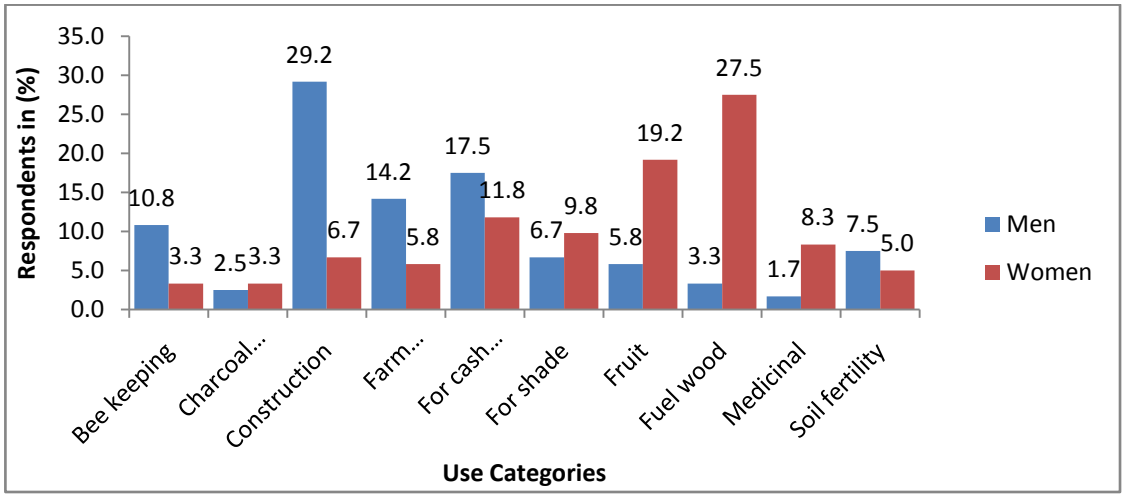

Figure 9; Percentage of Men and Women in Utilizing Different Plant Resources in farmlands

4.5.2 Woody Species Preference

In the study area the respondents have preferred different woody species in their farmland (Table 5). The most preferred species by respondents were asked to rank the most important woody species. *Cordia africana,croton macrostachyus, Persea americana, and Eucalyptus camaldulensis.* Higher market value and increased income potentials are the main reasons for preferring like pole, fuel wood, fruit and timber species. Almost all the identified farmland woody species provide more than one use.*Croton macrostachyus,* and *C. africana,* were the most important tree species which generate different purposes for farmers living in that study area. Since, these trees were identified, depending on their multipurpose uses as compared to

other woody species across the study sites. However the study areas of small farmers who cannot have enough money cooking gas or stove usually give top preference to fuelwood species. Women were usually responsible for collecting fuel wood. Most of the respondent stated that fuelwood and timber were in short supply. Although every farmer wants to plant timber species, this is possible for those with large homestead/farmland areas who can wait for long – term returns. The present finding is supported by Tolera*et al.*(2008) who reported that, *C. africana and C. macrostachyus*arethe most preferred tree species for different purpose in agricultural landscapes at Beseku Arsi Negelle. Biruk (2006) also reported that farmers in South East Langano, Ethiopia maintained trees/shrubs on their farms for different socio-economic purposes including cash generation, medicinal propose, provision of shade, timber and fuel wood.

Persea americana is one of the most preferred species among the other. Farmers in the study area have been retaining trees in different niches. Homestead, farm boundary, crop field, grazing land and live fence are the niche where tree retention has been undertaken. Among the abovementioned niches, homestead is the most preferred niche by the majority of the respondents for fruit tree. Similarly, home stead is the most preferred niche for fruitplantationintroductions of fruit trees also played a great role in enhancing the woody species diversity of homegardens.

Eucalyptus camaldulens is grows fast and produces posts and split wood that are highly demanded for housing construction. Andacted as a buffer against financial crisis for many poor farmers of the study area onland unsuited to sustainable agriculture andincome of a householdThe popularity of eucalyptus among farmers is also reported by Abebe (2005) for the agroforestry systems of Sidama homegarden in Ethiopia.The high density and high proportion of eucalyptus in the southern Ethiopia have definitely contributed to the overall high total number of trees. SimilarlyAmare (2002) reported that a substantial contribution to theincome of a household, even more than agricultural crop did, especially where the indigenouswoodland was degraded and the people were suffering from fuel shortages, water scarcity, erosion andland degradation.

Table 7: Respondents' preference of some selected species at the study sites

Legend

1. *Bee forage, 2 Charcoal productions 3. Firewood 4: Fruit, 5 Cash generation, 6. Medicinal 7: Shade: 8Soil fertility 9: Farm tools, 10 timbers. And other Preferred by M-male F-female and M&F-male and female..*

Scientific Name	Family	Local Name	Habit	Preferred by	Propose	Pr.R.R.S %
Cordia africana	*Boraginaceae*	Wedesha	tree	M&F	10,5,7,8,9,	15.7
Croton macrostachyus	*Euphorbiaceae*	Mesna	tree	M&F	6,7,8,	14.9
Persea americana	*Lauraceae*	*Avocado*	tree	M&F	4,5,	14
Eucalyptus camaldulensis	*Myrtaceae*	Behr zafe	tree	M&F	3,5,	12.4
Casimiroa edulis	*Rutaceae*	kazemir	tree	M&F	4,5,	6.6
Faidherbia albida	*Fabaceae*	Hamer keba	tree	M	8,9,3,2,	5.8
Mangifera indica	*Anacardiaceae*	Mango	Tree	M&F	4,5,	5.8
Podocarpus falcatus	*Podocarpaceae*	Zegeba	tree	M&F	10,5,	5.8
Albizia gummifera	*Fabaceae*	Menzochelal	tree	M	7,8,9,10,	5
Grevillea robusta	*Proteaceae*	Grevillea	tree	M	10,5,9,	3.3
Olea europaea	*Oleaceae*	Weger	tree	M&F	3,9,7,5,	3.3
Vernonia amygdalina	*Asteraceae*	Heba	Shrub	F	1,3,6,	2.5
Acacia abyssinica	*Fabaceae*	Lafto girar	tree	M	3,8,9,	1.7
Ficus sur	*Moraceae*	Shola	Tree	M	7,3,8	1.7
Syzygium guineense	*Myrtaceae*	Lumeya	Tree	M&F	4,3,7	1.7

Pr.R.R.S means Preference rank relative score

4.4.4 Correlation of Species Richness and Diversity with Socio-economic Circumstances

On farmlands woody species management can be influenced by many socio-economic factors across the study sites. The correlation analysis of the present study revealed thatHomegarden land size, distance of the farms from the market, educational back ground and wealth status of the households were the most important factors affect management of woody species diversity.Homegarden land size and wealth status of households were important factors that influence species richness. Tree species richness increase homegarden land size increases(Appendix.5). This might be more number of tree/shrub species requires sufficient land and farmers with more land size are favored for diversified woody species.

For this reason, current study finding illustrated that, householdhomegarden size played an important role to influence on the choice of trees/shrub species,arrangement, density, as well as on overall management.This is because of farmers with larger land sizes wish to plant/retain more species on their homegarden as compared to farmers with small size of landholdings in time of interview.The interviewed small size land owner farmers explained that they want to plant or retain trees but much of their land was already allocated for crop production to feed their families and they do not have extra land to retain trees for cash generation. In the same way, Abebe (2005) reported that larger homegarden land size had more woody species. A farmer with shortage of land may not be committed to incorporate trees with field crops as some trees/shrubs require long time to increase productivity of the farming system. Similarly Negash (2002) explained that the species characteristics are also important features because species that grow fast and need low input are highly preferred by farmer. In the study area the variation among different wealth groups is explained by Homegarden land size. The sizes of homegarden were significantly positively correlated ($P< 0.05$) with the woody species richness. Average area of homegardens ranged from 0.042 to 1 ha Appendix 5. It showed a declining trend from rich to poor wealth class with average values of 0.51, 0.23, and 0.075 ha for rich, medium and poor wealth classes respectively. In a case this studies household size to be having a positive effect on woody species richness. This indicates that households with fewer members are less likely to management woody species in farmlands. Most scholars agree that there is a positive relationship between household sizes in woody specie management (Agrawal, 2006).

Similar trend was observed for species richness, household head education level, and age of household heads. But,distance of farm from market and household head sex correlation was not significant with species richness (Table 5). Wealth status of farmers is highly correlated with farm land size. Tree species richness increase as farm land size increases.

Distance of farms from the market was one of the factor, although did not significant correlated with woody species richness, as a resultfarms close to local market have fewer tree species, lower density and less homogeneous tree population. This is because of the local market has increased market access to the farmers who sell different wood products on the local market.This is in agreement withfindings of Asfaw (2003);

Gebre(2005)increasedmarketing of wood products results in more intensive exploitation of trees in the farms, and this could lead to reduced diversity and density of trees,this is because farmers focus on a few commercial crops, especially wealthy farmers with larger farms.But contradicts the finding of Warner (1995), the number of species may increase with increasing access to markets,due to the presence of government nursery that provide seedlings and different woody species to the farmers.

According to FGD some of woody species not affected by market and rode access like *Eucalyptu*s species because,grows fast and split wood that are highly demanded for housing constructionand Cash generation. It is therefore an important cash crop for the farmersand acted as a buffer against financial crisis for many poor farmers of the study area on land unsuited to sustainable agriculture and in addition to that most of women and children are daily income get from collecting fuel woodof eucalyptus branches in the study area.

Table 8: Pearson correlation results of woody species richness index with socio-economic factors

Factors	**Species richness**	**p-values**
Wealth status	0.750***	0.000
Homegarden land size	0.661***	0.000
Household head education level	0.393^{***}	0.006
Age of household head	0.333**	0.017
Household head sex	-0.068^{ns}	0.336
Number of families	0.346**	0.013
Distance of farm from market	-0.0193^{ns}	0.113

***, and ** =Correlation is significant at the P<0.01, P< 0.05 level respectively. ns= not significant

5. CONCLUSIONAND RECOMMENDATIONS

5.1. Conclusion

Homegarden, crop field and grazing land are the main land use systems in the study area.The traditional management practices of woody species on farmlands include fertilizer application (mainly manure), branch pruning, coppicing, thinning, pollarding, loping, weeding and cleaning, and watering were the most common management practices across the study sites. There is a feeling that the properties in the homegardens are under full control of the farmer for protection as well as utilization. In addition the introductions of fruit trees also played a great role in enhancing the woody species diversity of homegardens as compared to other land use. The declining of woody species in grazing lands was relatively low due to the fact of shortage of land and presence of disturbance by human and animal interference. Whereas, diversity in the crop fields shows that hardly sustainable unless an extension intervention is devised with the community to introduce woody species in the crop fields. Instead of focusing only on increasing crop production per unit area, encourage the community to diversify woody species that are a high value, both ecologically as well as economically, without hampering agricultural production for ensuring sustainability of production and food security. Woody species providing to farmers both productive and service benefits include fodder, medicine, shade, soil fertility and others. A number of constraints associated with managing farmland woody species are mostly population growth, Shortage of capital, drought, free grazing or animal damage, thief, land shortage and seedling shortage among the others were occurred in study sites. Accordingly farm size, educational back ground, wealth status of the households and distance of farms from the market are the most important socio economic factors affecting woody species management practices on farmland in the study sites

Women are generally the keeper of homegarden and devote much of their time in care and management of the homegarden. They play an important role in the management of homegardens as well as in the introduction and maintenance of woody species diversity. The general tendency is for women to work in the homegardens and produce goods for domestic consumption. Women have low contributions in crop fields and grazing lands in woody species management. Finally, based on this study it can be concluded that farmers have long

aged traditional knowledge and experience to manage treesand shrub species on their farms but this practice has not been supported well by extension to solve the problem.

5.2 Recommendations

Based on these findings, the following recommended are suggested.

- There is a widespread awareness of women's roles and gender-differentiated responsibility in managing woody species in study area should be necessary for further study to document situation-specific gender roles in woody species management in the study area.
- Women were more involved in collecting fire wood and charcoal than male. Therefore, empower female economically should be creating alternative sources of livelihood gradually reducing their dependency on woody product.
- Woody species retain/management practices such as in grazing land must be promoted where species diversity is very limited due to conventional agriculture system and tree plantation with single species as woodlots.

- Further studies are also recommended on the possible link between the decline of woody species with increasing cultivation period and crop production. In crop fields in dry seasons the main problem are free grazing in the study area that should be of interest when developing control polices in free grazing in crop fields during the dry seasons.

- The contributions of farmland in the study area were multiple. The present research focused on traditional management practices and the driver factors of woody species diversity, but not has detail examination another issues. Therefore, detail income analysis and contributions of the woody species in farmlands at the study area should be necessary for any researchers who interested in the issue.

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7: APPENDIX

Appendix 1: Questioner's survey formats

Household Information

1.1. Name:_____
1.2. Code for household:_____
1.3. Sex (Male/female):_____
1.4. Age (years):_____
1.5. What is your religion? :_____
1.6. Marital status (Single/ Married/ Widowed/divorced/separated):_____
1.7. Family size _____
1.8. Educational status of the household head: 1)Illiterate 2) Read and Write 3) Grade 1-4 4)5-8 5) 9-10 6) >10
1.9. Wealth Categories: Poor_____ Medium_____ Rich_____
1.10. Total land size by ha. _____

List total land holding size	Hectare
homegarden	
Cultivated	
Grazing	
Others	

1.11. Occupation 1. Agriculture 2.Agriculture and others

1.12. Does he/she engage on off-farm activity? A) Yes B) No

1.13. Number of Livestock at this time…… Cattle…… Sheep …… goat…… Equine……and…… Other

2. Management of the woody species diversity on farmlands

2.1. Have you maintained/mange trees on your farmland?
1) Yes 2) No
2.2. If yes, specify the purpose of trees on your farmland?
Code for niche**)**: n_1= Homestead, n_2=Crop filed, n3=Grazing land, n_4=Road side n_5 = fence n_6 wind break n6 other

2.3. What type of benefits/contribution / do you obtain from your farmlands, which one is by man and women? ----------,----------,----------,----------.---------- and ----------,----------,----------,----------,----------

Woody species	Use type															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Note: 1=firewood; 2= construction; 3= income; 4=fruits; 5= medicine; 6=farm implements; 7=shade; 8= bee keeping; 9= soil fertility improvement; 10=fodder; 11=lumber; 13=charcoal; 14 =others/specify

2.4. Do you have any information about multipurpose trees in your farmlands? A) Yes B) No, If your answer for this question is yes, name the species----------
---

2.5. What are the dominant woody species in your farmlands? ----------
---

2.6. Have you ever planted or retained trees on your farmlands? 1) Yes 2) No

If yes, specify priority preference to plant or retain the tree species

No	Trees/shrub species preference	Rank	Reason	Source of seedling

Code for reason:r_1= firewood; r_2 =lumber; r_3= construction r_4= for cash generation, r_5= for fruit, r_6= for shade, r_7= for social purpose, r8 = for soil fertility r9= for soil and water conservation 10= medicine 11= bee keeping 12= farm implements 14= for fodder 15=Others---------- Code for sources of seedlings: ss_1= Self raised, ss_2= Self regenerate, ss_3= GOs nursery, ss_4= NGOs nursery, ss_5= others

3.7. What types of traditional management practices do you use for woody species in your farmlands?

No	Species	Management practices	Reason	Managed by	
				Men	Women

Code for management practices: mp_1=Thinning, mp_2= Pruning, mp_3= pollarding, mp_4= fertilizing, mp_5=Watering, mp_6=Lopping, mp_7=coppicing, mp8= Weeding and cleaning mp9= other _____

Code for reason: r_1= for growth, r_2= to reduce competition, r_3= to reduce shade, r_4= for fuel wood, r_5= for fodder, r_6 = increase soil fertility and r_7= Others_____

2.8, Is there traditionally managed trees/shrubs in your farm land based on above $Q_{3.7}$ for the purpose of code r_1 to r_7? Explain.

2.9. Where was preferable to retain and mange of woody species.

1=Homestead, 2=crop field, 3=grazing land and 5=other

Role of gender woody species management on farmlands

3.1.Is there gender difference in preference for specific woody species? A) Yes B) no

3.2.If yes, which species and why? _____

3.3.Is there any difference between men and women household headers in their awareness about issues related to indigenous woody species management?

3.5. Do you have difference between by men and women woody species management on farmlands?

1) Yes 2) No

3.6. If yes? What type of management practice implemented by men? .....

……and by women……...

……..

3.7 If yes where? 1) Homegarden 2) grazing land 3) crop land 4) other

3.8. If the answer for Q. 49 is no Why? .....

3.9. Who is more responsible or participant in planting of woody species on your farmlands? 1). Men 2).Woman 3).the whole family

3.10. Which species more preferable by women?

3.11. Q 5.9.4 list them and why

……
……

4. **Woody species managing factors on farmlands**

4.3. Do have any new market established in your area? 1) Yes 2) No

4.4. What is the distance of your farmlands to market ……km and major road……...km or……hour (min)

4.5. By availability of market your income on farmlands 1) Increase 2). Decrease

4.5. By availability market your woody species diversity on farm land 1) Increase

2) Decrease

4.6 4.3. What factors affect woody species diversity in your farmlands? (Rank)

1) Free grazing 2) Drought 3) population growth 4) Thief 5) farm size. 6) Seedling shortage. 7) Lack of capital 8) fire wood problem 9) Settlement 10) Other (Specify)

Appendix 2: Determination of total households by wealth class in the study villages

Kebele	**Village**	**Poor**	**Medium**	**Rich**	**Total**
Bewanja	Hero	141	105	72	318
	Gofere	130	85	82	297
Demeke	Dole	132	112	41	285
	Borera	136	84	39	259
Werabet	Ytekur	131	81	38	250
	Ayseche	136	98	39	273
Wacho	Gerba	132	96	36	264
	Bose	129	86	37	252
Total		**1074**	**784**	**340**	**2198**

Appendix 3: Determination of sample households by wealth class in the study villages

Study kebeles	**Villages**	**Wealth Status**			**Total wealth status**
		Poor	Medium	Rich	
Bewanja	Hero	8	6	4	**19**
	Gofere	7	4	4	**15**
Demeke	Dole	7	6	3	**16**
	Borera	8	5	2	**15**
Werabet	Ytekur	7	5	3	**15**
	Ayseche	8	5	2	**13**
Wacho	Gerba	7	4	3	**14**
	Bose	6	4	3	**13**
Total		**58**	**39**	**23**	**120**

Appendix 4: Wealth status of the household, area of homegarden (m^2), total number of woody species richness (WSPS.RI), diversity indices (DI) of tree species in homesteads/homegardens of sample households at the study sites.

Code HH	Area HG m^2	WSPS.RI	Total number	DI
HWP115	420	6	7	1.748
HWP114	480	6	8	1.56
HWP222	1640	8	13	1.839
HWP112	651	7	13	1.778
HWP223	625	5	11	1.468
HWP224	600	6	9	1.735
HWP225	525	4	8	1.213
HWP226	620	7	10	1.887
HWP227	529	5	8	1.56
HWP228	650	4	7	1.554
HWP229	868	5	7	1.55
HWP117	750	7	11	1.846
HWP109	680	6	11	1.673
HWP338	1500	11	16	2.274
HWM101	2200	7	19	1.837
HWM102	2500	7	15	1.899
HWM104	1404	8	13	1.925
HWM105	1250	7	17	1.789
HWM107	3500	7	14	1.81
HWM110	1400	8	11	1.972
HWM113	4000	6	12	1.705
HWM108	1600	7	12	1.864
HWM221	4100	10	14	2.243
HWM331	2025	8	15	1.927
HWM332	2475	10	14	2.243
HWM111	2000	6	12	1.633
HWM116	1085	5	16	1.544
HWR106	2750	11	15	2.303
HWR103	3300	8	17	1.956
HWR118	3200	11	24	2.268
HWR220	5500	8	19	1.941
HWR330	6000	9	19	1.777
HWR333	7650	10	16	2.22
HWR334	3100	8	16	2.047
HWR335	1368	6	15	1.657
HWR336	7200	11	21	2.31
HWR337	5800	13	17	2.507
HWR339	7225	7	17	1.84
HWR440	10000	14	32	2.488
HWR330	2700	12	19	2.406
	HulbaregeWorda(HW)		Poor (P)	Medium (M)

Appendix 5: Frequency (Fre), Dominance (Dom), Relative Frequency (RF), Density (Den). Relative density (RD), Relative dominance (RDO) Importance Value Index (IVI), and Family name woody species, with a diameter at breast height≥ 5 cm,

Scientific name	**Fre**	**RF**	**Dom**	**RDO**	**Den**	**RD**	**IVIs**
Acacia albida (Faidherbia albida)	0.03	3.07	0.05	4.69	44.44	2.14	9.90
Acacia decurrens	0.02	1.71	0.04	3.36	25.93	1.25	6.31
Acacia saligna	0.01	1.37	0.03	2.97	40.74	1.96	6.30
Acacia seyal	0.02	2.39	0.05	4.26	29.63	1.42	8.07
Albizia gummifera	0.02	2.39	0.07	5.96	29.63	1.42	9.77
Azadirachta indica	0.04	3.75	0.04	3.78	48.15	2.31	9.85
Casimiroa edulis	0.10	9.90	0.04	3.58	274.07	13.17	26.65
Casuarina quisetifolia	0.02	2.39	0.04	3.42	25.93	1.25	7.05
Cordia africana	0.13	12.97	0.05	4.10	348.15	16.73	33.80
Croton macrostachyus	0.11	11.26	0.06	4.94	225.93	10.85	27.06
Cupressus lusitanica	0.03	3.41	0.03	3.09	55.56	2.67	9.18
Eucalyptus camaldulensis	0.08	7.85	0.02	1.97	255.56	12.28	22.10
Ficus sur	0.01	0.68	0.09	7.87	11.11	0.53	9.08
Grevillea robusta	0.06	6.48	0.03	3.00	103.70	4.98	14.47
Jacaranda mimosifolia	0.03	3.41	0.04	3.79	51.85	2.49	9.69
Mangifera indica	0.03	2.73	0.04	3.55	40.74	1.96	8.24
Millettia ferruginea	0.01	1.02	0.07	5.97	18.52	0.89	7.88
Olea africana	0.03	3.07	0.04	3.61	40.74	1.96	8.64
Persea americana	0.07	7.17	0.05	4.65	144.44	6.94	18.76
Podocarpus falcatus	0.01	1.37	0.13	11.40	14.81	0.71	13.48
Schinus molle	0.03	3.07	0.03	2.86	44.44	2.14	8.07
Sesbania sesban	0.04	3.75	0.01	0.47	118.52	5.69	9.92
Syzygium guineense	0.01	0.68	0.06	5.52	14.81	0.71	6.92
Vernonia amygdalina	0.04	4.10	0.01	1.18	74.07	3.56	8.84
Total	**1**	**100**	**1.13**	**100**	**2081.481**	**100**	**300**

in homegarden

Appendix 6: Frequency (Fre), Dominance (Dom), Relative Frequency (RF), Density (Den). Relative density (RD), Relative dominance (RDO) Importance Value Index (IVI), and Family name woody species, with a diameter at breast height≥ 5 cm, in crop field

Scientific name	Den	Rel.Den	Fre	RF	Dom	Rel.dom	IVI
Acacia abyssinica	193.8	12.60	0.795	12.602	0.038	2.845	28.05
Acacia albida (Faidherbia albida)	187.5	12.20	0.769	12.195	0.057	4.321	28.71
Acacia decurrens	12.5	0.81	0.051	0.813	0.048	3.659	5.29
Acacia nilotica	75.0	4.88	0.308	4.878	0.045	3.397	13.15
Acacia seyal	193.8	12.60	0.795	12.602	0.026	1.97	27.17
Acacia toritilis	131.3	8.54	0.538	8.537	0.046	3.495	20.57
Albizia gummifera	68.8	4.47	0.282	4.472	0.051	3.822	12.77
Balanites aegyptiaca	31.3	2.03	0.128	2.033	0.063	4.768	8.83
Cordia africana	250.0	16.26	1.026	16.26	0.049	3.726	36.25
Croton macrostachyus	256.3	16.67	1.051	16.667	0.059	4.453	37.79
Ficus sur	12.5	0.81	0.051	0.813	0.186	14.049	15.68
Ficus sycomorus	6.3	0.41	0.026	0.407	0.06	4.561	5.37
Ficus vasta	18.8	1.22	0.077	1.22	0.261	19.731	22.17
Millettia ferruginea	18.8	1.22	0.077	1.22	0.089	6.705	9.14
Olea africana	56.3	3.66	0.231	3.659	0.041	3.138	10.46
Podocarpus falcatus	6.3	0.41	0.026	0.407	0.139	10.499	11.31
Syzygium guineense	18.8	1.22	0.077	1.22	0.064	4.864	7.30
Total	**1537.5**	**100**	**6.308**	**100**	**1.321**	**100**	**300**

Appendix 7: Frequency (Fre), Dominance (Dom), Relative Frequency (RF), Density (Den). Relative density (RD), Relative dominance (RDO) Importance Value Index (IVI), and Family name woody species, with a diameter at breast height≥ 5 cm, in grazing land

Scientific name	**Fre**	**RF**	**Den**	**RD**	**Dom**	**RD**	**IVI**
Acacia albida (Faidherbia albida)	0.20	20.22	156.25	17.24	0.14	17.41	54.87
Acacia seyal	0.17	16.85	131.25	14.48	0.03	4.20	35.54
Acacia toritilis	0.13	13.48	131.25	14.48	0.04	5.18	33.14
Albizia gummifera	0.03	3.37	18.75	2.07	0.11	14.62	20.06
Allophylus abyssinicus	0.04	4.49	25.00	2.76	0.05	5.86	13.12
Cordia africana	0.17	16.85	181.25	20.00	0.08	10.78	47.63
Croton macrostachyus	0.18	17.98	225.00	24.83	0.09	12.12	54.93
Ficus sur	0.03	3.37	18.75	2.07	0.12	15.76	21.20
Olea africana	0.02	2.25	12.50	1.38	0.05	6.37	10.00
Syzygium guineense	0.01	1.12	6.25	0.69	0.06	7.71	9.52
Total	**1**	**100**	**906.25**	**100**	**0.78211**	**100**	**300**

Appendix Table 8: Woody species inventory sheet on sample plots

1. Woody species inventory on sample plots

1.1 Plot number _____

1.2 Area or data recorded in grazing land 1600m^2in crop field 5000 m^2 for woody species

1.3 The slope in degree_____

1.4Elevation N _____, E_____

No	Species Name		No per plot	DBH (cm)	Growth habit	Uses
	Local	Scientific				

Figure 1: In focus group discussion

Figure 2: woody species inventory in grazing land

Figure 3: woody species inventory in grazing land

Figure 4: woody species inventory in crop field

Figure 5: In quaternary survey with KI

Figure6: woody species inventory in Homegarden